LIFE

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ASSET

MANAGEMENT

Good Practice Guide
GPG-FM-030

Prioritization

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Department of Energy
Office of Field Management
Office of Project and Fixed Asset Management

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PREFACE

This Guide was developed by the U.S. Department of Energy (DOE) Office of Field Management as part of a project to develop a series of instructional and source materials for better management of all projects undertaken by DOE. This Guide provides information on the four most widely used prioritization methodologies that are commonly practiced in DOE to rate and rank projects to ensure proper allocation of limited resources. However, other prioritization methods can be used that perform to the criteria established within the DOE O 430.1, LIFE-CYCLE ASSET MANAGEMENT. It is important to note that the models discussed herein are only tools; they are not intended to replace management review and judgment.

The intended audience for this Guide is field and headquarters program/project managers, engineers, design engineers, reviewing committees, and line managers. Personnel involved in facility maintenance and operations and decontamination and decommissioning may find applications of these models useful in allocating resources for these activities.

Suggestions or comments for improving this Guide are welcome and should be sent to the following address.

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Capital Asset Management Process (CAMP) Model

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ACRONYMS AND ABBREVIATIONS

ADS	Activity Data Sheet
ALARA	As low as reasonably achievable
ANSI	American National Standards Institute
CAA	Clean Air Act
CAMP	Capital Asset Management Process
CBR	Corporate Budget Review
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CSO	Cognizant Secretarial Officer
DNFSB	Defense Nuclear Facilities Safety Board
DOE	Department of Energy
DOT	U.S. Department of Transportation
DP	Defense Programs
E&WM	Environmental & Waste Management
EH	Office of Environment, Safety, and Health
EM	Office of Environmental Management
EMAB	Environmental Management Advisory Board
EPA	Environmental Protection Agency
ER	Energy Research
ES&H	Environment, Safety and Health
FTE	Full-time equivalent
G&A	General & Administrative
GPP	General Plant Project
H&S	Health & Safety
INEL	Idaho National Engineering Laboratory
IS	Information Systems
LANL	Los Alamos National Laboratory
LCAM	LIFE-CYCLE ASSET MANAGEMENT
LIPS	Laboratory Integration and Prioritization System
LLNL	Lawrence Livermore National Laboratory
M&I	Mission & Investment
MC&A	Material control and accountability
MEM	Management Evaluation Matrix
MIS	Management Information System
MSSA	Master Safeguards and Security Agreement
MUA	Multiattribute utility analysis
NAS	National Academy of Sciences
NFPA	National Fire Protection Association
NRC	National Research Council

OMB	Office of Management and Budget
OSHA	Occupational Safety and Health Administration
RBP	Risk-Based Prioritization
RCRA	Resource Conservation and Recovery Act
RDS	Risk Data Sheet
REM	Roentgen-equivalent-man
RPM	Risk-Based Priority Model
S&S	Safeguards & Security
SAIC	Science Applications International Corporation
SFIA	Surplus Facilities Integrated Assessment
SNL	Sandia National Laboratory
SNM	Special nuclear material
TRU	Transuranic waste
WBS	Work breakdown structure
WIPP	Waste Isolation Pilot Plant

EXECUTIVE SUMMARY

This Project Management Guide was developed by the U.S. Department of Energy (DOE) Office of the Associate Deputy Secretary for Field Management as one in a series of Project Management Guides for program/project mangers, engineers, and designers. This Guide provides information for consistently applying prioritization methodologies that allocate budget resources to the most important activities.

The four models discussed in this Guide are:

- Capital Asset Management Process Prioritization (CAMP),
- ES&H Risk-based Prioritization Model (RPM),
- Laboratory Integration and Prioritization System (LIPS), and
- the Management Evaluation Process.

Each of these models is a risk-based system and, with the exception of LIPS, measures the severity of a problem. LIPS emphasis is on cost-effective risk reduction. All systems can be used to evaluate a large number of diverse activities. All systems cover worker health and safety, environmental management, the safeguarding and security of materials, mission activities, projects that are good investments, and the care and feeding of our aging infrastructure. All systems involve rating, scoring, and ranking procedures and are reviewed by field and headquarters management.

CAMP is a simple and direct method of ranking proposed capital projects. It uses four major rating categories to span a wide variety of problems and issues facing the Department. The CAMP method does not require the user to estimate probabilities, but allows probabilistic input when relevant. A well-established and tested system in use since 1991, the CAMP model was recently updated to reflect current DOE strategic plans and missions. The update was accomplished by a subcommittee of Headquarters, Operations, and M&O Contractors.

The most widely used model for solving ES&H problems is probably RPM. RPM is the only model directly linked to the Department's budget process. The RPM score is calculated by taking the difference between the risk score before performance of the activity and the risk score after performance of the activity. This score measures the effectiveness of the activities/solution in reducing risks. RPM permits management to adjust RPM rankings to account for cost, precedence, and coupling relationships.

LIPS, developed by Defense Program Laboratories, is unique in that it prioritizes according to the value of a solution. LIPS emphasis is on cost-effective risk reduction, not to identify activities that address the greatest hazard or source of risk. LIPS is applicable to any set of activities, but its greatest value comes when diversity of the activities is the greatest. LIPS allows competing objectives to be compared on the same scale and scored on a benefit-to-cost ratio.

The Management Evaluation Process is used by the Office of Environmental Management (EM) to collect risk and associated information on Environmental Management activities. The Management Evaluation Process was developed from the process used in the ES&H Management Plan with modifications for application to the diverse range of EM activities. The Management Evaluation Process provides an initial framework for illustrating risks associated with environmental management activities and for linking risks in a qualitative fashion to compliance issues and budget. EM uses the Management Evaluation Process to prioritize the funding of activities.

The scope of this Guide includes the authority for using each model; program office points-of-contact for additional information and guidance; process attributes and applicability including what each model covers, when and where to use the process, and the model's current development status. Each model is discussed in a separate section that addresses the details of rating, scoring, ranking, and review and adjustment using real-life examples. In keeping with the advent of performance-based contracting and the prioritization requirements in DOE O 430.1, LIFE-CYCLE ASSET MANAGEMENT (LCAM), performance objectives, criteria, and measurements are provided. Each discussion of the four models includes an individual reference/reading list, list of definitions, and description of training courses or tools.

The Guide does not recommend which prioritization model or methodology to use when rating and ranking projects. With the new LCAM Order, Program Offices are responsible for developing, documenting, and maintaining a prioritization system for the acquisition of physical assets. The models discussed in this Guide are used by Program Offices to meet this requirement. Any prioritization model that meets the requirements of LCAM can be used. Program/project managers should consult their respective operations offices or program officials in determining which method to use.

Prioritization of projects has become a very critical and valuable tool for program/project managers in allocating the Department's resources in a preferred order that is credible, consistent, auditable, and technically sound. All the Guide models meet these requirements.

1. INTRODUCTION

This Project Management Guide describes and illustrates the various prioritization systems used by the Program Offices for rating and ranking line item, infrastructure, and major expense projects. This Guide provides an overview of the four most widely used risk-based prioritization (RBP) processes in the U.S. Department of Energy (DOE) for determining the preferred order for allocating limited resources to solve problems. As stewards of DOE's assets, managers should plan, acquire, operate, maintain, and dispose of their assets in a cost-effective manner. Any model that determines this preferred order must be credible, consistent, auditable, and technically sound. The four models presented in this Guide satisfy these criteria. The four systems are:

- Capital Asset Management Process Prioritization (CAMP),
- ES&H Risk-based Prioritization Model (RPM),
- Laboratory Integration and Prioritization System (LIPS), and
- the Management Evaluation Process.

Current direction on prioritization is found in DOE O 430.1, LIFE-CYCLE ASSET MANAGEMENT. This Order requires "a method for the prioritization of infrastructure requirements," asset management performance measures that address these methods, and a prioritization method for evaluating infrastructure needs associated with operation and maintenance of physical assets. Program Offices are to develop, document, and maintain a system to prioritize the acquisition of programmatic physical assets, including upgrades of site assets.

This Guide explains the structure, usage, and applicability of each process. It is not intended to be a comprehensive description of each process or to serve as a training document for any process. The Guide provides recommendations on when each method should be used, but it does not recommend a specific methodology to use. DOE O 430.1 gives that responsibility to the Program Offices. Consult your Program Office or Operations Office before selecting and starting any prioritization process. The four methodologies provide points of contact to call if you have any questions.

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2. CAPITAL ASSET MANAGEMENT PROCESS (CAMP)

The CAMP prioritization model is available for prioritizing proposed capital projects at DOE sites.

2.1 CAMP Process Specification

2.1.1 Authority

DOE 4320.2, *Capital Asset Management Process*

This Order was replaced by DOE O 430.1 in August 1995. However, the CAMP Order is still in effect until performance measures have been added to the M&O contract.

2.1.2 Program Office Advocates/Assistance

Kenneth C. Baker	Field Management (FM-20) (202) 586-4502
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Under DOE O 430.1, Program Offices develop, document, and maintain a prioritization model to use for capital projects and infrastructure needs.

2.2 Process Attributes/Applicability

2.2.1 Applicability

CAMP is used in prioritizing proposals for what are generally referred to as capital projects. These may include line item construction, expense-funded construction, general plant projects, and capital equipment projects for capital projects. This process is used at Defense Programs, Energy Research, and Environmental Management sites for capital projects, landlord facilities, and infrastructure needs.

The prioritization process methodology is intended to achieve consistency in the allocation of resources within the same funding source, project reporting, and the accomplishment of DOE goals. Projects are compared by each program only within the same “pot of money” or source of funds. Projects are not compared across programs.

The users or project requestors perform the first step on all types of capital projects in the CAMP rating process. They identify all construction and equipment projects necessary to accomplish site missions. They perform the initial ratings on all line item and major expense projects with planned new starts in the budget year and the budget year plus one. Projects rated and submitted previously are not rated again unless revisions to the project have occurred that would change the rating.

The CAMP prioritization process can be used for Line Item and major expense projects planned for the out years and for other types of projects such as Major Items of Equipment (>$1M), General Plant Projects, Productivity Improvement Projects, Accelerator Improvement Projects, maintenance (operating expense) projects, Capital Equipment Acquisitions (under $1M), and any related pre-decisional activities. Because of the diversity from one site to another, users may have to develop a site-specific, implementation prioritization procedure.

The most important thing to remember is that the process is only a tool, and it is not intended to replace management review and judgment.

2.2.2 Development Status

The CAMP model matrix was initially developed in 1990-91 at the Y-12 Plant in Oak Ridge, Tennessee, with input from a wide cross-section of DOE and M&O staff involved in capital projects, under the auspices of the DOE Albuquerque Capital Assets Task Group. In 1994, a subcommittee was formed from the CAMP Planning and Analysis Group to update the matrix to reflect the Department's current values and culture. Recent improvements to the model include the addition of subcategories—Infrastructure, Business Benefits, National Business Strategies/ Partnerships, and Asset Condition—reflect these changing values. This subcommittee consisted of users, contractors, and DOE personnel with broad participation from M&O contractors, Field and Operations Offices, and Headquarters Program Offices (Defense Programs; Energy Research; Field Management; Environment, Safety and Health (ES&H); and Environmental Management). This subcommittee plans to meet biennially to update the matrix as necessary to reflect Department goals and strategic plans.

2.3 Approach Summary

The CAMP prioritization model is a systematic, risk-based method of establishing priorities for proposed capital projects at DOE facilities. The method is organized around a priority rating system for capital-related problems and issues that are benchmarked according to four major categories.

- Health and Safety (H&S),
- Environmental and Waste Management (E&WM),
- Safeguards and Security (S&S), and
- Mission and Investment (M&I).

Proposed capital projects are rated by means of the CAMP model by placing them directly on a scale on or near existing benchmarks. Benchmarks are organized within a major category in subcategories to facilitate the rating process. Each major category with its subcategories and benchmarks is organized into four CAMP Prioritization Matrices. (See the matrices located at the end of section 2. An additional matrix covering all four major categories has been provided in Table V.) Because the need for capital projects may stem from a variety of sources that are not readily comparable and that may not be similarly quantifiable in terms of risk, the CAMP Prioritization Process is a simple and direct method for locating projects on a risk-weighted scale without the requirement to estimate probabilities when this is not possible or appropriate.

Weights have been integrated into the structure and scaling of the benchmarked matrices. The categories, subcategories, and benchmarks reflect current DOE priorities for capital projects based on the problems and issues these projects are designed to solve.

Proposed projects that are rated in more than one of the four major categories receive extra credit for solving problems in multiple areas through the CAMP prioritization model. This process results in the assignment of numerical priority scores--one per project--by which proposed capital projects can be compared. Projects are normally rated in groups by site and then reviewed for consistency among the rating matrices and with judgment regarding priorities. Project rankings may be modified relative to the numerical ratings to factor in considerations of cost, special site requirements, and other circumstances. DOE Field Offices further review projects and adjust rankings or even ratings where appropriate. All rating adjustments are constrained by the benchmarks on the rating scales. Further reviews are conducted at the Headquarters level prior to establishing final funding recommendations.

2.4 Process Principles

The steps in the CAMP prioritization process are: (1) problem/project assessment, (2) rating, (3) scoring, (4) ranking, and (5) review/adjustment.

2.4.1 Problem/Project Assessment

Problem/project assessment is the process of characterizing the need for and scope of a proposed capital project in terms of the problems or issues it is designed to address, the degree to which those problems/issues are actually solved by the capital project, and the impact of not funding the proposed project or delaying it. Typically, each site prepares documentation for proposed capital projects as part of its overall capital planning function. This documentation is generally sufficient to allow for prioritization within the CAMP system.

2.4.2 Rating Process

The **rating** of proposed projects requires the use of the four major category matrices provided at the end of this section. The arbitrary numerical scale used in the system ranges from 20 (which represents good condition with few problems) to 80 (which represents extremely serious and near-term problems). For many of the subcategories within a matrix, the benchmarks do not extend to 80, either because the priority of a severe problem in that specific area is less than the priority for other areas, or capital construction does not represent a viable solution to such a serious and immediate problem.

The initial rating step is to evaluate the relevance of the major categories. When a major category is relevant, one or more subcategories are selected as most applicable to the proposed project. For a subcategory, benchmarks are shown on the matrix that describe the condition and give its numerical rating. The proposed project is "placed" on the scale within a subcategory on or near existing benchmarks. For each appropriate subcategory, a project may be rated in 5-point intervals, which allows the person performing the rating to interpolate between the given benchmarks as desired. Within a major category, the overall category rating is selected from the highest subcategory rating identified on the matrix. The rationale here is that the subcategories are considered to be different aspects of the same general problem (such as a health and safety problem), and projects should not receive extra weight for scores in multiple subcategories within the same major category. This also discourages "gaming" of the system.

2.4.3 Scoring Process

With regard to overall project **scoring**, a scoring rule is provided that does give projects additional credit for scores in multiple major categories. The rationale here is that the major categories represent fundamentally different problems, and that projects that solve several different problems should have higher priority than projects that solve only one, other things being equal.

The scoring rule combines ratings in each of the four major categories, with a default score of 20 for any category that has not been scored. If a project is rated in only one major category, its overall score is the same as that category rating. Each additional category may credit the overall project score up to 3 points (up to 9 points total if all four major categories are involved). The full 3 points are awarded if the additional major category rating is equal to or near the highest major category rating. Less credit is awarded on a pro rata basis depending on the additional category rating relative to the highest category rating. Major categories that are rated low or defaulted at a 20 rating generate no additional points for the overall score.

The calculation for the CAMP prioritization score is as follows.

OVERALL SCORE =
HIGHEST MAJOR CATEGORY RATING +
3 x (NEXT CATEGORY RATING - 20)/(HIGHEST CATEGORY RATING - 20) +
3 x (NEXT CATEGORY RATING - 20)/(HIGHEST CATEGORY RATING - 20) +
3 x (NEXT CATEGORY RATING - 20)/(HIGHEST CATEGORY RATING - 20)

2.4.4 Ranking Process

The initial **ranking** of projects follows directly from the numerical scores obtained in the scoring process described above.

To minimize bias and provide consistency during the project rating and ranking, the process must include management participation. As an *option*, management could establish a focal point and a rating or review committee. These personnel would form the nucleus of the line management review and should promote consistency, equitable application of ratings, and fair and accurate comparisons.

These same steps or a variation should occur during DOE review. This starts with the DOE at the installation and progresses to the Operations Office and finally to Headquarters. DOE involvement and participation including upper management will lead to the formalization of a capital budget, which is used to implement projects that are carried out to correct prioritized deficiencies.

2.4.5 Review and Adjustment

The **review** and validation step is necessary to ensure that projects have been credibly and reasonably scored and that overall project rankings are in line with expectations, or that differences are well understood. The first step in the review is to look at projects as a set, examining each project score for reasonableness and performing pairwise-comparisons to

determine if relative rankings are reasonable as well. This review involves both a project-by-project review as well as a score "crosscut," which is used to examine all projects in a certain scoring range. This review process may result in either changes to the score for a project or simply changes in the ranking (without changing the score).

Project score changes should be well-justified and are always bounded by the benchmarks on the matrices. Any project with a high score must be considered higher priority than all benchmarks with lower numerical values. Sometimes, the relative ranking of a set of projects may be altered without changing the numerical scores simply by identifying considerations at the site, Field Office, or Headquarters level, which may not have been adequately factored into the overall prioritization. The validity of a recommended ranking change will, of course, be evaluated carefully by higher levels of management.

2.5 Approval Process

Once a project has been rated and ranked, it proceeds through an approval process that includes the sites, the Field Office, and Headquarters. The following paragraphs describe this process. It is important to note that the process described is not consistent for every DOE level of management from the site all the way to Headquarters, but could be labeled as typical.

DOE at Site. DOE oversight at an installation/site should always include management review and approval of the site's project rating and rankings. This management review and approval process may include contractor project and program manager presentations of each project and justification for the rating selection. Some sites have a DOE representative as a voting member on the contractor's rating committee. This DOE representative can then brief DOE management on the justification for the project ratings and validate the project rating scores. These are examples of DOE site involvement, and there are probably many other procedures that would be equally acceptable.

DOE Field Office. The DOE Field Office priority rankings should always include management's review and approval of the site's project rating and rankings. Some Field Offices have a Rating Committee that rates projects based on presentations from the site's contractor program and project managers. This Rating Committee is almost a necessity if the Field Office is responsible for many sites involving multiple contractors. The Rating Committee provides the first step in the line management review of projects. The first management review begins the project normalization process to ensure that projects from the various sites can be compared. The second step for Field Office management review may include an upper management review council. The Field Office CAMP Coordinator would present, the Rating Committee's rankings to this review council prior to obtaining

the Field Office Manager's approval. The Field Office Manager's approval would be the last step in this review process. All of the various levels of DOE management review and approval for the project rankings will help minimize bias and tend to normalize all the projects across the various sites.

DOE Headquarters. Headquarters may re-rate and will re-rank each proposed "new start" line- item project. Headquarters program offices base their rating scores on the project justifications developed and stated on the project documentation provided by the sites. Therefore, it is very important to have an excellent justification document that gives the significant reasons that support the identified rating criteria subcategory "drivers." Headquarters program offices value the CAMP rating process because it minimizes bias and results in a consistent and objective rating for all projects DOE-wide.

2.6 Real-Life Examples

Two rating examples are provided below. Very detailed explanations have been provided to facilitate understanding. These are actual projects that have been generalized slightly for illustrative purposes.

2.6.1 Example 1: Utility System Modernization

Description and Justification. This project will replace parts of an essential utility system (electrical) for a large multipurpose DOE site. The utility system is the only source of electricity for the site, which contains one-of-a-kind facilities for an ongoing national defense mission as well as one-of-a-kind waste disposal facilities serving the entire DOE complex.

The utility system is connected to the electricity source through two switching stations that have experienced frequent outages over the past 3 years. Some essential major components of the switching stations are so old that suppliers no longer stock parts. Failure of one of these major components, an event judged likely within the next 10 years, could close down the entire site for several weeks until replacements could be located and installed, resulting in delays in meeting mission assignments, particularly at the defense facility.

Step 1 - Identify the Relevant Rating Categories and Subcategories. The CAMP prioritization system does not restrict the number of subcategories that can be rated and it is in the interest of project proponents to rate all subcategories that apply. Each subcategory should be systematically examined to determine if it applies to the problem being remedied by the proposed project. Looking first at the Health & Safety

prioritization matrix sheet, for example, does this utility system modernization deal with a problem of **H&S: Compliance with Orders and Laws**?[1] No. Does the project deal with a problem of **H&S**: Technological Base? No. Does it deal with **H&S**: Industrial Hygiene? The process is continued until all subcategories that apply have been identified.

Not until we reach **H&S: Infrastructure** do we get close to a situation that may represent a problem. The utility system is infrastructure. However, both from the category heading and from the prototypical descriptions within the subcategory, it is clear that the intent of that subcategory is to identify situations in which an infrastructure problem may cause injury or death. The description of this project does not mention this possibility and for the purpose of this example, we will assume that the justification has all the relevant information. In real life, some relevant information may have been omitted from the justification; systematic review of all subcategories will help to surface such omissions so that the additional information can be added to make the description complete.

Turning to the environmental and waste management subcategories within the Environment & Waste Management Prioritization Matrix Sheet, each is found to be irrelevant until we reach **E&WM: Infrastructure**. (Each of the categories has a subcategory called Infrastructure, with the only difference being the type of secondary impact that infrastructure inadequacies may cause.) Failure of the electrical system could have an impact on the waste disposal operation at the site. Continuing in a similar manner through the remainder of the subcategories, only one more, **M&I: Infrastructure**, is identified as relevant. This is found in the Mission & Investment Prioritization Matrix Sheet The utility system modernization project will be given rating scores on these two subcategories.

Step 2 - Assign Rating Scores to Each Relevant Subcategory: Subcategory scores are assigned by comparing the severity of the situation described in the project justification with that of the prototypical situations on the subcategory scale. The real life situation is unlikely to correspond exactly to any of the prototypical ones, but usually one can use the prototypes to bracket the real situation being rated.

Working first with **M&I**: **Infrastructure,** it should be determined whether this problem is as severe as the prototypical 70: "System failure highly likely, with associated loss of critical/strategic mission capability." The national defense facility meets the definition of a

[1]For convenience, the notational convention is adopted in which category and subcategory are shown in bold type separated by a colon (**Category: Subcategory**). Categories are abbreviated: H&S for health & safety; E&WM for environmental & waste management; S&S for safeguards and security; M&I for mission & investment.

strategic facility (see Glossary); it is an essential facility in the accomplishment of a strategically-important national mission. Yet the project does not rate a 70 because the subcategory does not represent a "highly likely" system failure that would result in "loss" of "mission capability." At worst, failure of the switching station would cause delays.

Does the project rate a 60: "System failure likely, with associated inability to meet overall mission assignment"? The probability language, likely, is a match, but the consequence is delay, which is not likely to jeopardize an overall mission assignment. How about 50: "System failure possible, with occasional inability to meet some significant mission requirements"? This consequence, occasional inability to meet some significant mission assignments, is in concert with the delay described in the project description/justification. However, the probability of failure of this electric system is "likely," higher than the "possible" described for a 50 rating. Thus, the rating is higher than 50 and lower than 60; this subcategory rates a 55.

A similar procedure should be followed to assign a rating for the **E&WM: Infrastructure** subcategory. The score will be lower because only failures causing violations or excessive waste generation or severe environmental impact score points. Failures of this electric system may cause delays in the acceptance of wastes from other DOE sites, delays approximately equal to the length of the system outages. If these delays, days to weeks at most, cause additional violations of waste storage permits at shipping sites, then the project could score 40 (at most) in this subcategory. One could argue that even a 40 is too high, unless the system failures cause "numerous occasional" violations; however, as will be seen in the next section, the computation is not very sensitive to whether we assign a value of 30 or 40 to this subcategory.

Step 3 - Compute the Aggregate Rating Score. According to the CAMP aggregation rules, the category scores are as follows.

H&S:	20 (the default for unrated categories)
E&WM:	40
S&S:	20
M&I:	55

The category scores are combined by adding to the highest category score (55 in this case) up to 3 additional points for each rated category, according to the formula 3 * (secondary category score - 20)/(highest category score - 20).

The two category scores, 55 and 40, should be combined according to the CAMP formula.

M&I: 55
E&WM: +2 [3 * (40-20)/(55-20)]
Total Score 57

2.6.2 Example 2: Central Supply Facility Construction

Description and Justification: This project is to design, procure, and construct a Central Supply Facility for a large DOE site to replace existing deteriorated facilities scattered throughout the site. Functions of the facility will include receiving, storing, distribution, property management and shipping of general supplies, hazardous materials, and records.

The supply facilities are responsible for storing all records for the site and currently provide inadequate fire separations/enclosures in the storage area. Condition assessment survey findings based on DOE's CAS/CAIS system cited deteriorating sprinkler systems in the existing supply facilities, resulting in a potential for extensive fire damage, property loss, possible injury/death to personnel, and consequently a disruption of operations and services. The current facilities violate the American Disability Act regulations; industrial hygiene is adversely affected due to friable asbestos in the exterior building enclosure of many of the buildings; lighting and ventilation systems are inadequate, and the electrical and mechanical systems are unprotected and constitute a safety hazard.

Accountability of material, equipment, and staff time is compromised because records are stored in various buildings, inviting misplacement of records and theft and loss of equipment. The current facility hampers the efficient circulation and moving capabilities of property, equipment, and staff resulting in an inefficient operation that impairs the facility's ability to meet requirements and missions of the operating division.

Step 1 - Identify the Relevant Rating Categories and Subcategories. The CAMP model does not restrict the number of subcategories that can be rated and it is in the interest of project proponents to rate all subcategories that apply. Each subcategory should be examined systematically to determine if it applies to the problem being remedied by the proposed project. Does this central supply facility deal with a problem of **H&S: Compliance with Orders and Laws**? Yes. Does the project deal with a problem of **H&S: Technological Base**? No. Does it deal with **H&S: Industrial Hygiene**? Yes (and so on).

As a result of step 1, the following subcategories are selected.

H&S: Compliance with Orders and Laws

H&S: Industrial Hygiene
H&S: Industrial Safety
H&S: Fire Protection
S&S: Protection of Property from Theft and Loss
M&I: Mission Capability, Capacity, and Quality

Step 2 - Assign Rating Scores to Each Relevant Subcategory. Subcategory scores are assigned by comparing the severity of the situation described in the project justification with that of the prototypical situations on the subcategory scale. The real-life situation is unlikely to correspond exactly to any of the prototypical ones, but usually one can use the prototypes to bracket the real situation being rated.

Beginning with **H&S: Compliance with Orders and Laws**, the continuous violations of the Americans with Disabilities Act are judged to be "minor," rating a 40. The rating for **H&S: Industrial Hygiene** is based on the asbestos. The situation is not as bad as 50, which indicates "Frequent violation...leading to minor injuries - no controls in place"; however, it is worse than 30, and does not provide "Routine acceptable performance." The situation can be mitigated because the asbestos is in the exterior building shell so that exposure potential only exists when maintenance work penetrates the shell, in which case administrative controls can prevent exposure. Thus, the situation corresponds to 40, "Prevent against frequent violation of exposure standards only through administrative controls."

The **H&S: Industrial Safety** rating is based on the unprotected electrical and mechanical systems. This situation does not meet "established internal objectives," so is worse than 30. However, the Description and Justification does not mention any injuries, so the situation is not bad enough to rate a 40 and is assigned a 35. **H&S: Fire Protection** is harder to peg. It is not as bad as a 60 because no losses are noted in the Description and Justification and the 60 prototype says "significant property losses routine." It clearly rates higher than 30, which is described as "acceptable risk." A 40 rating, associated with "Events with minor injury likely," is probably not high enough because the Description and Justification says "possible injury/death." The situation in the existing supply facilities appears close to that described at a rating of 50, "serious injury moderately likely...occasional significant property loss."

The subcategory **S&S: Protection of Property** is assigned a rating of 35; existing facilities are apparently not quite up to "standard industrial protection" standards, which would rate a 30, but no losses have yet occurred, a requirement for a 40 rating. The subcategory, **M&I: Mission Capability, Capacity, and Quality** is rated a 40, "Adequate...; problems likely."

Step 3 - Compute the Aggregate Rating Score. According to the CAMP aggregation rules, the highest subcategory rating in a major category becomes the category rating. The category scores are as follow.

H&S:	50
E&WM:	20 (the default for unrated categories)
S&S:	35
M&I:	40

The overall score is computed by adding to the highest category score (50 in this case) up to 3 additional points for each rated category, according to the formula 3 * (secondary category score - 20)/(highest category score - 20).

Combining according to the CAMP formula, the total score is:

H&S:	50
M&I:	+2 [3 * (40-20)/(50-20)]
S&S:	+2 [3 * (35-20)/(50-20)]
Total Score	54

2.7 Measuring for Results

Two types of "results" are discussed here: (1) successful implementation of a prioritization methodology designed to rank proposed capital projects in a consistent fashion, and (2) actual selection of proposed capital projects which accurately reflect department priorities.

2.7.1 Performance Objectives

With respect to the capital prioritization method itself, the objective is to implement a risk-based method which creates an environment in which effective and consistent project selection can take place. The CAMP Prioritization model meets this objective.

Regarding the subsequent selection of capital projects, the objective is to identify and rank proposed projects which effectively address problems and issues at DOE sites based on DOE values and priorities. The CAMP Prioritization model provides a mechanism for accomplishing this, especially through the inclusion of factors from four diverse major rating categories.

2.7.2 Performance Criteria

Performance criteria for establishment of the capital project prioritization method relate to site adoption and implementation of an adequate method; DOE field and headquarters understanding and use of the method; and ability of DOE to integrate site results into DOE-wide project priorities where appropriate. There is no current assessment available of the degree to which these criteria are being achieved with the CAMP Prioritization model, since DOE is in a transition between the requirements of the CAMP Order and those of the LCAM Order.

A performance criterion regarding actual selection of capital projects is the ability to validate capital project rating scores and their linkage to benchmarks. The existence of explicit benchmarks with the CAMP Prioritization model allows for this validation to occur, with differing results from different DOE sites, depending on the degree of understanding of the model and the aggressiveness with which it has been applied.

2.7.3 Performance Measures

Measures for the prioritization method itself tend to be qualitative, and include whether an approach has been selected and implemented at a site (or field or headquarters); the degree to which that approach meets requirements that an approach be risk-based and consistent with Departmental values and priorities; and whether the implementation is adequately utilizing the features on the chosen method. Measures such as these are now under consideration regarding capital project prioritization as it relates to the implementation of the LCAM Order.

Possible measures for the actual selection of capital projects include the results of review and validation exercises which examine the extent to which project rankings change when ranked by an independent group using the same method, and a comparison with judgment-based orderings for small numbers of proposed projects. The latter approach has been used in the development and refinement of the CAMP Prioritization methodology. The independent rankings approach is encouraged on an ongoing basis for CAMP Prioritization model implementation and may be used at the Headquarters level in integrating project recommendations.

2.8 References/Reading List

DOE O 430.1, LIFE-CYCLE ASSET MANAGEMENT ORDER.

Capital Asset Management Process Handbook, section 8 - Prioritization Process; Suggested CAMP Prioritization Procedure, Appendix I

DOE O 4320.2A, CAPITAL ASSET MANAGEMENT PROCESS.

Memorandum from K.C. Baker (FM-20), November 18, 1994, *Supplemental Prioritization Information*. Contains guidance and background on use of recently updated prioritization matrices.

Capital Asset Management Process Prioritization Training Handouts, DOE FM-20 training materials for CAMP prioritization.

Department of Energy Capital Asset Management Process: Risk Based Prioritization System, Martin Marietta Energy Systems Y/GP-154, October 1991. Contains development history and analytical background for methodology of the system prior to 1994 updating.

Summary Report on CAMP Prioritization Update Support, SAIC, September 1994. Provides description of the update process and rationale.

Summary Comparison of Key DOE Risk-Based Prioritization Approaches, SAIC, March 1994. Provides comparison of main features of five selected DOE prioritization methods, before recent CAMP update.

2.9 Definitions for Terms Used in Prioritization Matrix

ALARA (As low as reasonably achievable). An approach to radiation protection to control or manage exposures (both individual and collective to the workforce and general public) so that they are as low as social, technical, economic, practical, and public policy considerations permit. ALARA is not a dose limit but a process, which has the objective of dose levels as low as reasonably achievable.

Capacity and Capability. Related terms for describing mission readiness; capability refers to the ability to perform while capacity refers to the achievable production rate.

Criticality. The assembly of fissile material in a quantity and configuration that causes a self sustained nuclear chain reaction. DOE's program to avoid accidental nuclear criticality is defined in DOE O 420.1, FACILITY SAFETY.

Infrastructure. Utility and other support systems on the DOE site that support the category specific equipment and facilities. For example, the site electrical distribution system is infrastructure that supports the operation of radiation monitors (Health and Safety category), waste processing facilities (Environmental and Waste Management

category), perimeter detection and alarm systems (Safeguards and Security category) and production facilities (Mission and Investment category).

MSSA (Master Safeguards and Security Agreement). A formal agreement requiring the joint approval of the Field Element manager and the cognizant Program Secretarial Officers for the levels of protection of graded safeguards and security interests from theft, sabotage, and other malevolent acts associated with special nuclear material (SNM) or vital assets that may adversely affect national security or the health and safety of the public.

Pairwise-Comparisons. Pairwise-comparisons are comparisons of proposed projects two at a time. This is done to better understand relative rankings.

Payback (Simple Payback). The length of time required to pay for an investment from the resulting stream of savings or revenue. Simple payback is an undiscounted measure of costs relative to benefits, computed as the ratio of one time cost to annual savings. For projects with more complicated cost and savings streams (e.g., recurring costs or declining savings), it will be necessary to compute a discounted present value cost and an annualized revenue or savings stream before computing the simple payback period. See OMB Circular No. A-94 Revised, "Guidelines and Discount Rates for Benefit-Cost Analysis of Federal Programs."

Probability and Frequency Languages. The languages used in the benchmark rating criteria for all four major categories (see Tables I through IV) and their respective subcategories have many different terms. Standardized languages and algorithms minimize the possibility of misinterpreting benchmark rating criteria for all four major categories and their respective subcategories. Definitions of these terms are subject to different interpretations among the various users. Those standards and their corresponding ranges are shown in the tables on the following page.

REM (Roentgen-equivalent-man). A measure of the biological effect of ionizing radiation, one REM is a dosage of ionizing radiation that will cause the same biological effect as one roentgen of x-ray or gamma-ray.

SNM (Special Nuclear Material). The acronym for "special nuclear material and/or tritium," consistent with colloquial usage in some parts of the DOE complex. The Atomic Energy Act of 1954 defines "special nuclear material" to include uranium enriched in the isotope 233 or in the isotope 235, and plutonium. By Atomic Energy Act definition, tritium is "by-product material."

PROBABILITY LANGUAGE	
Standardized Terms	**Range (Events/Year)**
Essentially Impossible	($<10^{-8}$)
Extremely Unlikely	(10^{-8}-10^{-6})
Unlikely	(10^{-6}-10^{-3})
Slightly Likely	(0.001-0.1)
Possible	(0.01-0.1)
Moderately Likely	(0.1-0.4)
Likely	(0.4-0.7)
Highly Likely	(0.7-1.0)

FREQUENCY LANGUAGE	
Standardized Terms and Synonyms	**Frequency Range (Context Dependent)**
Consistent(ly), continuous, almost always	>98% of the time
Routine(ly), generally	>90% of the time
Frequent(ly), often, common	12 to 120 per year
Many, numerous	10 to 100 per year
Some, several	5 to 50 per year
Occasional(ly), few	1 to 10 per year

SNM Accountability. A program set up to assure a high level and uniformity of protection for nuclear material. Program safeguards include those measures required to prevent, detect, and/or deter threats of diversion, theft, sabotage, and/or accidental or inadvertent loss of SNM. The criteria involved in the material control and accountability (MC&A) systems and procedures can be found in DOE O 5633.3B, CONTROL AND ACCOUNTABILITY OF NUCLEAR MATERIALS.

Strategic Facilities. Facilities that are essential for meeting goals of programs of national strategic importance, typically but not necessarily involving national security.

Technological Base (R&D). A subcategory of each of the four matrix categories that refers to research and development opportunities to expand the technological base available for solving the problems in that category.

2.10 Training Course/Program Assistance

A training course is available from DOE FM-20 on CAMP Prioritization. The course covers the prioritization method as well as intensive practical exercises in rating and ranking projects.

A software program to facilitate entering ratings and calculating overall project scores is available from DOE DP-32.

Attachments: Major Category Matrices

Attached are the four major category rating matrices.

I. HEALTH AND SAFETY RATING CRITERIA SUBCATEGORIES

Score	Compliance w/ Orders and Laws	Technological Base (R&D)	Industrial Hygiene	Industrial Safety	Fire Protection	Health Physics	Criticality	Infrastructure
20	Compliant, but upcoming problems slightly likely	Develop new approaches, techniques, and methodologies to improve health and safety operations	Very effective program to limit exposure below standards	Few concerns; occasional minor incidents	Property loss extremely unlikely or of trivial value	Effective ALARA program	Deviation–min or change from approved conditions or procedures (Category 1)	
30	Consistently compliant, occasional minor deviation; not best management practice	Develop new methodologies, processes, and techniques to improve/enhance health and safety mission capability and efficiency; high R&D risk	Routine acceptable performance in maintaining exposure at/below standards	Meeting established internal objectives	Standard industrial protection, acceptable risk; some property losses expected	Moderate exposure to public slightly likely (1-5 REM/yr); exposure to workers up to 1 REM/yr moderately likely	Infraction–significant change from approved conditions or procedures but no realistic way to cause a criticality (Category 2)	
40	Frequent minor violations	Develop necessary methodologies, processes, and techniques in support of critical health and safety mission objectives; high R&D risk	Prevent against frequent violation of exposure standards only through administrative controls	Minor injuries exceed goals	Events with minor injury likely		Event with probability approximately 10-8	System frequently inadequate or occasional failure, numerous associated minor injuries likely
50	Frequently in compliance, but serious violations occasionally occur	Develop new methodologies to improve/enhance health and safety mission capability and efficiency; acceptable R&D risk	Frequent violation of exposure standards leading to minor injuries – no controls in place	Minor injuries frequent, or serious injury moderately likely	Serious injury moderately likely; standard industrial protection; occasional significant property loss	Continuous low-level exposure to the public likely (.01-1 REM/yr); high exposure to workers slightly likely (10-100 REM/yr)		System failure possible, with serious injury moderately likely

I. HEALTH AND SAFETY RATING CRITERIA SUBCATEGORIES (continued)								
Score	**Compliance w/ Orders and Laws**	**Technological Base (R&D)**	**Industrial Hygiene**	**Industrial Safety**	**Fire Protection**	**Health Physics**	**Criticality**	**Infrastructure**
60	Serious violations frequent, or some continuing minor deviations with shutdown possible	Develop necessary methodologies, processes, and techniques in support of critical health and safety mission objectives; acceptable R&D risk	Potential substantial danger to site personnel through exposure; near-term action required	Serious injury likely	Serious injury likely; significant property losses routine	Excessive exposure to the public slightly likely (5-100 REM/yr); worker exposure above regulatory limits likely (5-10 REM/yr)	Violation– continuation of activity would significantly increase probability of criticality (Category 3)	System failure likely; serious injury likely
70			Substantial danger to personnel; fatalities possi-ble	Fatalities possible	Fatalities possible	Moderate exposure to the public likely (1-5 REM/ yr); worker fatality slightly likely	Event credible with possibility 10^{-6}	Life-threatening system failure highly likely
80			Life-threatening situation highly likely	Life-threatening situation highly likely	Life-threatening situation highly likely	Life-threatening situation highly likely	Criticality or near criticality (Categories 4 and 5)	

II. ENVIRONMENTAL and WASTE MANAGEMENT RATING CRITERIA SUBCATEGORIES

Score	Compliance w/ Orders and Laws	Technological Base (R&D)	Liquid and Hazardous Waste	Solid and Hazardous Waste	Airborne Pollutants	Waste Minimization	Environmental Restoration	Corrective Activities	Infrastructure
20		Develop new approaches, techniques, and methodologies to improve environmental and waste management operations			Consistently meets requirements	Process generates relatively little waste	Decontamination and decommissioning (D&D) at sites with no present imperatives		
30	Consistently compliant, occasional minor devia-tion; not best management practice	Develop new methodologies, processes, and techniques to improve/ enhance environmental and waste management mission capability and efficiency; high R&D risk	Occasional discharge exceeding material goals		Emissions currently within permitted levels, but hard to maintain	Process generates more waste than an efficient process	Remedial actions/ D&D needed to reduce risk, promote compliance, or maintain mission continuity		
40	Occasional/ or frequent minor violations	Develop necessary methodologies, processes, and techniques to support critical environmental and waste management mission objectives; high R&D risk	Occasional violation of discharge limit	Occasional inadequacy of permitted storage/ handling/ transport/ packaging/disposal capacity	Emissions occasionally exceed permitted levels by a small amount	Process generates excessive waste			System frequently inadequate or occasional failure, with numerous occasional environmental permit violations

II. ENVIRONMENTAL and WASTE MANAGEMENT RATING CRITERIA SUBCATEGORIES (continued)

Score	Compliance w/ Orders and Laws	Technological Base (R&D)	Liquid and Hazardous Waste	Solid and Hazardous Waste	Airborne Pollutants	Waste Minimization	Environmental Restoration	Corrective Activities	Infrastructure
50	Frequently in compliance, but serious violations occasionally occur	Develop new methodologies to improve/enhance environmental and waste management mission capability and efficiency; acceptable R&D risk	Many or immediate violations; lack of adequate storage/treatment/handling/ transport/pack-aging facilities	System capacity frequently inadequate	Emissions frequently exceed permitted levels by a large amount	Process generates waste that exceeds regulatory limits	Remedial actions/ D&D required by in-force agreements	Non-compliant, but no signed agreement	System failure possible, associated with occasional serious environmental violations or frequent excessive waste generation
60	Serious violations frequent; violation of law with potential serious civil or criminal problems	Develop necessary methodologies, processes, and techniques in support of critical environmental and waste management mission objectives; acceptable R&D risk	Offsite discharge extremely high on occasion, not life-threatening	System inadequate with likely serious environ-mental impact; shutdown possible	Emissions extremely high on occasion, not life-threatening	Process generates excessive waste such that severe environmental impact is likely	Actions required as part of a signed interagency agreement	Actions required as part of a signed inter-agency agreement	System failure likely, with associated frequent serious violations of environmental regulations or law
70			Offsite discharge extremely high on occasion (life-threatening possible)	System inadequate with highly likely serious environ-mental impact; near-term significant risks	Emissions extremely high on occasion (life-threatening possible)		Remedial actions/ D&D required to protect from near-term significant risks	Actions needed within 1 year to prevent significant risks	System failure highly likely, expected to result in severe environmental impact or extremely high emissions
80									

III. SAFEGUARDS AND SECURITY RATING CRITERIA SUBCATEGORIES

Score	Compliance w/ Orders, Policies, Regs, MSSA	Technological Base (R&D)	SNM Accountability	Protection of SNM	Protection of Class. Info., Technology, and Parts (Non-SNM)	Protection of Property from Theft/Loss (Non-SNM, Nonclassified)	Protection from Hostile Action	Infrastructure
20	Consistently compliant, some minor deviations	Develop new approaches, techniques, and methodologies to improve safeguards and security operations	Consistently meets standards	Very secure– only remote, unlikely scenarios could succeed		Some small losses expected		
30	Routinely compliant, some minor devia-tions; not best management practice	Develop new methodologies, processes, and techniques to improve/enhance safeguards and security mission capability and efficiency; high R&D risk	Frequent or minor problems, but compensatory measures available	Theft or diversion possibilities acceptably countered	Theft or diversion possibilities normally countered	Standard industrial protection	Safe and secure; normal concerns	
40	Frequently compliant, but serious violations occasionally occur for classified information, technology, and parts	Develop necessary methodologies, processes, and techniques in support of critical safeguards and security mission objectives; high R&D risk	Accountability difficult within reasonable response time, but resolution moderately likely			Occasional significant loss; frequent minor loss		System frequently inadequate or occasional failure, with associated frequent minor security/safeguards problems

III. SAFEGUARDS AND SECURITY RATING CRITERIA SUBCATEGORIES (continued)								
Score	**Compliance w/ Orders, Policies, Regs, MSSA**	**Technological Base (R&D)**	**SNM Accountability**	**Protection of SNM**	**Protection of Class. Info., Technology, and Parts (Non-SNM)**	**Protection of Property from Theft/Loss (Non-SNM, Nonclassified)**	**Protection from Hostile Action**	**Infrastructure**
50	Serious violations frequent for classified information, technology, and parts, or many continuing violations	Develop new methodologies to improve/enhance safeguards and security mission capability and efficiency; acceptable R&D risk	Serious problems; accountability uncertain within reasonable response time	Theft or diversion possibilities that evade initial detection systems		Occasional major loss	Cannot reasonably ensure protection; serious injury possible	System failure possible, with occasional serious security violations
60	Frequently compliant, but SNM violations occasionally occur	Develop necessary methodologies, processes, and techniques to support critical safeguards and security mission objectives; acceptable R&D risk	Numerous SNM violations	Cannot reasonably ensure protection	Loss of classified information, technology, or parts is likely (intentional or unintentional)		Cannot reasonably ensure protection; serious injury likely	System failure likely, with associated serious violations or inability to reasonably ensure SNM protection
70	Many serious violations for classified information, technology, and parts; many SNM violations; pervasive lack of compliance with SNM regulations			Reasonable scenarios likely; deviation or theft pathways apparent			Terrorist attack or hostage situation likely with fatalities possible	System failure highly likely, with numerous SNM violations or deviation/theft pathways apparent
80	Extreme threat to SNM or personnel (highly likely)							

IV. MISSION AND INVESTMENT RATING CRITERIA SUBCATEGORIES

Score	Compliance with Orders, Initiatives, and Directives	Business Benefits	Technological Base (R&D)	Mission Capability, Capacity, and Quality	Asset Condition	Infrastructure	National Business Strategies/ Partnerships
20	Compliant, but upcoming problems slightly likely		Develop new approaches, techniques, and methodologies to improve operations	Adequate to meet mission requirements	Good–performs to original specs with routine preventive maintenance		High likelihood of moderate growth over long-term in direct jobs and economy; DOE involvement required due to technology hurdles
30	Consistently compliant, with occasional minor deviations; not best management practice		Develop new methodologies, processes, and techniques to improve/ enhance mission capability and efficiency; high R&D risk	Adequate to meet mission requirements, but improvements warranted	Adequate–but cannot perform to all original specs; some corrective maintenance required		High likelihood of moderate growth over near-term or large growth long-term in direct jobs and economy; DOE involvement required due to technology hurdles
40	Frequent minor violations	Project payback 8-10 years for projects with continuing need	Develop necessary methodologies, processes, and techniques in support of critical mission objectives; high R&D risk	Adequate to meet mission requirements; problems likely	Fair–occasional sub-standard operation; extensive corrective maintenance	System frequently inadequate or occasional failure, with associated frequent minor impact on operation/ mission	High likelihood of large growth over near-term in direct jobs and economy; DOE involvement required due to technology hurdles
50	Frequently compliant, but serious violations occasionally occur	Project payback 4-7 years for projects with continuing need	Develop new methodologies to improve/enhance mission capability and efficiency; acceptable R&D risk	Moderately likely not to meet mission requirements	Poor–consistent sub-standard performance	System failure possible, with occasional inability to meet some significant mission requirements	

IV. MISSION AND INVESTMENT RATING CRITERIA SUBCATEGORIES (continued)

Score	Compliance with Orders, Initiatives, and Directives	Business Benefits	Technological Base (R&D)	Mission Capability, Capacity, and Quality	Asset Condition	Infrastructure	National Business Strategies/ Partnerships
60	Serious violations frequent, or many continuing minor deviations with shutdown possible	Project payback 0-3 years for projects with continuing need	Develop necessary methodologies, processes, and techniques in support of critical mission objectives; acceptable R&D risk	Cannot meet mission capability; or unique capability in jeopardy	Poor– operations/ mission threatened or at risk	System failure likely, with associated inability to meet overall mission assignment	
70					Critical– strategic facilities inoperable	System failure highly likely, with associated loss of critical/strategic mission capability	
80							

V. CAMP SUMMARY CRITERIA

Score	Summary for Action	Manager's Summary Criteria			
		Health & Safety	**Environmental & Waste Mgmt**	**Safeguards & Security**	**Mission & Investment**
20	Few problems. Few identified opportunities for improvement.	Compliant with toxicological and radiological exposure standards. Safe workplace, occasional minor incidents.	Consistently meets regulatory requirements. Remedial actions not justifiable on basis of risk reduction.	Consistently meets SNM accountability standards. SNM very secure. No credible threat from hostile action.	Asset adequate for mission requirements. R&D would improve operations. Promotes moderate economic growth long term.
30	Minor improvements warranted to enhance fulfillment of mission requirements and to further reduce slight risks to workers and the public.	Occasional minor violations of toxicological or radiological exposure standards. Site personnel exposed to acceptable risks. Slight likelihood of moderate exposure to the public.	Regulations difficult to meet. Occasional excessive toxic or radioactive releases. Remedial actions could reduce risk or promote compliance or mission continuity. Efficiency improvement could reduce waste.	Not best management practice. Frequent minor problems meeting SNM accountability standards. Possibility of theft of SNM acceptably countered. Secure against hostile action.	Asset adequate for mission requirements but cannot meet all original specs. Corrective maintenance needed. High-risk R&D could enhance mission capability. Promotes moderate economic growth near term.
40	Improvements needed to ensure ability to meet mission requirements and to reduce minor risks to workers and the public.	Excessive reliance on administrative controls to prevent frequent minor toxicological or radiological exposure violations. Minor injuries likely. 1E-8 probability of criticality.	Occasional releases of toxic or radioactive substances in excess of regulatory limits. Waste handling capacity occasionally inadequate.	SNM accountability difficult within reasonable response time. Serious violations occasionally occur for classified information, technology, or parts. Occasional losses of ordinary property.	Occasional substandard operation. Extensive corrective maintenance needed. High-risk R&D needed to support critical objectives. Promotes rapid economic growth near term. Project payback by 10 years.
50	Improvements needed to avoid failure to meet mission requirements and to reduce serious risks to workers and the public.	Minor injuries frequent or serious injury moderately likely. Continuous low level exposure to the public. High exposure to workers slightly likely. Frequent violations of exposure standards.	Frequent releases of toxic or radioactive substances far exceeding regulatory limits. Waste generation exceeds regulatory limits. Inadequate waste handling facilities. Remedial action required.	Serious problems with SNM accountability. Undetected theft of SNM possible. Inadequate protection against hostile action; serious injury possible. Serious violations frequent for classified information, technology, or parts	Consistent substandard performance. Failure to meet mission requirements moderately likely. R&D with acceptable risk could enhance mission capability. Project payback within 7 years.

V. CAMP SUMMARY CRITERIA (continued)					
Score	**Summary for Action**	**Manager's Summary Criteria**			
		Health & Safety	**Environmental & Waste Mgmt**	**Safeguards & Security**	**Mission & Investment**
60	Near-term action needed to prevent serious injuries and protect the ability to meet mission requirements.	Serious injury likely. Frequent serious violations of toxicological or radiological exposure standards. Potential danger to site personnel. Excessive exposure to the public slightly likely.	Severe environmental impact likely (not life threatening). Frequent serious violations of environmental regulations or law. Remedial actions required by signed interagency agreement.	Cannot reasonably assure protection of SNM; numerous violations. Inadequate protection against hostile action; serious injury likely. Likely loss of classified information, technology, or parts.	Overall mission at risk. Unique capability in jeopardy. R&D with acceptable risk could support critical mission objectives. Project payback within 3 years.
70	Immediate action needed to avoid worker fatalities and serious risk to the public.	Worker fatality slightly likely. Multiple fatalities possible. Likely moderate exposure of the public to toxic or radioactive substances. 1E-6 probability of criticality.	Occasional off-site releases, possibly life threatening, of toxic or radioactive substances. Highly likely serious environmental impact.	SNM theft likely. Terrorist attack likely; fatalities possible. Many serious violations for classified information, technology, or parts. Pervasive SNM noncompliance.	Critical strategic facilities inoperable. Further loss of strategic mission capability due to infrastructure failure highly likely.
80	Many lives at stake. Act now.	Life threatening situation highly likely. Near criticality.	Not available for rating.	Highly likely extreme threat to SNM or personnel.	Not available for rating.

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3. ENVIRONMENT, SAFETY AND HEALTH RISK BASED PRIORITY MODEL (RPM)

The Environment, Safety and Health RPM is available to facilitate ES&H activity ranking within the DOE ES&H Management Planning Process.

3.1 RPM Process Specification

3.1.1 Process Authority

In November 1991, the Secretary of Energy directed DOE Headquarters programs to develop a consistent Departmental methodology to identify and improve management of its environmental, safety, and health programs. It was recognized that within a tightly constrained budget environment "some activities will need to be eliminated, reduced in scope, or stretched out in time to accommodate new and higher priority initiatives and enhancements to ongoing programs." In response to the Secretary's direction, the Office of Environment, Safety, and Health (EH) coordinated the development and implementation of a risk-based DOE ES&H Management Planning Process that defines, prioritizes, and allocates budget resources to the most important ES&H activities.

Unlike many other risk-based planning processes, the ES&H Management Plan is directly linked to the Departmental budget process. Planning information generated through the process is used to support management decision-making during the Department's corporate budget review process, and an ES&H "crosscut" budget derived directly from the ES&H Management Plan is submitted to the Office of Management and Budget (OMB) and then to Congress in support of the Department's budget request. The ES&H Risk-Based Priority Model (RPM) is the management "tool" specifically developed to facilitate ES&H activity ranking within the DOE ES&H Management Planning Process.

3.1.2 Program Office Advocates/Assistance

The Office of Business Performance Systems of the Office of Environment, Safety and Health (EH-73), in its missions and functions, is charged with coordinating environment, safety, and health program planning, budgeting, and budget execution systems for the Department. The Environment, Safety, and Health Management Plan is the primary tool that enables consistent identification of needed Departmental environment, safety and health activities; risk-based priority setting; effective budget decision-making and allocation of environment, safety and health resources; and improved accountability for

environment, safety, and health performance on the part of all DOE line programs and operating contractors.

Frank Tooper, Director of the Office of Business Performance Systems, is responsible for overall management of Departmental ES&H business systems, principally the ES&H component of Contract Reform and use of the ES&H Management Planning process as a critical part of the contract reform initiative.

The principal point-of-contact for obtaining assistance in the implementation of the ES&H Management Plan and prioritization using the ES&H RPM is Raymond W. Blowitski, EH-73, 301-903-9878.

3.2 Process Attributes/Applicability

3.2.1 Introduction

ES&H issues and the activities proposed to resolve these issues are evaluated and ranked using the DOE RPM. The RPM is a simple utility model designed to support DOE management decision-making. Issues can be ranked based on the risk associated with the current situation (i.e., the level of consequences that might occur if the identified problem is not mitigated and the likelihood of experiencing those consequences). Activities developed to address the issues, documented in ES&H activity data sheets (ADSs), are ranked based on their risk-reduction potential (i.e., the difference in expected risk before and after implementation of the activity).

ES&H planners use the RPM to derive an ES&H ADS score by assessing the relative level of risk posed by current conditions (before the activities in the ADS are performed), and the relative level of risk expected to remain after the activities are performed. The ES&H ADS score is calculated by taking the difference between the risk score before performance of the activity and the risk score after performance of the activity. The figure-of-merit for ranking an ES&H ADS using the RPM, therefore, is the risk reduction expected to be achieved by the activity. This ensures that the score assigned to an ES&H ADS is a measure of the effectiveness of the activities in reducing risks, rather than a measure of the magnitude of current problems or issues that the activities are defined to correct.

"Risk" is defined as the product of consequence and probability. The scores assigned to risks by the RPM are derived from numerical weights that represent various levels of severity of adverse impacts (consequences). The impact weights are then multiplied by the

likelihood of occurrence (probability) of the impact. Each risk score assigned by the RPM is, therefore, the product of an impact weight and impact likelihood.

The RPM matrix (depicted in Table I at the end of this process description) provides the structure for examining both impact and likelihood and combining them into a risk-based ES&H ADS score. The rows of the matrix define impact levels; the columns define likelihood levels. Each matrix cell (row and column combination), therefore, defines a risk level. Each matrix cell contains a numeric weight corresponding to the product of impact weight and likelihood.

The RPM matrix includes impacts in six categories that represent the major types of risks important to ES&H activities.

(1) **Public Safety and Health** addresses potential adverse impacts on the health and safety of the *off-site* population surrounding a facility.

(2) **Site Personnel Safety and Health** addresses potential adverse impacts on the safety and health of individuals *inside the facility boundary*, i.e., site workers and visitors.

(3) **Compliance** addresses failures to comply with laws, regulations, compliance agreements, Executive Orders, and DOE Orders related to Environment, Safety and Health. Such failures may adversely affect the confidence of DOE or other agencies in the ability of the facility to operate while protecting the public, workers, and the environment.

(4) **Mission Impact** addresses potential adverse impacts on the ability to perform the research or production mission of the facility or the ability to carry out important parts of the mission.

(5) **Cost-Effective Risk Management** addresses potential accidental losses to a facility's capital investment (buildings, equipment) or an existing opportunity for cost savings, such as infrastructure upgrades, management systems upgrades, or improved program development.

(6) **Environmental Protection** addresses potential adverse harmful impact on natural resources (air, water, land, wildlife).

Each of the six categories includes two or more impacts representing different levels of impact severity. For example, the Site Personnel Safety category includes four impacts of

decreasing severity: catastrophic, critical, marginal, and negligible. A detailed description of the RPM impacts with examples is included in section 3.4.4.

The Cost-Effective Risk Management category differs from the other categories in that it is allows managers to assess the benefits of an ES&H ADS on the organization's ability to manage its risks efficiently, protect its capital investment, take preventive action before risks to the public, workers, or environment develop, and reduce overall costs.

As shown in Table II at this end of this section, the columns of the RPM (A through D) represent four likelihood levels used in assessing the risk reduction benefit of activities. Each likelihood level has an associated numerical value, which is multiplied by the impact weights to derive the risk value for each matrix cell in the matrix column corresponding to the likelihood level. The likelihood levels are as follows.

(1) **A. Very high** likelihood indicates an impact already exists with certainty or is expected to occur at least once per year. For example, if a facility is known to be out of compliance with a DOE ES&H Order, the likelihood of this impact falls into the *very high* category. If a condition at a facility has historically resulted in one or more lost-time worker injuries per year and the condition has not been corrected, the likelihood of this impact also fits this category.

(2) **B. High** likelihood indicates that an impact is expected less frequently than once per year, but more frequently than once every 10 years. Such impacts are expected to occur within the operating history of the facility, but have not occurred regularly every year.

(3) **C. Medium** likelihood indicates that an impact is expected less frequently than once every 10 years but more frequently than once every 100 years. Impacts with this likelihood are not expected frequently within the operating life of a facility, but may occur once in the facility's life.

(4) **D. Low** likelihood impacts are unlikely to occur within the operating life of a facility, but are not impossible. For example, impacts in this category may occur once in the operating life of one facility out of a population of 100 similar facilities. Impacts with this likelihood are expected to occur less frequently than once per 100 years, but more frequently than once per 10,000 years.

The RPM matrix includes discrete values for severity of impact (the rows of the matrix) and the likelihood of experiencing these impacts (the columns of the matrix). These discrete values should be adequate to support prioritization of ADSs in most instances.

However, if more precise risk assessment information is available, the RPM can accommodate such information. More precise information can be incorporated in two ways.

- Instead of using the discrete likelihood levels, the RPM can accept any likelihood between 0.0001 and 1.0, and

- a consequence multiplier can be applied to each impact to interpolate between or extrapolate beyond the discrete impacts levels of the RPM.

Adjusting Likelihood Values. As noted, in addition to the four discrete likelihood levels included in the RPM, any likelihood value from 0.0001 to 1.0 may be assigned if sufficient information is available on which to base a more precise likelihood estimate. This can be accomplished directly in the ES&H Management Information System.

Example: A portion of a nonreactor nuclear facility Safety Analysis Report analyzes a scenario in which an extreme overexposure of workers could occur. The likelihood of this scenario is estimated to be 10^{-3} per year. A fix has been defined to remove the possibility of this scenario. In deriving the RPM score for an ADS representing implementation of the fix, Impact 4 (extreme over-exposure of workers) applies. Because the estimated likelihood of the scenario falls between the representative likelihoods for RPM columns C and D (10^{-2} and 10^{-4}), this likelihood value may be entered directly in the Information System; the risk score for the impact-likelihood combination representing this scenario is 2 (=10^{-3} times 2000). Note that a likelihood value other than one of the RPM matrix column likelihoods was used in this case because specific information was available (i.e., part of a facility SAR) to support a different value.

Consequence Multiplier Adjustments. A consequence "multiplier" is also included in the RPM, as it is implemented in the ES&H Management Information System software, to allow a more precise assessment of impacts beyond that afforded by the discrete matrix row values. The consequence multiplier can be used to interpolate between (or extrapolate beyond) the discrete levels of the impacts defined in the RPM. For example, in scoring impacts in the Public Safety and Health and Site Personnel Safety and Health categories, the multiplier can be used to adjust for the number of persons affected by the impact.

The consequence multiplier should only be used when sufficient, documented analysis is available to justify more precise levels. The consequence multiplier is not intended for

application to the "Compliance" category, because the impact scale in this category is not considered to be continuous.

For example, the consequence multiplier that can be applied to the Public Safety and Health or Site Personnel Safety and Health categories accounts for the size of the population impacted. The RPM weights in each RPM matrix cell in these categories have been assigned based on an assumption that each impact affects 10 persons. If a significantly higher or lower number of persons is expected to be affected by an impact, however, different weights are appropriate. Specifically, the weight should vary proportionally to the number of affected persons.

The RPM cell weights may be used exactly as given in the matrix, without adjustment, if the ADS scorers determine that the implicit assumption of ten persons being affected by the impact is sufficient to score an ADS appropriately. If the number of persons expected to be affected by an impact diverges from this assumption significantly (either higher or lower), so that the RPM cell weights do not represent the risk benefits of the ADS appropriately the ES&H Management Planning process allows for an additional adjustment factor to be specified to multiply by the RPM cell weights.

The appropriate adjustment factor equals the number of persons expected to be affected divided by ten. For example, if 100 persons are expected to be affected by an impact, the multiplier equals 10 (i.e., 100 persons affected, divided by 10 persons implicit in RPM weights). If no more than one person is expected to be affected, the multiplier equals 0.1 (i.e., 1 person affected, divided by 10 persons implicit in RPM weights).

The consequence multiplier can be applied for those impact categories with continuous impact scales (e.g., number of injuries, risk management investment dollars) and where additional quantitative risk assessment information is available to establish a basis for the more precise values. The multiplier should not be used to interpolate between levels of compliance.

The ES&H Information System and ADS form includes fields in which the consequence multiplier may be entered when an ADS is scored. These fields have default values of 1, indicating no adjustment to the RPM weights.

Example: A national laboratory plans a program to reduce lost time injuries to lab workers. Currently, such injuries occur at a rate of 100 per year. The proposed program intends to reduce this rate significantly. An ADS is prepared to represent this program. In scoring this ADS, Impact 6 (lost-time worker injuries) applies with a RPM likelihood category of A (greater

than once per year). In addition, the number of persons affected by the impact significantly exceeds the 10 per year assumption implicit in the RPM weight for Impact 6. The appropriate multiplier for 100 injury victims per year is 10 (=100/10). This results in a scaled weight for the Site Personnel category equal to 1000 (Impact 6, Likelihood A RPM weight equals 100, multiplied by a scaling factor of 10).

Through the combined use of the continuous likelihood scale and the consequence multiplier, facility scorers can fully use the results of any available information from detailed, quantitative risk assessments. The RPM can reflect the most detailed risk assessment information available, while still maintaining its simple matrix structure to facilitate discussion and communication of these risks.

3.2.2 Applicability

The RPM was specifically developed to support prioritization of ES&H issues and activities; accordingly, the categories and weights of the RPM are optimized to rank ES&H programs. However, the RPM has been tailored to rank sitewide indirect activities at several DOE facilities, and is the model on which both the Surplus Facilities Inventory Assessment (SFIA) Threat-Based Priority Model and the QEM used by EM were developed. Coverage of the RPM includes ranking of ES&H issues and the proposed/actual work activities to address these issues. The RPM is used to rank all types of ES&H activities including those funded by direct funding sources: operating, capital equipment, general plant project, or line item project, and those funded by indirect or allocable cost arrangements.

The RPM can be used to evaluate sitewide ES&H risks, programs, and activities from initial issues/hazard ranking, through budget formulation and decision-making, and ES&H program execution, regardless of type or funding source. The RPM is used to evaluate issues and activities of many different types including occupational safety improvements, capital upgrade projects, infrastructure maintenance, improvements in conduct of operations, etc.

The RPM is used at all DOE facilities located throughout the United States and by all Headquarters Programs. Facilities using the process range from small solar energy laboratories and fossil energy facilities, to large nuclear weapons facilities.

3.2.3 Development Status

The ES&H Management Planning Process and the RPM are fully developed processes that have been used successfully through four complete Departmental budget cycles. The process is also now a critical component of the Secretary's Contract Reform Initiative. A DOE Technical Standard has been developed to assist contractors and DOE management in using the process and the ES&H Management Plan in this context, which in turn, includes use of the RPM or another consistent priority setting models. Such models include the QEM, and the SFIA Threat-Based Priority Model.

Furthermore, a powerful PC database system, the Environment, Safety and Health Management Information System (ES&H MIS), which includes a detailed User's Manual, has been developed to support the production, analysis, and use of ES&H Management Plans and to conduct prioritization using the RPM. The ES&H MIS has been designed using FoxPro development software and is distributed to all DOE facilities as a run-time application. The user interface consists of menus, windows, dialogues, and other features that facilitate communication with the database system.

In addition to direct input and update of data, the MIS provides powerful but easy-to-use filtering, indexing (sorting), and output reporting capabilities. The Database System includes an RPM "Scoring Screen" for each issue or activity record and a "Resource Screen" that captures budget costs of an activity in a variety of resource categories. The ES&H MIS supports efficient risk-management and resource allocation by presenting activities in risk-ranked order, displaying budget cut-off lines and scenarios, and allowing automatic deferral to later years of less important activities that fall "below the line." The database system is comprised of four major modules.

(1) **Assessments**, in which users can enter records and provide information about specific assessments (evaluations, etc.) that spawn ES&H issues.

(2) **Issues**, in which users can enter records and provide information about specific ES&H issues identified in the assessments. Many issues can be linked to an assessment in the database.

(3) **Activities**, in which users can enter records and provide information about specific ES&H activities defined to resolve the identified issues. Activities can be linked to issues within the database and through issues to assessments.

(4) **Milestones**, in which users can enter records and provide information about the specific tasks or deliverables associated with an Activity and the due dates for

these accomplishments. By linking the Milestones to Activities (and thereby to Issues and Assessments), this module allows the MIS to serve as a powerful, integrated commitment management and tracking system.

3.3 Approach Summary

A comparison of priority setting methods is best achieved within the context of their intended use or management processes. However, it is important to realize that the EM QEM and SFIA methods are similar to and consistent with the ES&H RPM. Each of these methods has proven to work for its intended application.

With regard to the RPM, the DOE ES&H Management Planning Process produces a plan through a combination of top-down guidance and bottom-up analysis and decision-making. It is a **continuous, risk-based, resource-constrained, management process** designed to improve DOE and contractor use of available resources to manage ES&H risks. The process is designed to help managers produce and communicate integrated information necessary for safety and health strategic planning and operational management. Both the development and output of the ES&H Management Plan are directly tied to the Departmental budgeting process. The major steps of the Plan development process are the following.

(1) Strategic Planning Guidance is provided by the Secretary of Energy, and key ES&H issues are identified by the Assistant Secretary for Environment, Safety, and Health.

(2) Headquarters managers provide direction to operating facilities, including budget targets to be used in preparing field planning data.

(3) Field Elements conduct a needs analysis to identify ES&H needs and risks, identify ES&H activities/programs to address the needs or risks, prepare ES&H ADSs to document these activities, and enter the ADSs into the ES&H Management Information System data base.

(4) ES&H ADSs are ranked using the DOE ES&H RPM. The ranking is reviewed by successive levels of management; other planning factors (such as precedence and coupling relationships between ADSs, strategic factors, etc.) are applied to adjust rankings. (A complete description of the RPM ranking process is provided in section 3.2.1).

(5) Available resources are allocated to the activities. The ranked listing of ADSs is used to support budget decision-making during the Department's Corporate Budget Review (CBR) process. Less important activities that cannot be accomplished within prescribed budget constraints are reduced in scope or deferred to subsequent years.

(6) Corporate budget review decisions are reflected in the ES&H Management Plans, and an ES&H "crosscut budget" is prepared for OMB.

(7) Final OMB allowances are reflected in the ES&H Management Plans, and a revised ES&H "crosscut budget" is prepared to accompany the Department's congressional budget request.

(8) Budget decisions and planning implications are communicated back to the operating facilities, and the updated ES&H Management Plans provide the baseline for incorporation into the ES&H program executed during the budget year and for the next annual planning and budget formulation cycle.

The RPM supports but does not replace the expertise of field and headquarters staff and management. The RPM is viewed as one tool within an overall management process that structures and focuses management decision-making. The RPM does not attempt to encompass all factors or provide all information required to determine the ultimate priority of an issue or activity. The ES&H planning process is designed to allow various factors important to the setting of priorities to be incorporated into the final adjusted ranking. Such factors include strategic considerations concerning the expected lifetime of the facility, the level of uncertainty in the risk evaluation, or project management considerations such as precedence relationships among activities. The RPM is not intended to provide a concise quantification of risk, but to structures management experience and knowledge (and any available quantitative risk data) into a defensible and traceable relative ranking of ES&H issues and activities.

3.4 Process Principles

3.4.1 ES&H Activity Scoring and Ranking with the ES&H RPM

Available resources may not be adequate to allow full and immediate implementation of all proposed ES&H programs and activities. Risk-based ranking of ES&H activities supports management's ability to allocate resources to the set of activities that will most reduce risk during the planning period. ES&H managers and planners should assess the risk-reduction benefits of each ES&H activity and rank them accordingly.

The ES&H RPM is the tool provided to produce the initial activity rankings. Operating organization planners use the RPM to derive risk-reduction scores for each ADS. This risk-reduction benefit score is the primary consideration for establishing the relative ranking of ADSs. However, facility, Operations Office, and Headquarters management may adjust the ADS rankings to account for additional planning factors not considered by the RPM. In addition, Operations Office and Cognizant Secretarial Officer (CSO) ES&H planners are responsible for reviewing priorities for consistent application of the RPM and may adjust ADS scores to ensure consistency in Departmental prioritization and budgeting for ES&H activities. After the risk-based priorities are established and adjusted, management will use the ranked list of ADSs to allocate available resources to the most important activities.

3.4.2 ADS Ranking Steps

Three major steps are associated with ranking ADSs:

(1) Use the RPM to characterize and score the existing risks addressed by the ADS;

(2) Characterize and score the risks that would remain after implementation of the ADS;

(3) Apply other planning factors to adjust ADS scores and produce the ADS rankings. The difference between the scores in the first two steps is the risk-reduction score. The last step also includes Operations Office and CSO adjustments to ensure consistent and correct application of the RPM.

The RPM provides a convenient framework for structuring risk information and focusing facility management and staff expertise on the assessment of risks related to ES&H issues and activities. It is strongly recommended that ADS scoring at a facility be performed by an evaluation group with expertise in diverse fields and extensive experience with a facility's operations, potential risks, and operating history. This enhances the quality of the information used in the activity risk scoring and the validity of the ADS rankings.

The ADS form and the ES&H Management Information System provide fields for documentation of the basis for RPM scoring by operating organization scoring groups and the basis for scoring adjustments by operating organization management, Operations Office reviewers, and CSO reviewers. Thorough and clear documentation in these fields is essential for effective review and use of the ADS risk-based rankings by decision-makers as the ES&H planning information is rolled up. High-quality documentation of the ADS ranking process is particularly important to support

Headquarters budget deliberations and to provide feedback from Operations Office and CSO reviewers to operating organizations.

Step 1: Assess and score risks before ADS implementation.

The ADS scoring group will consider existing risks addressed by the activities included in the ADS. Each ADS includes an *appraisal* section, in which the ADS preparer should document these risks. The scoring group will consider the risks documented in the ADS along with any additional risks that apply.

For each RPM impact category, the scorers perform the following steps.

(1) Identify all impact levels that could occur because of the current situation.

(2) Estimate the likelihood for all impacts identified in (1) above. One of the likelihood levels represented by the RPM columns A-D may be chosen. Alternatively, if information is available to support a different likelihood value, that value may be specified.

(3) If more detailed information is available on the estimated impacts, specify a consequence multiplier to interpolate between or extrapolate beyond the impact levels designated in the RPM rows.

(4) Select the combination of impact, likelihood, and multiplier that produces the highest risk score to represent the category in the overall ADS score.

The risk score *before* performance of the ADS activities is the sum of the representative risk scores from all categories that are scored by the scoring team. The risk score is calculated automatically in the ES&H Management Information System upon entry of the selected matrix cells.

Step 2: Assess and score risks after ADS implementation and calculate ADS risk reduction score.

After using the RPM to determine the ADS risk score for existing risks, the scoring group will consider the effect on facility risks of performing the activities defined by the ADS and the level of risk remaining after performance of the activities. The group will consider risks documented in the ADS appraisal section along with any additional applicable risks. The scorers will derive the risk scores for the expected condition *after* completion of the activities in the same manner as they determined the before risk scores before ADS

implementation in Step 1. The risk score for the ADS *after* completion of the ADS activities is the sum of the representative risk scores from all categories that are scored by the scoring team, and is calculated automatically in the ES&H Management Information System.

The net ADS risk reduction score is the difference between the *before* risk score, calculated in Step 1, and the *after* risk score, calculated in Step 2. This net risk reduction score is also calculated automatically within the ES&H Management Information System. Comparing these risk reduction scores for all ADSs at a facility offers a preliminary relative ranking of the ADSs. ADSs with high scores represent activities that are most effective in reducing current risks at the facility, while ADSs with low scores offer low benefits in curbing risk.

Step 3: Adjust ranking according to other planning factors.

Other factors besides the risk reduction potential of activities may influence the ranking of ADSs. These factors may include cost, precedence and coupling relationships, and other planning factors. After the scoring group completes the RPM scoring and ranking using the RPM, operating organization management and Operations Office and CSO reviewers may adjust the ADS ranking to account for these factors. Scoring adjustments may be made by adding to or subtracting from an ADS RPM score to achieve the desired relative ranking for the ADS. Scoring adjustments must be thoroughly documented in the ADS "scoring comments" section in the ES&H Management Information System.

Cost of Activities. Although the primary objective of implementing ES&H activities is to remove or reduce major risks, an additional important objective is to achieve risk reduction as efficiently as possible. To promote the efficient use of ES&H resources and the cost-effective conduct of ES&H programs, managers may adjust the priorities of ADSs based on the cost of activities included in each ADS. Following are examples of situations in which scoring adjustments based on ADS cost may enhance the ADS rankings.

- Managers should adjust upwards the ranking of low-cost ADSs with substantial risk reduction to ensure such activities are near the top of the ranked list of ADSs.

- Managers should reassess each high-cost ADS with a high or moderate risk reduction score to determine if some subset of activities in the ADS or some alternative activities could provide comparable benefits for lower cost. This may require redefinition, reformulation, or repackaging of corrective actions included in the ADS.

Precedence and Coupling Relationships. Implementation of activities in some ADSs may not be feasible without previous implementation of activities in other ADSs. If the prerequisite ADS is ranked below the dependent ADS, facility managers may want to adjust the ranking of the prerequisite ADS to reflect a realistic priority of activities. Similarly, two or more activities in separate ADSs may require simultaneous implementation. In this case, ADS rankings may be adjusted so that the priorities of the dependent activities allow them to be performed in the same budget period.

Other Practical Planning Factors. Practical constraints may change the relative desirability or practicality of certain activities beyond the rankings provided by the RPM scores. Examples of planning factors that may merit adjustments in ADS priority include:

- expected life of a facility;
- changes to facility mission;
- strategic goals of the Department, EH, or the Program Office;
- management workloads and the ability to provide adequate management and oversight to the activity;
- staff loads and ability to hire additional staff;
- uncertainties in changing requirements;
- uncertainties in obtaining project benefits; and
- perception of facility risks by the public or other external stakeholders.

After each ADS has received an RPM risk reduction score and the ranking has been adjusted, the result is a ranked list of facility ADSs for use in resource allocation.

Operations Office and CSO planners should review the results of operating organization ADS scoring and ranking to ensure consistent application of the RPM and proper scoring adjustments. This review may result in additional ranking adjustments at the Operations Office or CSO level.

As part of their review, responsible managers should assess those ADSs representing significant risks for which effective mitigating activities have not been identified. This may be the case if ADS scoring results in both a high *before* and a high *after* score, indicating

that the ADS does not fully address some significant risk of concern. The low risk-reduction score, if viewed alone, may result in deferral of the activity. However, if this activity is deferred, the significant current risk would remain unmitigated. Such ADSs should be evaluated further to determine if alternative corrective activities would more successfully reduce the risks or if risk reduction is not practical due to other considerations. Compensatory actions, which reduce current risks in the near-term while longer-term solutions are being developed, should always be considered for high- or moderate-risk situations.

3.4.3 Resource Allocation

After the risk ranking of Activity Data Sheets has been completed, the next step in the ES&H Management Planning Process is to allocate available resources to these activities. This process establishes which ADSs will be funded within target level budgets and the level of funding associated with each activity. This process also identifies ADSs that cannot be funded under current resource limitations.

The allocation of resources to ES&H activities is a multistep process that involves all levels of the Department. Allocation of available resources to ADSs requires that budget targets (or resource constraints) be established. Because there are often several different funding sources for ES&H activities, separate targets may be required to allocate resources to ES&H activities funded from these different sources. For example, one funding limitation would be needed for ES&H activities funded out of the sitewide overhead pool, and a separate target would be needed for ES&H General Plant Projects (GPPs), which are funded out of the site's GPP appropriation.

Targets for programmatic funding should be provided by each CSO as part of the Departmental budget process. In some instances, these budget targets are summary (decision unit) level values. In such cases, targets for use in allocating resources to ES&H activities are derived from these summary level targets. For activities funded by allocable cost mechanisms, funding targets must also be derived by operating organization budget personnel. For example, operating organization management (with Operations Office approval) is responsible for determining the size of the overhead pool of resources, and the portion of the overhead funds that will be allocated to ES&H activities.

After targets have been defined, the following major steps should be followed in allocating resources to ES&H activities for each funding source.

(1) Produce the ranked list of ADSs from the ES&H Management Information System. This list shows activities in order of priority and their cumulative cost.

(2) Starting with the highest ranking activities on the list, determine which activities can be supported within the target funding level (i.e., draw a line on the ranked list where the cumulative cost of activities in the ranked list equals the target level of funding). This budget target can be input to, and shown on the output report from, the ES&H Management Information System.

(3) Operating organization financial management, ES&H, and senior management should assess the implications of this first cut at differentiating funded from unfunded activities. This review should examine both the funded and unfunded activities. The following questions should be considered.

- Are all essential ES&H programs covered within the current funding target?
- Are any significant ES&H risks not being addressed because the proposed activity falls "below the funding line"?
- Are any of the unfunded ADSs critical to achieving the Department's ES&H strategic goals or programmatic missions?
- Do any of the unfunded ADSs represent sound risk management investments or provide important preventive benefits that will yield long term benefits?
- Are certain ES&H programs, or parts of these programs no longer essential due to changing mission, program needs, etc.?
- Could any activities "above the line" be done more cost effectively to free resources to fund some of the currently unfunded ADSs?

(4) After this review, the ADS rankings, ADS funding levels, and target budgets should be adjusted to reflect management's final decisions. To ensure management's ES&H resource allocation decisions are consistently captured and communicated, the ADSs should be characterized as follows in the ES&H Management Information System.

- Management's relative priorities should be reflected by adjusting the relative ranking of the ADSs. As discussed in the previous section, this is accomplished by adding or subtracting points from the raw ADS RPM

score to move it up or down in the relative ranking. The justification for these changes should be documented in the Scoring Comments field.

- Activities to be funded should be designated as "Target" in the Funding Case field. Activities that management determines cannot be funded within the budget target should be designated as "Unfunded."

- The ADS annual cost profile for all funded ADSs should be consistent with funding decisions and budgets for the appropriate fiscal year.

3.4.4 RPM Matrix Impacts and Scoring Examples

Public Safety and Health

Impact 1: Immediate or eventual loss of life/permanent disability

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. (It does not address impacts to site workers or visitors.) This impact includes immediate 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. Such releases could be the result of accidents that release hazardous materials within a building combined with failures in building confinement or containment, accidents during off-site transportation, or catastrophic events resulting in direct release of materials (e.g., fire, explosion).

Example: A facility has proposed a set of seismic safety improvement projects to correct structural and equipment deficiencies that could contribute to building failures during an earthquake. Under current conditions, there is a high likelihood of structural failure during a strong earthquake. Structural failure may result in a chemical release or fire that could spread off-site. Because a number of public facilities and private residences are close to the site boundary, public safety could be threatened and fatalities are possible.

Impact 2: Excessive exposure and/or injury

This impact indicates the potential for excessive exposure or injury to the off-site population, but without the potential for death or permanent disabling injury (i.e., recovery from potential injuries is expected). Excessive exposures to radioactive or hazardous materials are those that exceed published acceptable limits.

Example: The example given for Impact 1 could apply to this impact if the potential volume of chemicals released were reduced such that death or permanent injury was not expected. However, public exposures to hazardous substances that exceed limits would still be expected.

Impact 3: Moderate- to low-level exposure

This impact indicates the potential for exposure of off-site population to hazardous or radioactive materials, but these exposures are no greater than published acceptable limits. Immediate deaths or injuries are not expected. Rates of cancer incidence in the population would not detectably increase.

Example: A facility must purchase modern radiation survey equipment to comply with DOE O 231.1, DOE N 441.1, and American National Standards Institute (ANSI) N323. Existing survey equipment does not meet requirements for lower limits of detection for release of equipment or materials from radioactive materials management areas at the facility. Because of this inadequacy in detection instrumentation, contaminated materials may be inadvertently released to uncontrolled areas and subsequently disperse off-site. Because of the nature and volume of the contaminated materials, however, the potential releases would not constitute a threat to public health, but could result in a minimal exposure of members of the public to radioactive material.

Impacts 1, 2, and 3 differ in the extent of potential off-site consequences. In evaluating the potential consequences of a condition at a facility, the following factors should be considered:

- the nature of possible accidents that could occur at the facility;
- the potential for off-site release of hazardous or radioactive material in case of an accident;
- the amount and type of hazardous or radioactive material present; and
- the potential for deaths, injuries, or exposures of the off-site population.

Site Personnel Safety and Health

Impact 4: Catastrophic: Injuries/illnesses involving permanent total disability, chronic or irreversible illnesses, extreme overexposure (e.g., 1000 rem/yr), or death

This impact encompasses potential permanent effects among the site worker population. Such effects may result from industrial accidents or excessive exposures to hazardous or radioactive materials. This impact includes immediate deaths and disabling injuries as well as future deaths from latent effects such as cancer.

Example: A facility has proposed a set of seismic safety improvement projects to correct structural and equipment deficiencies that could contribute to building failures during an earthquake. Under current conditions, there is a high likelihood of structural failure during a strong earthquake. Persons inside the deficient buildings would be at risk and fatalities are possible.

Impact 5: Critical: Injuries/illnesses resulting in permanent partial disability, temporary total disability (>3 months), or serious overexposure (e.g., 100 rem/yr.)

This impact involves injuries, illnesses, or exposures that result in lengthy hospitalization and significant recuperation time, but are not expected to result in death or permanent total disability. This impact includes exposures to radioactive or hazardous materials that may exceed published acceptable limits.

Impact 6: Marginal: Injuries/illnesses resulting in hospitalization, temporary reversible illnesses with a variable but limited period of disability (<3 months), slight overexposure (e.g., 5-10 rem/yr.), or exposure near limits (20-100%)

This impact involves worker injuries, illnesses, or exposures that result in emergency room treatment, limited hospitalization, and lost work time. Time required for recuperation from these effects, however, is not extensive.

Example: A facility proposes a Line Item Project to improve pedestrian and vehicular safety through roadway modifications. This project will improve sight lines at turns and intersections and widen narrow portions of site roadways. Under current conditions, the facility experiences about two road accidents per year. These accidents are typically minor, but do occasionally result in injuries requiring limited hospitalization.

Impact 7: Negligible: Injuries/illnesses that do not result in hospitalization, temporary reversible illnesses that require minor supportive treatment, or exposures below 20% of limits (e.g., <1 rem/yr)

This impact involves worker injuries, illnesses, and exposures that would be expected to result in no lost work time (unless the exposure resulted in a cumulative dose exceeding limits). Standard first aid is expected to be adequate treatment.

Compliance

Impact 8: Major noncompliance with Federal, State, or local laws; enforcement activities; or compliance agreements significant to environment, safety, or health and involving significant potential fines or penalties

This impact includes major violations of laws, regulations, codes, enforcement actions, compliance agreements, or standards. These noncompliances have the following characteristics.

(1) Violation of the law, regulation, code, enforcement action, compliance agreement, or standard could result in the imposition of fines on DOE or the operating organization, imprisonment of DOE or operating organization personnel, liability for the payment of significant damages, or other legal penalties.

(2) The existing situation must represent a *major, substantive* noncompliance with the law, regulation, code, or standard. If existing conditions are substantially in compliance with only minor exceptions, this impact does not pertain. (See definition of Impact 10 below.)

(3) The violated law, regulation, code, or standard must be significant to environment, safety, or health.

If an ADS addresses a major noncompliance with an environmental law or regulation, such as the Clean Air Act (CAA), the Resource Conservation and Recovery Act (RCRA), or the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or it addresses a major noncompliance with a rule subject to penalties under the Price-Anderson amendments act, Compliance Impact should be 8.

In general, noncompliance with a DOE Order should be scored using Impact 9 or 10 below because fines or criminal penalties do not typically result from DOE Order noncompliance. Likewise, noncompliance with an Occupational Safety and Health

Administration (OSHA) requirement or a DOE occupational safety and health Order should be scored using Impact 9 or 10 below unless OSHA has the force of law at a facility (which is currently not the case at most DOE facilities). If an ADS addresses a major noncompliance with an environmental law and a DOE Order simultaneously, the applicable compliance impact with the highest potential risk reduction score should be chosen (in this case, Impact 8).

Example: A facility has proposed a project to expand its hazardous waste storage and disposal capability. Currently, hazardous waste handling capability is inadequate, so that waste remains in temporary storage locations for longer than 90 days. This is a violation of RCRA and the facility may be fined by he EPA. Because this example involves noncompliance with an environmental law, it would be scored with Compliance Impact 8.

Impact 9: Major noncompliance with Executive Orders, DOE Orders/Notices, or Secretary of Energy Policy Statements that are significant to environment, safety, or health but do not involve *significant potential fines and penalties*

This impact includes significant noncompliances with any DOE Order/Notice or policy statement that is significant to ES&H. To distinguish Impact 9 from Impact 8, noncompliances included under Impact 9 cannot result in fines, imprisonment, or other legal penalties. Impact 9 also includes facility noncompliance with laws, regulations, codes, and standards (e.g., OSHA, NFPA, ANSI, NEC, MSHA) that are referenced in DOE Orders, but do not have the force of law at the facility.[2] As with noncompliance covered under Impact 8, conditions of noncompliance included in this impact must be *major, substantive* noncompliances and must relate to requirements that are significant to environment, safety, and health. The impact does not include marginal noncompliances, such as minor administrative discrepancies (see definition of Impact 10 below).

Example: A recent audit finding indicated that the Hazards Communication Program at a facility is not in compliance with the requirements of DOE O 440.1. All aspects of the program are lacking, including surveillance, communications, and record keeping. A facility proposes to add five full time equivalents (FTEs) to upgrade the Hazards Communication Program.

[2]OSHA may have the force of law at a minority of facilities. At these facilities, significant non-compliances with OSHA would be included under Impact 8.

Impact 10: Marginal noncompliance with Federal, State, and local laws; enforcement actions; compliance agreements; Executive Orders; DOE Orders; or that are significant to ES&H

This impact includes *minor* noncompliance with laws, regulations, codes, standards, Orders, or directives that are significant to ES&H (the same group of laws and orders that are included in Impacts 8 and 9). It is differentiated from Impacts 8 and 9, which cover major noncompliance conditions. This impact pertains to conditions in which current ES&H programs largely conform to the requirements of applicable laws and Orders, but do not fulfill certain marginal or administrative aspects of the requirements. For example, if a facility has fulfilled the actual substantive physical requirements of a law or Order, but has not completed all administrative requirements or paper work, Impact 10 applies.

Example: A facility proposes to add one clerical employee to assist the IS Manager in support of the Hazards Communication Program that was recently upgraded as required by DOE O 440.1. The responsibilities of this new employee will be record keeping and clerical support for visiting assessment teams. Recent audits have indicated that the program is adequate, but to be in full compliance the facility must keep better records of communication activities and provide better clerical support for visiting assessment teams to allow them to obtain a more comprehensive picture of the state of the facility's compliance.

Impact 11: Significant deviation from good management practices

This impact indicates serious deviation from accepted industry or DOE standards for performing activities in a given area. Such directives or good practices do not have the weight of a law, Order, or Policy Statement issued by the Secretary of Energy.

Mission Impact

Impact 12: Serious negative impact on ability to accomplish major program mission

This impact includes conditions that seriously curtail or prevent accomplishment of the mission of a major program at a site. The condition need not shut down the entire site, but must threaten continuation of at least one of the facility's major research or production missions. Under this impact, the interruption of the affected program mission must be of sufficient duration to pose serious doubts about the feasibility of accomplishing yearly goals or objectives set for the program.

The program mission impact may be due to regulatory or administrative shutdown of part of a facility, a catastrophic accident preventing continued activities, or the unavailability of equipment, staff, or other resources required by the program.

Example: Radiological surveys of chemistry laboratories at a site have revealed previously unknown contamination outside of posted radiological areas. To fully comply with DOE N 441.1 and DOE as low as reasonably achievable (ALARA guidelines, the facility proposes to fund systematic, detailed surveys of the laboratories and management of any contamination discovered. If this work is not performed, all chemistry division laboratories could be zoned as radiation areas, which would result in loss of effective use of the laboratory facilities and prevent progress in major programs that rely on the facilities.

Impact 13: Moderate negative impact on ability to accomplish major program mission

This impact includes conditions preventing accomplishment of major program missions at a site. Program interruptions considered under this impact are shorter than those included under Impact 12 above. Interruptions included under Impact 13 may pose risks to the achievement of set program goals or objectives, but still allow the possibility that such goals or objectives may be met.

Example: A facility must institute a site roadway safety and stabilization program to meet Federal and State safety standards. This project will stabilize landslides adjacent to roads at the site. Without this work, the landslides threaten to displace roadways and underground utilities. If this occurred, access and utility supplies to some site buildings could be disrupted, interrupting programs in these locations. Repairs to re-establish access and utilities are not expected to cause an excessive disruption of progress on these programs.

Cost-Effective Risk Management

Impact 14: Significant avoidable cost due to degrading infrastructure, inefficient management systems or program implementation, accident-related capital loss (total cost >$25M or annual cost >$5M), or the opportunity for cost savings

Impacts 14 and 15 involve either the loss of DOE capital investment due to accidents or an existing opportunity for cost savings (such as infrastructure upgrades, management systems upgrades, or improved program development). The difference between Impacts

14 and 15 is the dollar value shown to be at risk or the dollar value of the cost savings opportunity.

For Impact 14, the loss of investment could include loss of buildings, equipment, materials, finished products, or supplies, in which DOE had invested greater than $25M. Such loss could be incurred by events such as fire, explosion, human errors, or natural occurrences.

In addition to situations involving financial loss due to accidents, Impact 14 also includes opportunities for cost savings that would have a positive financial impact. Prominent among such opportunities are situations in which an immediate preventive investment can help avoid a potentially greater cost impact in the future. Examples include neglected facility infrastructure for which short-term expenditures on physical upgrades or increased maintenance or surveillance can help avoid increased long-term costs due to continued neglect or degradation or potential catastrophic damage. For Impact 14 to apply, the total cost savings must exceed $25M.

Impact 14 also includes annual cost impacts greater than $5M incurred as a result of a condition causing losses to a facility's capital stock. Similarly, Impact 14 includes opportunities for recurring annual preventive or other positive financial impacts exceeding $5M. Examples include opportunities to develop improved ES&H management systems that increase the efficiency of managing ES&H issues, thereby promoting early identification of problems; setting appropriate priorities for addressing issues; and defining cost-effective activities for addressing issues.

Example: A site contractor has proposed launching a behavior-based safety process to improve worker safety and decrease the frequency of on-the-job injuries. The process includes workplace observation and feedback to workers to improve the safety of workplace behaviors. In addition to substantial expected safety improvements, the process is expected to yield substantial annual cost savings through reduction of workman's compensation expenses. The avoided costs could exceed $5M per year.

Impact 15: Moderate avoidable cost due to degrading infrastructure, inefficient management systems or program implementation, or accident-related capital loss (total cost <$25M or annual cost $1M-5M)

This impact is similar to Impact 14, with the exception of the dollar amounts, which include smaller investment losses or cost savings opportunities.

Example: A national laboratory and DOE Operations Office ES&H division propose to develop an integrated issue management and commitment tracking system to improve the efficiency of ES&H management at the lab, increase accountability, and allow the Operations Office to perform its oversight role more productively. Implementation of such a system is expected to improve the cost effectiveness of risk management activities with savings expected to approximate $1.5M per year.

Example: A production facility plans to perform a pollution prevention/waste minimization opportunity assessment on one segment of the plant's process and to implement waste minimization activities based on the findings of the assessment. Preliminary evaluations indicated that the resulting waste reduction would substantially reduce disposal costs. It is estimated that costs could be reduced by around $3M per year.

Environmental Protection

Environmental impacts are defined as damage to a significant public resource such as: air, water, land, or wildlife. These impacts would primarily result from accidents involving the release or spill of radioactive or hazardous materials to the environment.

Impact 16: Catastrophic damage to the environment (widespread and long-term or irreversible effects)

This impact includes the most severe environmental effects, those with both of the following characteristics.

- The effects spread or may spread over a wide area and are not easily containable in a limited area, *and*

- the effects are irreversible or may only be reversed over a period of several years.

Example: A process at a facility involves the use of industrial solvents. The facility has proposed a project to improve the monitoring of releases from the process. Under current conditions, solvents may be released, disperse off-site, and contaminate groundwater that supplies the drinking water for a nearby community. The water supply would be unusable and an alternative supply would be needed. Cleanup of the groundwater is thought to require 30 years.

Impact 17: Significant damage to the environment (widespread and short-term effects or localized and long-term or irreversible effects)

This impact includes serious environmental effects that are less severe than those considered under Impact 16 above. These impacts must have one of the following characteristics.

- The effects spread or may spread over a wide area but may be reversed in no more than a year's time, *or*
- the effects are confined to a limited area but are either irreversible or require several years to reverse.

Impact 18: Minor to moderate damage to the environment (localized and short-term effects)

This impact includes less severe effects on the environment than those covered in Impacts 16 and 17 and include both of the following characteristics.

- The effects are confined to a limited area, *and*
- the effects may be reversed within a year's time.

Example: A facility proposes a project to construct double containment of feed lines into a diesel fuel tank to help prevent leaks. The tank is vulnerable to leaks, which could spill fuel and contaminate the soil surrounding the tank. Because of the volume and location of the tank, however, the contamination will not spread off-site and will not contaminate any water sources. Cleanup should require only a few weeks.

3.5 Measuring Results

ES&H planning information developed and prioritized using the ES&H Management Planning Process provides the basis for defining the ES&H performance measures, objectives and metrics by which contractor ES&H performance will be evaluated and through which ES&H accountability will be established. Existing site processes should be used to propose, review, and establish contractually binding performance measures. The ES&H Management Planning process does not mandate the specific performance objectives, criteria, and measures to be used but is designed to communicate answers to basic risk-management questions concerning ES&H activities.

- Who, specifically, is responsible and accountable for ES&H performance at each site, and how is this accountability enforced?

- What specific performance measures will be used to evaluate progress and ensure accountability for ES&H performance?

- What is the achieved level of ES&H performance?

Award/incentive fee criteria and performance milestones, based on performance of ES&H activities, should be incorporated into existing site incentive systems for the budget execution year.

3.6 References/Reading List

DOE Technical Standard, DOE-EH-XXXX-95, Environment, Safety and Health Management Planning Process and ES&H Management Plan

DOE ES&H Management Plan, Guidance Manual FY-BY

3.7 Definitions

Activity Data Sheet (ADS). The basic data record that documents ES&H activities in the ES&H Management Planning Process and provides the fundamental building blocks of the ES&H Management Plan (i.e., essential scope, schedule, cost, and management information).

Allocated (Indirect) Cost/Funding. A cost that is incurred by an organization for common objectives and that cannot be identified specifically with a particular project or activity.

Commitment. A written declaration by contractors to accomplish certain activities or meet certain conditions, as described in the ES&H Management Plan.

Direct Costs/Funding. Any costs that can be specifically identified with a particular cost objective that are directly related to and are being incurred principally for the benefit of the program receiving the charges.

ES&H Activities. Work conducted whose primary intent is to protect the health and safety of the public, workers, and the environment.

ES&H Management Information System (MIS). The computer-based system in which the information, obtained through the application of the ES&H Management Planning Process is collected, analyzed, and reported.

Program Execution Guidance. Guidance developed jointly by DOE Headquarters and Operations/Field Offices and issued to contractors that provides programmatic assumptions, expected outcomes, milestones, performance measures, financial controls, and reporting requirements; to be used to develop, implement, and monitor fiscal year operations at a site.

Risk-Based Priority Model (RPM). The methodology for establishing risk rankings of the ES&H activities at DOE sites. The ranking method relates likelihood of occurrence of these risks and their adverse potential effects on the public, site personnel safety and health, compliance issues, program mission, management investment, and environmental protection. This method provides the essential information for deriving ADS priorities.

Roll-up. The flow and integration of data at the contractor, Operations/Field Office, and Headquarters levels.

Target Funding Level. The total available funding specified in the Budget Control Tables provided by Headquarters.

Unfunded Activity. ES&H work that is desirable to conduct, but for which target funding is not anticipated to be provided, based on planned program direction and budget decision-making.

3.8 Training Courses/Program Assistance

Technical Assistance is available to DOE sites, Operations/Field Offices, and Headquarters programs to assist in implementation of the ES&H Management Planning Process including prioritization with the RPM. Requests for Technical Assistance should be made to Raymond W. Blowitski, EH-73, at 301-903-9878.

Table 1. ES&H Risk-Based Priority Model (RPM)

Impacts	Likelihood of Occurrence1			
	A	**B**	**C**	**D**
	Very High	**High**	**Medium**	**Low**
CATEGORY: PUBLIC SAFETY & HEALTH				
1. Immediate or eventual loss of life/permanent disability	3000	300	30	0.3
2. Excessive exposure and/or injury	300	30	3	0.03
3. Moderate to low-level exposure	30	3	0.3	0.003
CATEGORY: SITE PERSONNEL SAFETY & HEALTH				
4. Catastrophic - Injuries/illnesses involve permanent total disability, chronic or irreversible illnesses, extreme overexposure (e.g., 1000 rem), or death	2000	200	20	0.2
5. Critical - Injuries/illnesses result in permanent partial disability or temporary total disability >3 months; serious overexposure (e.g., 100 rem)	200	20	2	0.2
6. Marginal - Injuries/illnesses result in hospitalization; temporary, reversible illnesses with variable but limited period of disability <3 months; slight overexposure (e.g., 5-10 rem); exposure near limits (20-100%)	100	10	1	0.01
7. Negligible - Injuries/illnesses do not result in hospitalization; temporary reversible illnesses require minor supportive treatment; exposures <20% of limits (e.g., <1 rem)	10	1	0.1	0.001
CATEGORY: COMPLIANCE				
8. Major noncompliance with Federal, State, or local laws; enforcement actions; or compliance agreements significant to ES&H and involving significant potential fines or penalties	150	15	1.5	0.015
9. Major noncompliance with Executive Orders; DOE Orders; or Secretary of Energy directives (Notices or Guidance Memoranda) significant to ES&H and not involving significant potential fines and penalties	75	7.5	0.75	0.0075
10. Marginal noncompliance with Federal, State, local laws; enforcement actions; compliance agreements; Executive Orders; DOE Orders; or Secretary of Energy directives significant to ES&H	20	2	0.2	0.002

Impacts		Likelihood of Occurrence1			
		A	**B**	**C**	**D**
		Very High	**High**	**Medium**	**Low**
11.	Significant deviation from good management practices	1	0.1	0.01	0.0001
CATEGORY: MISSION IMPACT					
12.	Serious negative impact on ability to accomplish major program mission	150	15	1.5	0.015
13.	Moderate negative impact on ability to accomplish major program mission	75	7.5	0.75	0.0075
CATEGORY: COST-EFFECTIVE RISK MANAGEMENT					
14.	Significant avoidable cost due to degrading infrastructure, inefficient management systems/program implementation, or accident-related capital loss (total cost >$25M, or annual cost $1M-5M)	40	4	0.4	0.004
15.	Moderate avoidable cost due to degraded infrastructure, inefficient management program systems/program implementation, or accident-related capital loss (total cost <$25M, or annual cost $1M-5M)	15	1.5	0.15	0.0015
CATEGORY: ENVIRONMENTAL PROTECTION					
16.	Catastrophic damage to the environment (widespread, long-term or irreversible effects)	2000	200	20	0.2
17.	Significant damage to the environment (widespread, long-term or irreversible effects)	200	20	2	0.02
18.	Minor to moderate damage to the environment (localized and short-term effects)	20	2	0.2	0.002

Table II. RPM Matrix Likelihood Levels

	A	B	C	D
Likelihood	**Very High**	**High**	**Medium**	**Low**
Numerical Value	1.0	0.1	0.01	0.0001
Expectation	≥1 in 1 year	<1 in 1 year, ≥1 in 10 years	<1 in 10 years ≥1 in 100 years	<1 in 100 years, ≥1 in 10,000 years

The likelihood levels are defined in section 3.2.1.

A. **Very high** likelihood indicates an impact already exists with certainty or is expected to occur at least once per year. For example, if a facility is known to be out of compliance with a DOE ES&H Order, then the likelihood of this impact falls into the *very high* category. If a condition at a facility has historically resulted in one or more lost-time worker injuries per year and the condition has not been corrected, then the likelihood of this impact also fits this category.

B. **High** likelihood indicates that an impact is expected less frequently than once per year, but more frequently than once every 10 years. Such impacts are expected to occur within the operating history of the facility, but have not occurred regularly every year.

C. **Medium** likelihood indicates that an impact is expected less frequently than once every 10 years but more frequently than once every 100 years. Impacts with this likelihood are not expected frequently within the operating life of a facility, but may occur once in the facility's life.

D. **Low** likelihood impacts are unlikely to occur within the operating life of a facility, but are not completely precluded from occurring. For example, impacts in this category may occur once in the operating life of one facility out of a population of 100 similar facilities. Impacts with this likelihood are expected to occur less frequently than once per 100 years, but more frequently than once per 10,000 years.

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4. LABORATORY INTEGRATION AND PRIORITIZATION SYSTEM (LIPS)

The LIPS is available to facilitate ES&H activity ranking within the DOE ES&H Management Planning Process.

4.1 LIPS Process Specification

4.1.1 Authority

LIPS was developed in 1993 to prioritize laboratory activities that compete for limited resources. The Los Alamos National Laboratory (LANL), the Lawrence Livermore National Laboratory (LLNL), and the Sandia National Laboratory (SNL) collaborated with DOE Defense Programs to develop a risk-based prioritization system and implementation process to achieve as much risk reduction and benefit enhancement as possible with available resources.

4.1.2 Program Office Advocates/Assistance

LIPS is sponsored by DP-31. Questions should be directed to Kenneth P. Ferlic, Senior Technical Advisor, at (301) 903-6703.

4.2 Process Attributes/Applicability

The LIPS approach enables management to thoroughly, accurately, and defensibly consider the diverse objectives of competing projects as well as the diverse viewpoints of stakeholders. It was designed as a management tool for prioritizing operational activities or tasks. These activities or tasks may address continuing requirements or new problems and issues.

Unlike many other prioritization processes, LIPS is used to identify the activities producing the most cost-effective risk reduction, not to identify the activities addressing the greatest hazard or source of risk. LIPS prioritizes the value of solutions, not the severity of problems. Despite the emphasis on cost-effective risk reduction, the LIPS prioritization model can be used to help track and report on baseline risk levels. The most appropriate applications of LIPS arise when managers have to allocate limited resources to many different proposed activities. Applications of LIPS are particularly useful when activities are costly, are in different sub-functional areas managed by several different

individuals, and/or the constraint on available resources is tight enough to generate difficult, and possibly unpopular, decisions.

Managers may use LIPS to evaluate all activities within an organizational or functional area. They may also elect to evaluate only the subset of their activities about which funding or manpower decisions are particularly hard, such as investment/disinvestment options. LIPS could also be used to select the most effective solution to a problem from several competing solutions. Alternatively, if limited funding prevents all activities from being undertaken simultaneously, the decision on which ones to implement could be assisted by a ranking of only those activities for which some flexibility exists.

This systematic prioritization procedure helps managers make rational choices in the midst of technical, environmental, legal, economic, and political complexities. The approach documents decision-making logic and helps managers explain and defend the allocation of resources. The process also provides a basis for communicating the logic of prioritization to the public, employees, regulators, and if necessary, the courts.

LIPS was designed to do the following.

- Calculate the risk and benefits of proposed activities in equivalent dollars.
- Ensure consistency and ease of interpretation across DOE sites while accurately considering site-specific differences in objectives.
- Prioritize a large number of diverse activities such as mission or safeguards and security.
- Give appropriate credit for partial, sequential, and phased-action plans.
- Facilitate communication of results to a wide range of audiences, including DOE, the public, the courts, and outside technical reviewers.
- Provide technical defensibility to independent organizations and regulators.

Through its broad coverage of decision objectives, LIPS is applicable to any set of activities. Its greatest value comes when the diversity of the activities is greatest (e.g., when some pertain primarily to health and safety, others to enhancing mission, and others to improving productivity). LIPS allows competing objectives to be compared on the same scales and scored on a benefit-to-cost basis.

4.3 Approach Summary

LIPS combines technical assessments and value judgments using a rigorous but flexible analytical approach known as Multiattribute Utility Analysis (MUA). MUA models have been successfully applied to a variety of problems at DOE and its laboratories over the past decade. These applications have been reviewed by the National Academy of Sciences, which judged MUA an "appropriate decision-aiding tool," and by several outside technical (academic) review groups, which found it to have "the greatest potential among existing approaches" and to be "the best approach to such complex prioritization problems."

LIPS formally quantifies the benefits of proposed risk-reduction and other "added-benefit" activities by scoring the: (1) activity-specific technical judgments about activity impacts on relevant objectives, and (2) management value judgments of the "willingness to pay" to achieve positive or avoid negative impacts. LIPS assists managers in decision-making by formally combining and scoring the technical assessments of scientific and engineering experts and the policy judgments of managers and key stakeholders.

The ability of each proposed activity to reduce risk or add some other benefit is then evaluated according to its scores. The scores are assigned based on a measurement scale that measures activity benefits rather than baseline conditions. Thus, LIPS generally asks technical experts to estimate conditions that will exist assuming: (1) the activity is not implemented (e.g., baseline risk), and (2) the activity is implemented (e.g., modified risk). The difference between these conditions is used to establish a measure of the benefit of the activity.

Once an activity's impacts are quantified or scored, LIPS converts the impacts into equivalent dollars of benefit based on a set of value judgments made by senior management. These value judgments are obtained using a formal elicitation process and are applied consistently to measure the total benefit of the activity. The total benefit is then compared to the estimated resources required so that the laboratory can determine the most cost-effective portfolio of activities to conduct given constraints on funding and other resources. The LIPS process explicitly identifies activities whose benefits do not justify their cost. Such activities can then be reinvestigated with key stakeholders to negotiate a more efficient version of the activity.

4.4 Process Principles

4.4.1 MUA Process

LIPS is based on a formal approach for multicriteria decision making known as MUA. The MUA process extends traditional decision analysis to problems for which monetary issues are not the only concern. A multiattribute model involves identifying decision objectives and organizing them into a hierarchy, specifying attributes and measurement scales for quantifying the degree to which objectives are achieved, and defining a utility function to represent the decision-maker's preferences, including the "willingness to pay" to achieve benefits or avoid adverse impacts. A multiattribute model is typically developed by a group, which enables it to address the competing demands of multiple stakeholders and facilitate communication among affected organizations. It provides a logical and consistent basis for solving prioritization problems.

4.4.2 LIPS Process Steps

Using the MUA model, LIPS provides a consistent process for approaching risk-based prioritization, but the model itself is only a small part of the LIPS process. A discussion of each step is contained in Los Alamos National Laboratory unclassified report LA UR 94-1696, "Supporting Documentation - Laboratory Integration and Prioritization System," June 15, 1995, section 4 - Model Use. These steps are described in the section that follows and are summarized in Table I at the end of this process description.

LIPS can be customized for most applications to ensure that the MUA model is appropriate. The degree of customization required depends on how closely the problem or activity matches those envisioned when LIPS was designed. At a minimum, the objectives, scales, values, and scoring instructions are reviewed. Customization typically involves identifying new objectives or evaluation criteria and modifying some individual measurement scales to ensure that the information they contain is application specific. Prior to any specific application, the unrefined values must be reviewed by relevant decision-makers and modified, if necessary, to reflect the management philosophy of that site, as well as to reflect any changes made to the generic scales. Value judgments in multiattribute utility models must reflect decision-maker and other stakeholder values. Lastly, LIPS scoring instructions must be adapted to include site-specific and work-specific examples and instructions to ensure that scorers generate reliable and consistent data.

4.4.3 Scoring Process

The LIPS scoring process consists of four steps as follows.

Step 1: Screening/Grouping Activities. Any activities that do not need to be evaluated are screened out. There are a variety of screening models available. Remaining activities are grouped to a level that facilitates evaluation. In this Guide, these groups will be referred to as individual activities, though each may, in fact, consist of many activities.

Step 2: Definition of Activity Duration. Each activity can be scored on a one-year or multi-year basis, but consistency must be maintained.

Step 3: Scoring. For each activity, detailed measurement scales are used to develop a quantitative estimate of the benefits of the activity. A score is assigned for each objective (see section 4.5) that is relevant to the activity. The difference between the baseline (without the activity), and the modified (with the activity) is the benefit value of the activity.

Step 4: Quality Assurance. Benefits of activities are calculated and various outputs are produced, including a prioritized list of activities by benefit-to-cost ratio. "Surprises" and "outliers" are considered for re-scoring.

4.4.4 Rating/Ranking

By the time the scoring process is complete, a numerical measure is calculated that represents how well each relevant objective is met by each given activity. A "total benefit" for the activity is also calculated by grouping the individual benefits. This total benefit is divided by the cost of the activity to calculate the benefit-to-cost ratio. The activities are ranked from the highest ratio to the lowest ratio.

4.4.5 Real-Life Examples

Prioritization applications to date include such diverse activities as indirect budgets, environmental programs, facilities upgrades, seismic studies, training programs, site cleanup, and environmental restoration applications at various locations throughout the DOE complex. Collective experience with LIPS indicates that each new application introduces new issues.

The following are brief descriptions of LIPS applications.

Indirect Budgets. The original, or baseline, LIPS model was designed to look at a broad spectrum of decision problems at various labs. However, most of the early applications were directed toward the allocation of laboratory indirect budgets. The LANL ES&H Division applied LIPS to its G&A budget to prioritize all division activities after facing a 20% reduction in funds. This application, like most other indirect budget applications at LANL, LLNL, and SNL, used a version of the model that closely resembled the original LIPS baseline model. All activities were prioritized by cost-benefit. The resulting prioritized list of activities was separated into thirds and used to assist management in allocating division funds across 20 technical groups.

Environmental Programs. A more specific application of LIPS was conducted for Idaho National Engineering Laboratory (INEL) to prioritize environmental programs. Each year INEL funds a variety of environmental projects for protecting the natural environment, ensuring the health and safety of workers and the public, and complying with applicable regulations. Due to budget constraints, INEL management anticipated being unable to fully fund all of the work proposed in the FY 1996 and FY 1997 budgets. Projections indicated that the shortfall could be in excess of $100M. To help make FY 1996 and FY 1997 budgeting decisions, INEL management chose to apply LIPS. Each of the environmental programs was prioritized by cost-benefit. The cost-benefit results were then combined and optimized, resulting in a recommended allocation of funding for all programs.

Environmental Restoration and Remedial Alternatives. Former Los Alamos Technical Area 10 in Bayo Canyon, commonly called Bayo Site, was used as a firing site from 1944 through 1961 and encompassed an area of approximately 100 acres, most of which is now owned by Los Alamos County. In 1977 a subsurface investigation revealed the presence of radiological contamination of the soil in the area of the former radiochemistry laboratory. Administrative control of the affected subsurface was initiated. A concurrent surface investigation showed that radiological constituents were not present in surface soils at concentrations that affect human health; however, metal fragments contained higher-than-background levels of radiation.

As part of the Environmental Restoration program, a number of alternatives were developed to remediate the Bayo Canyon site. A customized version of LIPS was used to evaluate strengths and weaknesses of these alternatives. A team of experts contributed information for ten remedial alternatives. The result of this analysis determined the overall benefits and costs for each remedial alternative.

Facility Upgrades. Several successful LIPS applications have been conducted to evaluate facility upgrade alternatives for the Los Alamos CMR building and the Pantex Plant. The most recent application was an evaluation of seismic upgrades to the LANL administration building.

The most fundamental assumption for facility upgrades is that they should be evaluated based on the benefits they produce and the costs required to produce them. Determining the cost of an upgrade involves the relatively straightforward and well-understood process of cost estimation. Determining upgrade benefits, however, is much more complicated. Thus, the LIPS model focuses significant effort on the determination of upgrade benefits.

In the LIPS model, the benefit of an upgrade was defined in terms of its ability to improve the quality of outcomes at to the upgraded facility. Determining the benefit of an upgrade requires quantifying the quality of two alternatives: one in which the upgrade being evaluated is not conducted (the baseline option), and one in which the upgrade is conducted (the upgrade option). The difference in quality of outcomes between the upgrade option and the baseline option defines the benefit of an upgrade.

In the administration building project, a team of experts identified five specific upgrade alternatives. Several modifications to the baseline LIPS model were required for these applications. The most significant modification involved adding a series of additional risk models to capture the short-term risk effects created by conducting the actual upgrades to the facility. The results of this application determined the overall benefits and costs for each upgrade alternative.

4.5 Measuring Results

The backbone of LIPS is its "value hierarchy," which represents the fundamental DOE objectives to be achieved by the activities to be evaluated. The value hierarchy is used to evaluate project or activity benefits only, not costs, using performance measures.

The standard LIPS model scores six primary objectives. Two of the primary objectives are further broken down into lower-tier (or "secondary") objectives to delineate and more clearly define what should be accomplished by the primary objectives.

The hierarchy is shown below.

- Maximize Health and Safety

  -- Maximize Public Health and Safety

-- Maximize Worker Health and Safety

- Maximize Environmental Protection
- Maintenance Regulatory Compliance
- Maximize Safeguards and Security
- Maximize Strategies Positioning and Effective Use of Resources

  -- Maximize Value of Applied Science and Technology Scope (Mission)
  -- Maximize Quality of Facility and Equipment Management
  -- Maximize Cost Savings
  -- Maximize Employee Ability/Efficiency
  -- Maximize Employee Motivation

- Maximize Public Assessment

The six primary objectives (or a subset of them) should suffice for most, if not all, DOE applications. For certain applications, some of the secondary objectives may change or be expanded. This determination is part of each new application. Each objective is associated with a corresponding performance measure used to characterize and quantify the extent to which the objective is being met.

The steps below summarize the process required to tailor the LIPS model to the specific decision-making context.

Step 1: Select objectives from the LIPS value hierarchy. Selecting the relevant set of objectives for the projects to be evaluated depends on the types and variety of activities considered in an application. One option is to use all the objectives and simply not score those not relevant to different activities. However, the presence of irrelevant objectives may be confusing for scorers. A "good" value hierarchy is both complete and nonredundant. Complete means that all the benefits of all activities are reflected somewhere in the value hierarchy. Nonredundant means that the same benefit is not counted twice.

Step 2: Select performance measure scales. Given the objectives to be included in an application performance measurement scales should be developed to provide for an easily determined and accurate representation of the scorers' knowledge. It is possible to develop different measurement scales in LIPS that measure the same impact but are appropriate to

specific applications. The choice of which performance measurement scales to use should depend on which format is most useful and accurate.

Step 3: Validate or adjust value weights and utility functions. The final step in the LIPS multiattribute model is the definition of the utility functions and the value weights representing the worth or value of achieving different objectives in the LIPS value hierarchy. Though a set of "default" values has been used in some LIPS applications, a variety of values reflecting site-specific issues has been used.

The actual LIPS performance measures (i.e., values and value scales) are as follows.

PUBLIC HEALTH AND SAFETY

Severity	Value
No effect	$0
Minor effect (minor burns, bruises, cuts, etc.)	$550
Moderate effect (moderate injury or illness with the effect of less than 1 year)	$55,000
Serious effect (permanent debilitating injury/serious long-term illness of >5 years)	$550,000
Very serious effect (death or near total loss of quality of life)	$5,500,000

These values are multiplied by the number of people experiencing the health effect.

WORKER HEALTH AND SAFETY

Severity	Value
No effect	$0
Minor effect (minor burns, bruises, cuts, etc.)	$225
Moderate effect (moderate injury or illness with the effect of less than 1 year)	$25,500
Serious effect (permanent debilitating injury/serious long-term illness of >5 years)	$225,000
Very serious effect (death or near total loss of quality of life)	$2,250,000

These values are multiplied by the number of people experiencing the health effect.

ENVIRONMENTAL PROTECTION

Severity	Value
Zero impact to the environment.	$0
Low threat to the environment - No significant impact on sensitive environmental resources. Environmental exposures leave no lasting damage.	$400,000
Moderate threat to the environment - May affect local abundance of sensitive species or unique historical properties. Action required within 10 years to prevent spread of contaminants. Impact would be largely self-correcting within 10 years.	$1,000,000
High threat to the environment - Widespread and severe damage to sensitive species or unique historical properties. Action required within 5 years to prevent spread of contaminants. Permanent damage to the environment.	

These values are affected by a multiplication factor to account for the type of environmental resource impacted as shown below.

Type of Resource	Weight
Population or habitat of sensitive species, species of concern, species under review, and/or unique biotic communities (multiplied by number of species).	0.333
Population of habitat of Federal or State designated or candidate endangered or threatened species (multiplied by number of species).	0.667
Wetlands (multiplied by number of wetlands)	0.5
Sites or areas of prehistoric, historic, or cultural significance (multiplied by number of structures).	0.167
Sites, or areas determined eligible for registration by the State Historic Preservation Office (multiplied by number of structures).	0.167
Surface water or ground water quality	1
Landfill uses (agricultural, recreational, open space)	0.0016

As indicated in the parentheses above, most of these values are multiplied by the number of each resource experiencing the environmental effect. The total weight is the sum of the weights over all of the types of resources impacted, which is then multiplied by the appropriate severity value.

REGULATORY COMPLIANCE

Severity	Value
No significance - No violation.	$0
Violation of minor significance: Slippage in meeting a nonlegally binding agreement/internal contractual agreement. Violation perceived as a breach of promise.	$52,500
Violation of moderate significance: A slippage in meeting a generally nonenforceable obligation in a DOE Order/directive.	$750,000
Violation of major significance: A slippage in meeting one or more enforceable obligations within 3 years. Contractual penalties <$250K.	$2,500,000
Violation of very major significance: Numerous enforceable obligations (at least 10 or more) will be missed within 3 years. Contractual penalties greater or roughly $1M.	$10,000,000
Violation of most serious significance: Regulatory agencies will formally charge the lab as the responsible party for reckless behavior.	$25,000,000

SCIENCE AND TECHNOLOGY SCOPE (MISSION)

Severity	Value
Critical adverse impact: The total economic loss to the lab is $500M or greater.	$-50,000,000
Major adverse impact: The total economic loss to the lab is at least $10M.	$-10,000,000
Moderate adverse impact: The total economic loss to the lab is at least $1M.	$-1,000,000
No discernible impact: status quo is maintained.	$0
Moderate beneficial impact: The total economic benefit to the lab is at least $10M.	$1,000,000
Large beneficial impact: The total economic benefits top the lab is at least $100M.	$10,000,000
Very large beneficial impact: The total economic benefit to the lab is ~$500M.	$50,000,000

COST SAVINGS AND LOSSES

The value is determined by multiplying a value of $600 per year for each person-hour saved per month by the number of person-hours saved each month.

SECURITY AND SAFEGUARDS

Severity	Value
Security incident not resulting in any compromise of security or loss of materials.	$0
Security incident resulting in loss or compromise of sensitive or proprietary information.	$562,000
Security incident resulting in loss of classified information	$4,500,000
Security incident resulting in loss, diversion, theft, or compromise of accountable classified materials, category III or IV quantities of SNM, radiological sabotage, and/or harm to individuals.	$11,250,000
Security incident results in loss, diversion, or theft of category I or II quantities of SNM.	$45,000,000

PUBLIC ASSESSMENT

Severity	Value
High negative visibility (media response will be strongly negative, will occur over the long-term, and will extend beyond local level).	$-10,000,000
Moderate negative visibility (media response will be negative, and will occur over the long term).	$-5,500,000
Slight negative visibility (media response will be largely negative, but will occur primarily on a short-term basis).	$-1,400,000
No impact.	$0
Slight positive visibility (media response will be positive, but will occur primarily on a short-term basis).	$200,000
Moderate positive visibility (media response will be unanimously positive, and will occur over the long term).	$500,000
High positive visibility (media response will be strongly and unanimously positive).	$1,000,000

EMPLOYEE ABILITY/EFFICIENCY

Severity	Value
Maximum decrease. Productivity of identified workers likely to decrease ~100%.	$-100,000
Large decrease. Productivity of identified workers is likely to decrease ~15%.	$-15,000
Moderate decrease. Productivity of identified workers is likely to decrease ~5%.	$-5,000
No change/status quo.	$0
Moderate increase. Productivity of identified workers is likely to increase ~5%.	$5,000
Large increase. Productivity of identified workers is likely to increase ~15%.	$15,000
Very large increase. Productivity of identified workers is likely to increase ~30%.	$30,000

These values are multiplied by the number of employees whose ability would be affected.

EMPLOYEE SATISFACTION AND MOTIVATION

Severity	Value
Poor: Dissatisfied and severely unmotivated as evidenced by significant attrition, turnover, absenteeism, labor strife, and formal complaints.	$0
Low: Moderately unsatisfied and unmotivated as evidenced by morale, turnover, attrition, and complaints.	$1,750
Employees are not dissatisfied but are not motivated.	$5,950
Moderate: Moderately satisfied and motivated as evidenced by morale, turnover, attrition, and complaints.	$6,580
High: Morale is judged to be very high relative to other employers. Employees are performing at or near their potential.	$7,000

These values are multiplied by the number of employees whose motivation would be affected.

ADEQUACY OF FACILITIES AND EQUIPMENT MANAGEMENT

Severity	Value
Facilities/equipment will meet or exceed requirements, essentially 100%.	$0
Facilities/equipment meet some requirements, ~75%.	$7,500,000
Facilities/equipment only partially meet requirements, ~50%.	$15,000.000
Facilities/equipment meet few requirements, ~25%.	$22,500,000
Facilities/equipment meet essentially no requirements.	$30,000,000

These values are adjusted by a multiplication factor for the importance of the facilities and equipment as follow.

Importance of Facility	Weight
Very high importance: Facilities or equipment would contribute ~$100M per year to the value of laboratory operations.	1
High importance: Facilities or equipment would contribute ~$10M per year to the value of laboratory operations.	0.75
Moderate importance: Facilities or equipment would contribute ~$1M per year to the value of the laboratory operations.	0.5
Low importance: Facilities or equipment would contribute ~$100,000 per year to the value of laboratory operations.	0.25
Little or no importance: Facilities or equipment are not needed for current or projected future operating needs of laboratory.	0

ADEQUACY OF BUSINESS AND FINANCIAL ACTIVITIES

Severity	Value
Business/financial management operations meet or exceed requirements, ~100%.	$0
Business/financial management operations meet some requirements, ~75%.	$30,000
Business/financial management operations meet some requirements, ~50%.	$300,000
Business/financial management operations meet some requirements, ~25%.	$3,000,000
Business/financial management operations meet essentially no requirements to achieve desired functions and capabilities.	30,000,000

These values are adjusted by a multiplication factor for the importance of the business and financial activities as follows:

Importance of Activity	Weight
Very high importance: Business or financial operations would contribute ~$100M per year to the value of laboratory operations.	1
High importance: Business or financial operations would contribute ~$10M per year to the value of laboratory operations.	0.1
Moderate importance: Business or financial operations would contribute ~$1M per year to the value of laboratory operations.	0.01
Low importance: Business or financial operations would contribute ~$100,000 per year to the value of laboratory operations.	0.001
Little or no importance: Business or financial operations are not needed for current or projected operating needs of laboratory.	0

4.6 References/Reading List

Anderson, R., *The Laboratory Integration and Prioritization System (LIPS): Trials, Tributes and Tribulations*, LANL: 1995. Presented at the Second Annual Prioritization Workshop, August 22-23, 1995, Idaho Falls, Idaho.

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Barber, D., and Judith Mead, *Applying the Laboratory Integration and Prioritization System (LIPS) to Decision-Making at Sandia National Laboratories*, SNL: 1995. Presented at the Second Annual Prioritization Workshop, August 22-23, 1995, Idaho Falls, Idaho.

Committee for Utilization and Technical Evaluation, Robert G. Anderson, et al., *Laboratory Integration and Prioritization System Supporting Documentation*, LA UR 94-1696, version 2.1, June 1995.

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Kadvany, John and Voth, Michael, *A Priority System Training Course* - Draft, Applied Decision Analysis, Inc., California: January 1995.

Merkhofer, M.W., Conway, R., Anderson, R.G., *A Successful Effort to Involve Stakeholders in the Selection of a Site for a Corrective Action Management Unit*, ADA, 1995, LAUR-95-4214.

Report of the Technical Review Group of the Department of Energy's Priority System for Environmental Restoration, Washington, D.C.: 1991.

U.S. Department of Energy, *A Multiattribute Utility Analysis of Sites Nominated for Characterization for the First Radioactive-Waste Repository--A Decision-Aiding Methodology* (DOE/RW-0074, Office of Civilian Radioactive Waste Management, Washington, D.C.: 1986, Appendix H.

Voth, M., Merkhofer, M.W., Anderson, R.B., *The Laboratory Integration and Prioritization System: Validation*, LANL, LAUR-95-3687, 1995.

Voth, M., *Quantifying the Benefits of Prioritization*, Second Annual Prioritization Workshop, Idaho Falls, Idaho, August 1995.

4.7 Definitions

Decision Units. The options that are evaluated and prioritized by the LIPS (e.g., activities).

LIPS Tool Kit. A general purpose prioritization and MUA model intended to streamline and simplify development of priority systems.

Multiattribute Utility Analysis (MUA). Formal decision-making approach based on Multiattribute Utility Analysis (MUA), originally formalized 50 years ago by Von Neumann and Morgenstern. MUA is mathematically derived from basic "axioms of rationality."

Objectives. Goals that determine the importance and benefits for applying risk criteria and are used to interpret results to be included in the scope of the RBP effort. Objectives should comprehensively address the scope of risk issues found in the purpose statement; they should be independent and minimal in number.

Performance Measures. Units of measure that will be applied to characterize the risk from each objective. A specific scale is developed for each measure. Numbers are assigned to characterize the benefit of activities on the objectives according to specified rules.

Resource Allocation. Integrates requirements with resources such that work can be performed and capabilities maintained in accordance with both the mission and within the constraints of available funding.

Risk-Based Prioritization (RBP). The process of evaluating and comparing activities that compete for limited resources based on quantification of costs, risks, and benefits of the activities.

Stakeholders. Any individuals or organizations with a significant interest in prioritization results.

Value Weights. The relative importance of different objectives used to translate project "scores" into a single overall measure of project benefit, expressed in dollars.

4.8 Training Courses/Program Assistance

DOE is currently developing a training course on prioritization systems to provide DOE and its contractors with an efficient means for disseminating the concepts, techniques, and tools needed to develop practical, accurate, and defensible prioritization systems. The course is also intended to promote a common understanding and consistent language for discussing prioritization systems. While the course is being refined, it is available for presentation and is adequate to assure sufficient training.

The course materials are divided into modules that may be combined in alternative ways to produce different versions of the course. This accommodates different views regarding the extent to which the course should be tied to LIPS. LIPS applications have generated numerous submodels, scoring instructions, training materials, and other prioritization system elements that can significantly speed and simplify the development of a system tailored to an organization's specific needs. Thus, with one version of the course, LIPS can be presented as a "tool box" for developing new prioritization systems. However, LIPS represents a specific type of priority system (an activity ranking system) and adopts a particular evaluation approach (e.g., separate scales requiring "best-estimate inputs"). Although useful for many situations, LIPS may not represent the best approach in all instances. For situations where focusing solely on LIPS is not desirable, a more general version of the course can be provided.

The DOE contact for assistance and training is Kenneth P. Ferlic, DP-31, (301) 903-6703, or Robert Anderson, LANL, (505) 665-9960.

Table I. LIPS Process Steps

LIPS Process Steps	Purpose	Outputs
1. Identifying Prioritization Issues and Needs	-Define management need for prioritization and how LIPS results are to be used. -Identify resource limitations or constraints. -Identify other management systems or processes relevant to priority-setting process.	-Understanding by management of LIPS outputs, process, and resource requirements. -Description of LIPS outputs and how they will address management needs with given resources. -Any special issues to be addressed by LIPS application.
2. Identifying Stakeholders, Project Team, Scorers	-Ensure that all groups and individual preferences, values, and interests are adequately represented. -Ensure that project team has adequate mix of qualifications. -Ensure that scoring team has the requisite knowledge of the projects to be scored.	-List of stakeholders to be represented. -Project team members and their qualifications. -Scoring team assignments.
3. Defining Activities or Tasks to be Scored	-Ensure activities to be ranked are meaningful and comparable "decision units." -Ensure activities are relatively independent of one another, or that dependencies are minimized. -Ensure resource estimates include funding sources, multiyear funding, and other details.	-Detailed definition of all activities as defined. -List of activities to be included in prioritization. -Consistent costing information for activities.
4. Customization of LIPS Model if Required	-Select objectives or criteria to be scored from LIPS and intended interpretation for decision context. -Select performance measures for each objective. -Modify performance objectives if needed. -Assess or validate weights and utility functions for application.	-A LIPS prioritization model. -Software requirements. -Scoring form for input. -Value weights and utility functions.

LIPS Process Steps	Purpose	Outputs
5. Planning the Scoring Process	-Lay-out time line and resource requirements for prioritization application. -Alert scorers, project team, and stakeholders of resource needs, key milestones. -Estimate total costs of conducting application...readjust application scope if necessary.	-Time line and milestones for application. -Number of participation hours necessary, other resource estimates.
6. Pilot Testing	-Determine if range of activities can be scored, finalize "decision unit." -Fine tune performance measures. -Clarify exceptions, scoring details. -Check that value weights plus inputs give reasonable results. -Evaluate "learning curve," determine training needs.	-Finalized performance measures, activity definitions, input requirements. -Training needs. -Confident in model integrity.
7. Training Sessions	-Provide guidance for scorers and scoring facilitators to ensure consistency of approach. -Maximize value of prioritization process for participants, beyond just collecting inputs. -Develop buy-in through appropriate understanding of the prioritization process.	-Trained scorers and scoring facilitators. -Start communication process between scorers and process team
8. Conducting Scoring Sessions	-Efficiently and accurately obtain technical inputs for LIPS model. -Achieve additional objectives of scoring process: clarification of activity purpose, validation of cost estimates, etc.	-Inputs needed to score activities included in ranking process. -Additional process benefits, depending on application.
9. Quality Assurance of Scoring Data	-Validate consistency and completeness of inputs. -Identify "outliers" -Revise inputs if needed.	-Finalized set of inputs to LIPS model on which rankings will be based. -First look at ranking patterns.

LIPS Process Steps	Purpose	Outputs
10. Generating and Communicating LIPS Results	-Create LIPS outputs and various rankings. -Develop package summarizing by results in useful formats for decision makers, stakeholders.	-Rankings and graphs using: -Benefit-cost ratio -total benefit only (no costs) -Including or excluding various criteria (e.g., compliance) -Cost groups (e.g., activities over $1M. -Comparison of LIPS rankings to "adjusted" rankings.
11. Evaluation of the Model and the Process	-Document lessons learned from model use and priority setting process. -Determine if resources were used well, how process and model can be improved. -Obtain and summarize stakeholder and participant feedback on all aspects of the application.	-Summary of lessons learned and evaluations. -Targeted advice on training approach, scoring sessions, model design, etc.

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5. MANAGEMENT EVALUATION PROCESS

5.1 Introduction

The Management Evaluation Process is used by the Office of Environmental Management (EM) to collect risk and associated information on Environmental Management activities. The process incorporates the Risk Data Sheet (RDS), the RDS database, the RDS instructions, the Management Evaluation Matrix (MEM) instructions, and associated training. The Management Evaluation Process was developed because there has been no consistent framework for considering in an integrated fashion the multiple risks and hazards present in the nuclear weapons complex. It is derived from the process used in the ES&H Management Plan, modified to apply to the diverse range of Environmental Management activities while meeting the Department's objectives for using risk analysis.

The Management Evaluation Process is not intended to be used for developing a national priority list or a corporate set of weights, due to the level of effort required to come to agreement with stakeholders on these weights. A single national weighing system ignores site-specific considerations (e.g., small site initiatives). Nevertheless, sites are encouraged to work with stakeholders to develop site-specific priority lists.

The Environmental Management program is currently facing a decreasing budget and competing requirements and risks to workers, public, and the environment. The Department recognizes that credible risk assessment and the best risk management tools are needed to meet its primary mission of addressing the most immediate, urgent risks to human health and the environment from the nuclear weapons complex, while managing long-term contamination and safety threats. Therefore, to allocate resources during the budget process, EM is using qualitative risk, mortgage reduction, compliance issues, and stakeholder concerns to prioritize the funding of activities. The process of using this information to establish priorities will improve as the Department improves data quality, incorporates peer review, defines the future of its sites, and keeps its stakeholders fully informed and involved.

5.2 Process Specification

5.2.1 Authority

The Draft Risk Report to Congress, entitled *Risks and the Risk Debate: Searching for Common Ground*, provides the first link between budget, compliance requirements, and risk reduction/ pollution prevention activities. The Management Evaluation Process used to develop the report provides an initial framework for illustrating risks associated with

environmental management activities and for linking these risks in a qualitative fashion to compliance issues and the budget. The process allows managers to discuss the possible effects of budget reduction on the ability of a site or program to adequately manage risk and compare results across the complex. Because the information supplied through the Management Evaluation Process has been beneficial in FY 1997 budget formulation decisions, the Assistant Secretary for Environmental Management now requires that risk be considered formally in the annual budget formation process.

The *Office of Environmental Management Guidance for FY 1998 Budget Formulation* integrates risk information into the budget formulation process and provides guidance for developing RDSs, including guidance on the use of multi-disciplinary teams for risk assessment and follow-on review. The guidance stresses the importance of establishing priorities and enhances the prioritization process by the use of a Management Evaluation Matrix based on seven core criteria. Using these criteria, all Environmental Management activities will be mapped into five priority lists corresponding to (1) maximized risk reduction, (2) achieving compliance, (3) cost effectiveness and mortgage reduction, (4) addressing stakeholder concerns, and (5) an optimized case.

5.2.2 Program Office Advocates/Assistance

Table I at the end of this chapter lists Points of Contact for the Management Evaluation Process from each Environmental Management program office and Field element doing Environmental Management work.

5.3 Attributes/Applicability

While many different risk analysis systems exist within the DOE complex, there has been no consistent framework for considering and integrating multiple types of risks and hazards. In addition, these systems are not linked to the Department's budgeting and planning process. Since the Department cannot attempt to address all risks simultaneously or address some risks as rapidly as some stakeholders would like, an integrated risk analysis and management process is needed. A number of tools can be used to prioritize activities. The Management Evaluation Process is one that can also help managers prioritize the work to reduce risks.

Congress has been urging the Department to develop a risk-based approach for prioritizing its activities. Specifically, the *Conference Report of the Energy and Water Development Appropriations Subcommittee for Fiscal Year 1994* indicated that the Department "...needs to develop a mechanism for establishing priorities among competing cleanup requirements."

In response to the Congressional request, the Department initiated a major effort to define its risks site-by-site in a systematic way. The Department announced its intent to establish more credible and consistent methods of conducting risk assessments at its sites and facilities.

Information about risks is generally collected and analyzed at a specific facility or site or for a particular contaminant or hazard. Such information has not been available for decision making or for establishing priorities. Many risk-related reports are completed based on requirements specific to a regulation or a compliance agreement and do not allow for comparisons of risks or for an integrated complex-wide analysis of risk. A primary objective of the draft report entitled *Risks and the Risk Debate: Searching for Common Ground "The First Step"* (hereafter the "Draft Risk Report"), submitted to Congress in June 1995, was to develop a process that provides an integrated approach to evaluating the risks to human health, worker safety, and the environment posed by conditions at the Department's sites and facilities and links those risks to compliance requirements and the budget.

The Draft Risk Report represents a first step toward developing a consistent approach to evaluating the risks to human health, worker safety, and the environment. The Management Evaluation Process (formerly the Qualitative Risk Evaluation Process) was developed for the Draft Risk Report. The intent of the approach was to develop a consistent framework for integrating and communicating prioritization information. The process is not designed to replace existing approaches but to group information to increase the understanding of activities, particularly those related to compliance requirements and budget allocations across the EM programs. Field program managers with appropriate expertise categorized the activities. This allowed the Department to capture the full spectrum of risks associated with all currently planned environmental management activities and to determine how Environmental Management is currently funding its risk/ prevention activities.

The information provided a baseline that both DOE and its stakeholders can use to discuss the risks and costs associated with various Environmental Management activities, the assumptions used to categorize the risks, and the types of information that are available or that need improvement. This baseline information was successfully used in the fiscal year 1996 and 1997 budget processes as one tool in the decision making process that determined how Environmental Management would allocate its funding, establish priorities, and sequence its work.

5.4 Approach Summary

The Management Evaluation Process uses the Management Evaluation Matrix (see Table II at the end of this chapter) as a tool for scoring activities and providing input for setting priorities and developing the Risk Data Sheet. Planners can use the Management Evaluation Matrix to assess the relative risk of current conditions (before the activities are performed or initiated) and the relative long-term impact. The overall level of impact reduction is evaluated in each category by analyzing the difference between the impact before and after performance of the activity.

Applying the Management Evaluation Matrix to an activity (on an RDS) involves four major steps:

(1) Characterize and evaluate the situation (i.e., risks, costs, requirements, mission impacts, stakeholder concerns) that exist **BEFORE** a planned activity occurs, or that would exist if a current activity were to cease.

(2) Characterize and evaluate the inherent risks and stakeholder concerns that occur **DURING** the performance of the activity.

(3) Characterize and evaluate the situation **AFTER** successful completion of the activity. The difference between the before and after evaluations represents a qualitative estimate of the risk reduction.

(4) Conduct an internal and external review to ensure consistent and correct application of the Management Evaluation Matrix.

The Management Evaluation Matrix provides the structure for examining both the degree and likelihood of seven impact categories. For each of the seven impact categories, the rows of the matrix define impact levels (two to four levels of impact, depending on the category - see Table II at the end of this chapter); the columns define likelihood levels (either time to impact or probability). Each matrix cell (row and column combination) defines the severity and likelihood of an impact. The seven Management Evaluation Matrix impact categories are as follows.

(PS) Public safety and health, including potential adverse impacts on the health and safety of the off-site population surrounding a facility (three severity levels).

(SP) Site personnel safety and health, including potential adverse impacts on the safety and health of individuals inside the facility boundary. This includes visitors (four severity levels).

(EN) Environmental protection, including potential adverse impact on natural resources (air, water, land, wildlife) (three severity levels).

(CO) Compliance, including failures to comply with laws, regulations, compliance agreements, Executive Orders, DOE Orders, and Implementation Plans for Defense Nuclear Facilities Safety Board (DNFSB) recommendations. Such failures may adversely affect the confidence of DOE or other agencies in the ability of the facility to operate while protecting the public, workers, and the environment (four severity levels).

(MI) Mission Impact, including potential adverse impacts on the ability to perform the current and future missions of the facility (two severity levels).

(MR) Cost-effectiveness, including mortgage reduction, which includes potential accidental losses to a facility's capital investment (buildings, equipment) or an existing opportunity for cost savings, such as infrastructure upgrades, management systems upgrades, or improved program development (two severity levels).

(SC) Social/Economical/Cultural Impacts, including the various attitudes, interests, and community activities that will/could be inadvertently affected or disrupted by an activity. This includes important community activities, traditions, or ceremonies practiced by populations or groups; the local economy; and community values (two severity levels).

The Management Evaluation Matrix columns constitute the levels of likelihood (probability or time to impact) used in assessing the impact-reduction benefit of activities. The matrix uses four levels of likelihood as follows.

(A) Very High likelihood indicates an actual or probable occurrence of 1 per year. For example, if a facility is known to be out of compliance with a DOE ES&H Order, the likelihood falls into the very high category. If a condition at a facility has historically resulted in one or more lost-time worker injuries per year and the condition has not been corrected, the likelihood also fits this category.

(B) High likelihood indicates a probability of occurrence of between 0.1 and 1 per year, or at least once within 10 years, but no sooner than in a year. Such impacts are

expected to occur within the operating history of the facility, but have not occurred regularly every year.

(C) Medium likelihood indicates a probability of occurrence of between 0.01 and 0.1 per year, or at least once within 100 years but no sooner than in 10 years. Impacts with this likelihood are not expected frequently within the operating life of a facility, but may occur once in the facility's life.

(D) Low likelihood impacts are unlikely to occur within the operating life of a facility, but are not impossible. For example, impacts in this category may occur once in the operating life of one facility out of a population of 100 similar facilities. Impacts with this likelihood indicate a probability of occurrence of less than 0.01 per year no sooner than within 100 years.

5.5 Process Principles

5.5.1 Description

The *Principles for Using Risk Analysis* (developed by an interagency working group and adopted by Under Secretary Curtis in 1995) are designed to be a first cut at defining risk analysis, its purposes, and the principles to be followed by the Department of Energy if it is to be done well and credibly. These principles include four major categories:

(1) Risk Assessment. Use the best available information from all sources; all judgments and assumptions should be explicitly stated.

(2) Risk Management. Analyze the distribution of risk and the costs/benefits of potential risk management strategies.

(3) Risk Communication. State risk management goals, assumptions, uncertainties, and comparisons clearly, accurately, and meaningfully; provide public access in a timely manner.

(4) Priority-Setting. Compare risks by grouping them into broad categories of concern (e.g., high, medium, low) and identifying the population at risk; include as broad a range of views as possible, ideally with consensus.

The objective of the prioritization process facilitated by the Management Evaluation Process is to qualitatively determine the relative priority of all EM activities. In response to Field requests for additional guidance on prioritization, and to encourage consistency,

all Operations Offices have been instructed to consider the following minimum core criteria in developing priority lists.

- Public Safety and Health
- Site Personnel Safety and Health
- Environmental Protection
- Compliance with Laws, Regulations, and Orders (including DOE Orders and Implementation Plans for DNFSB Recommendations)
- Mission Impact (e.g., the impact of activities that support a high level of performance against EM's mission-oriented, summary-level performance measures, including the critical few; or that are needed for continued support of EM's mission, the strategies of individual EM programs, or the mission of another Departmental program)
- Cost Effectiveness and Mortgage Reduction
- Social/Cultural/Economic Factors

Three of the categories described above (Public Safety and Health, Site Personnel Safety and Health, and Environmental Protection) define potential risk impacts. The remaining four define other factors that may modify the overall priority of an activity. Taken together, these factors form the basis for the Management Evaluation Matrix, a data collection tool used within the Management Evaluation Process to evaluate activities described in Risk Data Sheets (RDSs). RDSs, built upon the seven criteria mentioned above, will provide input for the prioritization process. For certain activities (e.g., administrative support), some or all evaluation criteria may not apply. Furthermore, Field/Operations Offices may wish to consider other criteria to reflect local considerations. Other criteria might include contractual obligations, technology innovation, workforce and economic transition, and safeguards and security.

Qualitative risk-based evaluation of activities supports management's ability to allocate resources to activities that will provide the greatest reduction in risk during the planning period.

5.5.2 Planning Assumptions

To allow comparisons among sites and promote consistency, the core criteria should be evaluated using the following definitions and assumptions:

- Institutional, administrative, and surveillance and maintenance program controls are assumed constant and 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).

- Landlord responsibilities will not deviate from accepted DOE practices.

- Populations and distribution (on- and offsite) are assumed to be fixed at current levels.

- Current land use plans, consistent with other EM planning documents such as the Baseline Environmental Management Report, will be used when evaluating activities.

- Stakeholders include the surrounding affected, interested, and/or concerned public; labor unions; employees; interest groups; affected Indian Nations; State and local governments; regulatory agencies; and Site-Specific Advisory Boards.

- Where risk documentation for an activity exists, it should be used to facilitate this evaluation.

- All defense-related transuranic (TRU) waste will be disposed of at the Waste Isolation Pilot Plant (WIPP), which will receive a No Migration Variance and open in FY 1998. In general, treatment of mixed TRU waste to meet Land Disposal Restrictions will not be necessary; however, proposals for waste treatment to levels more prescriptive than the WIMP Waste Acceptance Criteria will be considered and evaluated case by case.

- All High-Level Waste will be stored on site in an interim storage facility until a Federal repository is available for permanent storage.

- Information contained in the Site Treatment Plans will be used in this evaluation.

- Affected parties will successfully negotiate timely onsite/offsite shipment of waste.

- Requested permits/licenses will be granted in a timely manner.

- The necessary and appropriate safety and health programs will be in place to provide worker protection during all phases of the activity.

- Radiological criteria for free release of buildings and grounds will remain constant, and any changes will not require reassessment or rework of areas already released.

- Waste will be packaged in approved containers that meet waste disposal facility regulations and, where applicable, Department of Transportation (DOT) regulations.

5.5.3 Tiered Approach to Peer Review

The Environmental Management Advisory Board (EMAB), an advisory group charted under the Federal Advisory Committee Act, was requested to review the Draft Risk Report and the Management Evaluation Process used to develop information linking risk, compliance, and budget for all Environmental Management activities. To improve the risk assessment/risk management process, the EMAB recommended the following three-tiered approach, which is being implemented in the Management Evaluation Process.

Tier 1: A central group of experts, stakeholders, and regulators develop the guidance for the comparative risk assessment process.

Tier 2: Risk assessment professionals, environmental experts, former DOE employees, and Field Office representatives conduct the comparative risk assessment. This method would ensure cross-site input, thereby reducing bias, promoting consistency, and building credibility for the process.

Tier 3: Some of those in the first and second tiers, as well as other independent experts, should evaluate the process and provide guidance on implementation.

To implement this three-tiered approach, Operations Offices should establish evaluation groups to review RDSs. The groups should consist of a representative from each site line organization (i.e., Waste Management; Environmental Restoration; Stabilization; and Environment, Safety and Health) and could also include Headquarters program managers and stakeholders (e.g., Environmental Protection Agency [EPA], State, and/or local Environmental, Safety, and Health professionals or local public groups). Evaluations of RDS data and process quality should be conducted by personnel representing all EM sites and programs, and by peer review experts from outside DOE. Recommended changes to data will be at the discretion of Field/Operations Offices.

5.5.4 Identifying the Unit of Analysis

EM activities need to be packaged into distinct units for risk evaluation. Two critical components of this process are determining: (1) what level of activity should comprise an

RDS and (2) how multiple activities in a single RDS should be related. When possible, RDSs should be packaged to address problems with specific physical conditions (e.g., a building or group of buildings, a process, a physical location).

Consideration could be given to the following questions. If the answers are "yes," the RDS will likely be at an appropriate level for evaluation.

- Do all of the activities contained in the RDS need to be completed before its objectives can be met? If not, are the results of the risk and nonrisk evaluation categories approximately the same for each activity? Independent lower-risk activities should not be "carried" within higher RDSs.

- If budget reductions occur, can all the activities be postponed or delayed? If not, it may make sense to regroup some of the activities into another RDS.

- Will the grouping of activities in the RDS stand up to an internal and/or external quality assurance review (e.g., RDS completed within the parameters established in training, instructional, and/or guidance documents)?

A complementary approach would be to evaluate how the implementation of work at the site is planned and managed (e.g., at what level of the work breakdown structure). It is recommended that each site create activity packages that correspond to the level of its own work breakdown structure. This activity level is typically, but not always, one level or more detailed than the associated ADS.

5.5.5 Completing Basic Risk Data Sheet Information

Sites complete basic RDS information (e.g., scope, preliminary scores). Any relevant information from existing sources (e.g., past RDSs, risk analysis reports, site databases) should be used.

For completing the data fields within an RDSs, the Field has several options:

- An ADS that contains the same scope as an RDS. The ADS data can be directly imported into the RDS. The RDS is then ready for evaluation without any additional work.

- An ADS that contains activities corresponding to more than one RDS. The "parent" ADS can then be subdivided into "child" packages corresponding to RDSs. The RDSs can later be used as source documents for creating ADSs.

- Existing RDS or RDS-level site information. If the site developed RDSs last year at the level of site planning and decision-making, and believe that they represent a good starting point for this year, these RDSs can be used. Other pertinent RDS information that may exist electronically at a site can also be included. The ADS corresponding to these RDSs needs to be noted, so that summary RDS information can be "rolled up" into that ADS.

5.5.6 Evaluating Risk Data Sheets

Operations Offices should establish evaluation groups to review RDSs. Group composition will vary from site to site but should consist of the appropriate expertise to make informed decisions concerning the seven evaluation categories and the three scenarios (i.e., before, during, and after an activity, where applicable). Group members could consist of a representative from each site line organization (i.e., Waste Management; Environmental Restoration; Stabilization; and Environment, Safety and Health), and could include Headquarters program managers and stakeholders (e.g., EPA, State, and/or local Environmental, Safety and Health professionals, local public groups).

The four major steps of RDS evaluation are described in detail below. The Management Evaluation Matrix provides a convenient framework for structuring risk information and focusing facility management and staff expertise on the evaluation of risks related to programmatic issues and activities. It is strongly recommended that RDS evaluation at a facility be performed by a group with expertise in diverse fields and extensive experience with a facility's operations, potential risks, and operating history.

The RDS form and the supporting information system provide fields for documentation of the basis for Management Evaluation Matrix evaluation by operating organization scoring groups. Thorough and clear documentation in these fields is essential for effective review and use of the RDS evaluations. High-quality documentation of the RDS evaluation process is particularly important to support Headquarter's budget deliberations and to provide feedback to operating organizations from Operations, Field Office, and Cognizant Secretarial Office reviewers.

Multiple scenarios with varying degrees of impact should not be employed in the evaluation; this approach may unduly mask the true risk issues associated with a RDS. The risks identified in the evaluation must represent a reasonable, credible scenario in which accidents/incidents postulated may manifest the impact selected within the identified time frame or probability of occurrence. The postulated scenarios should be depicted in Field # 20, Evaluation Scenarios.

Managers and planners should assess the risk-reduction benefits described in each RDS and evaluate them accordingly. All RDSs should be evaluated. This includes mission essential activities (such as administrative support) that may provide no apparent risk reduction. Examples include program management and control and administrative, legal, financial, planning, and other business services.

For such activities, some or all risk categories may not apply. Regardless, the RDS should be completed to ensure that a comprehensive site program is depicted.

5.5.6.1 RDS Evaluation Step 1: Assess and evaluate activities BEFORE implementation

Each RDS includes a summary description section, outlining the activity to be evaluated. The evaluation group will consider the risks based on the activity description in the RDS, the postulated scenarios, and available quantitative data.

For each Management Evaluation Matrix impact category, the evaluators perform the following steps:

(1) Identify all impact levels that could occur because of the current situation, assuming institutional controls are in place.

(2) Estimate the likelihood for all impacts identified in (1) above. One of the likelihood levels represented by the Management Evaluation Matrix columns A-D must be chosen. For the "before" scenario only, in each of the applicable evaluation categories, select a "P" or "T" for a likelihood based on probability or time to impact, respectively.

(3) Select the combination of impact and likelihood that represents the highest risk within the category.

The evaluation information should discuss the basis for the severity and likelihood decisions. The severity information includes the physical event or hazard and the potentially impacted population or environment. Determination of the likelihood will be derived from information on the exposure pathway and the probability or time to impact of occurrence. This information will be used to provide better understanding of the RDS and its goals. The selection of the applicable cells from the Management Evaluation Matrix should be validated and information that could affect management decisions documented.

All memo fields for which an impact is selected should be completed. In addition, for the memo fields for public, worker, and environmental impact, appraisals should briefly

describe the hazard source (the radionuclides, chemicals, etc.) associated with the activity under evaluation, the exposure setting/pathways (the physical environment), and potentially exposed human and ecological receptors. In addition, the field should reference any documents that may help explain the selection should be referenced (completed risk evaluations, safety and analysis reports, vulnerability studies, etc.).

Planning assumptions have been developed to help obtain consistency throughout DOE. When a planning assumption is not true for the RDS being evaluated, this fact is documented in the RDS Exception Assumptions section and the accurate assumption is used to evaluate the RDS.

5.5.6.2 RDS Evaluation Step 2: Assess and evaluate risks DURING implementation

The Management Evaluation Matrix is used to determine the RDS risk associated with the performance of the activity, such as the exposure of workers to radiation or toxic substances during remediation activities. The evaluation group will consider the risks based on the activity description in the RDS and based on the use of available quantitative data.

The following assumptions apply when evaluating the risks during an activity:

- Safety and health requirements are being met.
- Operations hazardous to the worker, even if the activity is in the conceptual stage.

5.5.6.3 RDS Evaluation Step 3: Assess and evaluate activities AFTER implementation

Using the same assumptions and scenario as in Step 1, the group will consider risks documented in the RDS description section along with any additional applicable risks.

The net RDS risk reduction is based on the comparison of the before risk cell and the after risk cell selected. Comparing these cells for all RDSs at a facility offers a relative, qualitative evaluation of the RDS activities for each impact category. Those RDSs directed at reducing high impact, high likelihood consequences represent the activities that are most effective in mitigating risk at the facility, while RDSs evaluated as low impact/low likelihood will have minimal benefits in curbing risk.

5.5.6.4 RDS Evaluation Step 4: Evaluate, review, and provide feedback

Operations, Field Office, and Cognizant Secretarial Office planners should review the results of operating organization RDS evaluations to ensure consistent application of the Management Evaluation Matrix. Recommendations and resolutions must be thoroughly documented in the RDS evaluation comments section.

As part of their review, responsible managers should assess those RDSs representing significant risks for which effective, risk-mitigating activities have not been identified. This may be the case when the RDS does not fully address some significant risk or concern. Such RDSs should be evaluated further to determine if alternative corrective activities would more successfully reduce the risks or if risk reduction is not practical due to other considerations. Compensatory actions, which reduce current risks in the near-term while longer-term solutions are being developed, should always be considered for high- or moderate-risk situations.

5.5.7 Quality Assurance, Process, and Training

To ensure the ability to compare RDS evaluations across programs and sites, a quality assurance program will be implemented to help increase the consistency in the evaluations. Parts of the program will include the following.

(A) Development of a detailed overall guidance package to provide consistent instructions for RDS development at the various sites. Please note that the Guidance for FY 1998 Budget Formulation contains these instructions.

(B) An EM-wide formal training program conducted at each site for all personnel completing RDSs, including data input and evaluation.

(C) Evaluations of RDS quality at three levels.

(1) A review conducted at the site level by site personnel representing all program areas.

(2) An EM-wide review conducted by personnel representing all EM sites and programs.

(3) An external review (i.e., "Peer" Review) conducted by experts from outside of the Department of Energy.

5.5.8 Stakeholder Involvement

The success of the EM program hinges on its ability to involve all interested stakeholders in its decision-making process. Stakeholder involvement provides information to improve decision-making and helps build crucial public support for the EM program. Thus, it is imperative that priority lists and RDSs are created with input from the Department's stakeholders, including the affected, interested, and/or concerned public; Indian Tribes; regulators; citizens' organizations; labor unions; employees; site-specific advisory boards; and State and local governments. To that end, regulators and other stakeholders must have sufficient access to budget, planning, and risk information and the opportunity to participate in the program development process.

Throughout the process, Operations Offices and sites should seek meaningful input from interested stakeholders. Methods of involving stakeholders will vary from site to site and from one stakeholder to the next. Operations Offices should determine the level of information and the extent of involvement most appropriate for stakeholders based on past experience. Interactions should focus on the scope of EM activities and the priorities that are being assessed as Operations Offices develop and prioritize their programs. In many cases, stakeholder concerns are known and documented and may be specifically captured in the ADS narrative and RDSs.

The process of using the Management Evaluation Matrix to complete an RDS is a key tool for developing priority lists, and stakeholders should become acquainted with its use, where applicable. Stakeholder involvement can favorably impact the process in several areas, including:

- activity definition;
- standard assumption review and site assumption formation;
- risk evaluation; and
- final peer review of evaluated RDSs, consistent with the recommendations of the EMAB.

Because the process of completing RDSs is time-intensive, Operations Offices should take this into account when planning stakeholder involvement activities.

Further discussion of involving stakeholders in the budget development process is provided in the Office of Management and Finance's, "Guidance for Stakeholder

Involvement in Allocation and Priority Setting for the Environmental Management Program," dated January 27, 1994. In addition, the Office of Public Accountability, which provides overall public participation guidance, has published a useful resource, "Citizens Guide to Influencing the Fiscal Year 1998 Office of Environmental Management Budget," which may be obtained from the Center for Environmental Management Information (1-800-7-EM-DATA).

5.6 Measuring Results

The Management Evaluation Process can be used to assess current risk level every year. Risk reduction can be measured by the change in level from year to year. Each site and program should, in addition, develop specific performance measures for risk reduction (e.g., types of waste treated, number of release sites completed, and number of stabilization units of nuclear material stabilized) to supplement the RDS process using information from existing data sources (e.g., critical few performance measures, strategic plans, contract performance plans, etc.).

5.7 References/Reading List

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5.8 Definitions*

Activity Data Sheets (ADSs)2. Data prepared at the installation level to show specific plans, milestones, funding, compliance requirements, human resources, and other pertinent information for a 5-year period. 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.

Compliance Agreements[1]. Agreements between regulatory agencies and regulated parties are legally binding and include consent order and compliance agreements, Federal facilities agreements, and Federal facility compliance agreements.

Hazard[1]. A source of risk that does not necessarily imply potential for occurrence. A hazard produces risk only if an exposure pathway exists and if exposures create the possibility of adverse consequences.

Environmental Impact (National Environmental Policy Act)[2]**.** Positive or negative effect of an action (past, present, or future) on the environment. Environmental impacts are usually categorized as (1) Natural Environment (Land Use, Air Quality, Water Resources, Geological Resources, Ecological Resources, Aesthetic and Scenic Resources), or (2) Human Environment (Infrastructure, Economics, Social, Cultural). Within an Environmental Impact Statement/ Programmatic Environmental Impact Statement, cost, health risks, transportation and transportation accidents, and treatment, storage, and disposal (TSD) facility accidents are treated separately from environmental impacts.

Human Health Risk[1]. The likelihood (or probability) that a given exposure or series of exposures may have damaged or will damage the health of individuals experiencing the exposures.

Inherent Risk. Actual or potential risk to the worker or the environment during implementation and conduct of environmental management activities.

Institutional Control[3]. Active institutional control refers to control of sites by the authorized party (DOE) by restrictions which limit human or animal access to or use of land or resources, e.g., with deeds, fences, and patrols. Passive institutional control refers to measures, such as site markers, used to warn human intruders of possible exposure to hazardous substances or conditions.

Likelihood. Statistical probability that an event, such as harm or injury, may occur as a result of exposure to a risk agent.

Nuclear Weapons Complex[1]. Major facilities involved in the production and testing of nuclear weapons, operating under DOE Office of Defense programs.

Off-site Population[2]**.** For facility accident analyses, the collective sum of individuals located within an 80-kilometer (50-mile) radius of a facility and within the path of the plume with the wind blowing in the most populous direction.

Probability[1]. The likelihood of an event occurring expressed as a number.

Public. Anyone outside the DOE site boundary at the time of an accident or during normal operation. With respect to accidents analyzed in an Environmental Impact Statement, anyone outside DOE's site boundary at the time of an accident.

Public Participation[1]. The process by which the views and concerns of the public are identified and incorporated into DOE's decision-making process.

Quantitative[1]. Numerical for measured information, such as the dose needed to produce an effect, or the number of people affected.

Risk[1]. In risk assessment, the probability that something will cause injury, combined with the potential severity of that injury.

Risk Analysis[1]. Methods of risk assessment as well as methods to best use the resulting information.

Risk Assessment[1]. The technical assessment of the nature and magnitude of risk.

Risk Characterization[1]**.** The final phase of the risk-assessment process that involves integration of the data and analysis involved in hazard identification, source/release assessment, exposure assessment, and dose-response assessment to estimate the nature and likelihood of adverse effects.

Risk Data Sheet (RDS). 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 or characterization. If sufficient information is not available to determine risk, then hazard information may be substituted, along with expected time to impact

Risk Management[1]. Uses information from risk assessment and analysis together with information about technical resources, social, economic, and political values, and control or response options to determine means of reducing or eliminating a risk. The differences between risk assessment and risk management are widely debated and controversial. The controversy centers on the degree to which risk assessment can be kept free from biases or values that typically are part of management decisions.

Stakeholder[1]. An individual or institution who has a stake in the outcome of the results of the action. Specific examples noted in the report include: local residents; Federal, State, and local citizen groups; Federal, State, and local environmental groups; Native American governments and associations; workers, unions, industry, and economic interests; Federal, State, and local environmental, safety, and nuclear regulatory agencies; local, county, and

State government; universities and research groups; DOE "self regulators"; technical advisors; and reviewers.

*NOTE: Definitions in this section are derived from several sources, mainly:
[1]The National Academy of Sciences, *Building Consensus Through Risk Assessment and Management of the Department of Energy's Environmental Remediation Program*
[2]The *1992 Five Year Plan* and the *Draft Programmatic Environmental Impact Statement*
[3]The *Draft Waste Management Programmatic Environmental Impact Statement*

5.9 Training Courses/Program Assistance

An EM-wide formal training program will be conducted at each site for all personnel completing RDSs, including data input and evaluations. One co-located DOE review team should be formed with members from each Operations/Field Office and Headquarters Program Office, and these individuals should be centrally trained. These trained representatives would then take the training materials back to the Operations/Field Offices and provide training (in a workshop format) to additional field individuals preparing RDSs and any interested Stakeholders.

The first of several RDS Workshops was held on November 28, 1995, in conjunction with the Second Annual Office of Financial Management Conference to kick-off the FY 1998 budget formulation process. The objectives of the workshop were to:

- Thoroughly review the reporting level of the RDS.
- Evaluate the relationship between the site's work packages (i.e., WBS) and the RDS reporting level.
- Review/evaluate the adequacy of scenario descriptions.
- Complete sample RDSs (including the Management Evaluation Matrix shown in Table II at the end of this chapter).
- Gain familiarity with the revised RDS software for the FY 98 budget formulation.

Table I. Field/Operations/Program Office Points of Contact

Field, Operations, or Program Office	Points of Contact	Telephone	Fax
Albuquerque	Peggy Hanson Beverly Otero	(505) 845-5266 (505) 845-4433	(505) 845-4834 (505) 845-5866
Chicago	Mark Bollinger Mary Jo Acke	(708) 252-9126 (708) 252-8796	(708) 252-2654 (708) 252-2654
Idaho	R. Mark Shaw David Sire	(208) 526-6442 (208) 525-5630	(208) 526-0160 (208) 525-5665
Nevada	Dave Hippensteel	(702) 295-1467	(702) 295-1113
Oakland	Paul Thrase Ross Champion	(510) 637-1624 (510) 637-1498	(510) 637-2001 (510) 637-2078
Oak Ridge	Teresa Perry Joyce Dail	(423) 576-8956 (423) 576-5998	(423) 576-6074 (423) 241-2593
Ohio	Lydia Boada-Clista Dennis Long	(513) 865-4164 (513) 865-4521	(513) 865-4402 (513) 865-4063
Richland	Steve Hwang Jim Kautzky	(509) 376-7796 (509) 376-7093	(509) 372-2610 (509) 372-2610
Rocky Flats	Lance Schlag Frazer Lockhard	(303) 966-3171 (303) 966-7846	(303) 966-2212 (303) 966-4871
Savannah River	Virginia Gardner	(803) 725-5752	(803) 725-3616
Headquarters: Waste Management Environmental Restoration Science and Technology Facility Stabilization	 Ker Chi Chang Lisa Treichel Joe Letourneau Eric Huang	 (301) 903-1383 (301) 903-8177 (202) 586-9034 (301) 903-4630	 (301) 903-1397 (301) 903-3675 (202) 586-4553 (301) 903-4307

Table II. Management Evaluation Matrix

Impacts		Likelihood of Occurrence[1]			
		A	**B**	**C**	**D**
		Very High	**High**	**Med**	**Low**
CATEGORY: PUBLIC SAFETY AND HEALTH					
PS1	Immediate or eventual loss of life/permanent disability	H	H	M	M
PS2	Excessive exposure and/or injury	H	M	M	L
PS3	Moderate to low-level exposure	M	M	L	L
CATEGORY: SITE PERSONNEL SAFETY & HEALTH					
SP1	Catastrophic - Injuries/illnesses involving permanent total disability, chronic or irreversible illnesses, extreme overexposure, or death	H	H	M	M
SP2	Critical - Injuries/illnesses resulting in permanent partial disability or temporary total disability >3 months, or serious overexposure	H	M	M	L
SP3	Marginal - Injuries/illnesses resulting in hospitalization; temporary, reversible illnesses with a variable but limited period of disability of <3 months; slight overexposure, or exposure near limits (20-100%)	M	M	L	L
SP4	Negligible - Injuries/illnesses not resulting in hospitalization, temporary reversible illnesses require minor supportive treatment; or exposures <20% of limits	M	L	L	L
CATEGORY: ENVIRONMENTAL PROTECTION					
EN1	Catastrophic damage to the environment (widespread and long-term or irreversible)	H	H	M	M
EN2	Significant damage to the environment (widespread and short-term effects, or localized and long-term or irreversible effects)	H	M	M	L
EN3	Minor to moderate damage to the environment (localized and short-term effects)	M	M	L	L

Impacts		Likelihood of Occurrence[1]			
		A	**B**	**C**	**D**
		Very High	**High**	**Med**	**Low**
CATEGORY: COMPLIANCE					
CO1	Major noncompliance with Federal, State, or local laws; enforcement actions; or compliance agreements significant to ES&H and involving significant potential fines and penalties	H	H	M	M
CO2	Major noncompliance with Executive Orders; DOE Orders; or Secretary of Energy directives (Notices or Guidance Memoranda) significant to ES&H and not involving significant potential fines and penalties	H	M	M	L
CO3	Marginal noncompliance with Federal, State, local laws; enforcement actions; compliance agreements; Executive Orders; DOE Orders; or Secretary of Energy directives significant to ES&H	M	M	L	L
CO4	Significant deviation from good management practices	M	L	L	L
CATEGORY: MISSION IMPACT					
MI1	Serious negative impact on ability to accomplish major program mission	H	H	M	M
MI2	Moderate negative impact on ability to accomplish major program mission	H	M	M	L
CATEGORY: MORTGAGE REDUCTION					
MR1	Significant avoidable cost (today's dollars) due to degraded infrastructure, inefficient management systems or program implementation, accident-related capital loss, or operational expense (annual cost >1% of annual site EM budget or >$5M)	H	H	M	M
MR2	Moderate avoidable cost (today's dollars) due to degraded infrastructure, inefficient management systems or program implementation, accident-related capital loss, or operational expense (annual cost .1-1% of annual site EM budget or $1-5M)	H	M	M	L

Impacts		Likelihood of Occurrence[1]			
		A	**B**	**C**	**D**
		Very High	**High**	**Med**	**Low**
CATEGORY: SOCIAL/CULTURAL/ECONOMIC					
SC1	Significant adverse: Damage so severe to a social, economic, or cultural value (e.g., a Tribal burial ground) that no mitigation is possible (i.e., the value would be irrevocably lost).	H	H	M	M
SC2	Moderate adverse: Damage the social/cultural/economic value. Mitigation may be possible, but would involve a considerable investment of time and money.	H	M	M	L

[1](A) Very High -- an actual occurrence or a probable occurrence of at least 1 per year.

(B) High -- a probability of occurrence of between 0.1 and 1 per year, or at least one occurrence within 10 years, but no sooner than within a year.

(C) Medium -- a probability of occurrence of between 0.01 and 0.1 per year, or at least one occurrence within 100 years but no sooner than within 10 years.

(D) Low -- a probability of occurrence of less than 0.01 per year, or one occurrence after at least 100 years.

Table I. LIPS Process Steps