DISCUSSION DRAFT

ON

STRATEGIC PRINCIPLES FOR PLANNING AND DECISIONMAKING

IN THE

CIVILIAN RADIOACTIVE WASTE-MANAGEMENT PROGRAM

Office of Civilian Radioactive Waste Management
U.S. Department of Energy

November 21, 1990

TABLE OF CONTENTS

FOREWORD

The Office of Civilian Radioactive Waste Management (OCRWM) intends to govern the planning, decisionmaking, and implementation of the nation's high-level radioactive waste-disposal program through the use of a set of strategic principles. These strategic principles will serve as the "constitution" of the program.

In keeping with the policy of open dialogue Secretary of Energy James D. Watkins has established, OCRWM will develop the strategic principles in consultation with stakeholders. We will sponsor two public workshops to provide an opportunity for affected and interested parties to contribute to the substance of the strategic principles.

We have prepared this working paper, entitled "Discussion Draft on Strategic Principles for Planning and Decisionmaking in the Civilian Radioactive Waste-Management Program," to serve as a basis for dialogue at the workshops. The paper reviews the waste-management program's mission, objectives, policies, and current strategic principles; presents issues from which additional strategic principles may be developed; and provides background information to assist in workshop discussions.

After the workshops, and with the receipt of other comments, we will use the statement of policies and principles in preparing the Mission Plan Amendment, which will be issued in draft form for public comment.

The Federal waste-management program is an undertaking unprecedented in its requirements, complexity, and challenges. To succeed it must have a firm and unassailable foundation for progress, decisions, and plans. Essential to the development of this foundation is meaningful involvement by stakeholders. Their participation in the development of the fundamental strategic principles that will guide the program is a critical step for its success.

1. INTRODUCTION

The Office of Civilian Radioactive Waste-Management in the Department of Energy (DOE) is responsible for disposing of this nation's spent fuel and high-level radioactive waste* in a manner that protects the health and safety of the public and the quality of the environment. Although embodied in the Federal repository program that began with studies in the late 1950s, this mission was explicitly established by the Nuclear Waste Policy Act of 1982 and reaffirmed by the Nuclear Waste Policy Amendments Act of 1987.

To fulfill our mission, we are developing a waste management system consisting of a geologic repository for permanent disposal deep beneath the surface of the earth, a facility for monitored retrievable storage, and a system for transporting the waste.

This discussion draft was developed to help involve parties affected by or interested in the waste-management program in the formulation of the basic principles on which the program will be based. Chapter 2 reviews existing objectives, policies, and strategic principles under which the system is currently being developed. Chapter 3 then discusses issues of strategic importance for which additional strategic principles may be needed. For these issues in particular, views from affected and interested parties is solicited, but comments regarding alternative approaches to the issues presented as well as suggestions for additional issues will also be welcome. Chapter 4 presents background information on the waste-management program pertinent to the issues discussion.

*For brevity, this document often uses the words "radioactive waste" or simply "waste" to mean spent fuel or high-level radioactive waste.

2. MISSION, OBJECTIVES, POLICIES, AND STRATEGIC PRINCIPLES FOR PLANNING AND DECISIONMAKING

MISSION

Dispose of the Nation's spent fuel and high-level radioactive waste in a manner that protects the health and safety of the public and the quality of the environment.

PROGRAM OBJECTIVES

To direct the implementation of our mission, we have established the following objectives:

- Timely disposal: to establish as soon as practicable the ability to dispose of radioactive waste in a geologic repository licensed by the Nuclear Regulatory Commission (NRC).

- Timely and adequate waste acceptance: to begin the operation of the waste-management system as soon as practicable in order to obtain the system development and operational benefits that have been identified for the MRS facility.

- Schedule confidence: to establish confidence in the schedule for waste acceptance and disposal such that the management of radioactive waste is not an obstacle to the nuclear energy option.

- System flexibility: to ensure that the program has the flexibility necessary for adapting to future circumstances while fulfilling established commitments.

BASIC POLICIES

The basic policies under which the program is conducted are as follows:

- The protection of public health and safety and the quality of the environment are of paramount importance.

- The program must be distinguished by its technical integrity and excellence and directed at reaching consensus in the scientific community, establishing public understanding and confidence, and obtaining the licenses needed for waste-management facilities.

- Opportunities and means must be provided for meaningful participation by affected and interested parties.

- The program must be managed and conducted in an efficient and cost-effective manner.

STRATEGIC PRINCIPLES

In addition to the basic policies, strategic principles are needed for planning and decisionmaking. This section presents the established principles under which the program is currently being developed. The following section addresses strategic issues for which additional principles may be needed. Yet other issues or principles, not identified in this discussion draft, may be suggested by affected and interested parties.

Purpose of the strategic principles

The purpose of the principles is to permit decisions to be made in a rational, goal-oriented manner directed at achieving the objectives of the program while giving adequate opportunity for meaningful predecisional involvement by affected and interested parties, including those public and private segments of our society that have an interest in the safe and reliable completion of this program.

The principles will serve as guides for the more-detailed plans and studies that will be necessary to successfully administer waste management activities. In view of the complexity of the program and its first-of-a-kind nature, the principles are to be used as guides for decisions and actions rather than rigid constraints.

Management principles

Maintain the focus of the program on permanent disposal. Disposal is the primary objective, it is the DOE's principal responsibility under the law, and success in achieving it is vital to maintaining the nuclear energy option. All program activities must be conducted in a manner that supports and facilitates permanent disposal.

Provide facilities for the timely acceptance of spent fuel. This principle is critical to achieving timely and adequate waste acceptance and obtaining the system-development and operational benefits that have been identified for an MRS facility, including the flexibility essential for spent fuel management logistics.

Maintain and implement strict environmental compliance programs. Although preliminary analyses indicate that the development of facilities and waste-management and disposal operations are not likely to result in significant environmental impacts, implementing this principle will ensure that environmental protection is given priority and that field activities are closely monitored for compliance with all applicable environmental protection standards.

Maintain standards of excellence. Technical excellence has always been a fundamental requirement of the program, and its importance increases with the increasingly difficult challenges that arise as the program moves forward. It is essential for success in licensing, establishing scientific consensus, increasing public confidence, and the prudent management of resources. Similar standards of excellence will be applied to all other aspects of the program, including institutional activities, outreach, and management.

Ensure that all quality-assurance requirements are met. Quality assurance comprises all the planned and systematic actions necessary to provide adequate confidence that the product or result of a quality-affecting activity meets its intended purpose and/or function; it is a prerequisite for licensing. All quality-affecting work must be performed in accordance with established quality-assurance requirements. We fully embrace the NRC's quality-assurance requirements.

Assign equal importance to institutional and technical activities. The history of the program has shown that institutional challenges are as difficult as the technical ones, and their importance must be recognized in all program plans and activities. Although the yardsticks of performance in technical and institutional activities are different, the highest level of quality and professionalism will be pursued in both.

Coordinate the technical, institutional, and management activities of the program. Implementation of this principle should enhance the integration of technical and institutional activities, contribute to the control of program schedules, and enhance the prospects for the success of the mission.

Technical principles

Apply the concept of defense in depth in waste-management and disposal. Backup safety systems will be provided in all operations involving waste handling, and multiple barriers against waste migration will be used in the repository. This approach should facilitate licensing and help to establish public confidence in safety.

Provide alternatives and contingency plans. This principle is needed to ensure success despite the inevitable surprises and unexpected problems that will arise in a complex, first-of-a-kind enterprise. It requires the parallel analysis of alternatives to key components of the system so that if the primary candidate encounters difficulties, a workable alternative can be available with minimized delay. It also requires anticipating the difficulties that might be encountered and developing in advance plans for minimizing their effects. While the provision of backups and contingency planning increase the initial costs of the program, they are insurance against unforeseen

problems that could otherwise lead to delays and real or perceived programmatic failure.

Use state-of-the-art systems-engineering techniques in developing and designing waste-management facilities and operations. Systems engineering is an orderly process for the development of complex systems. It consists of defining objectives and requirements, developing a design that meets the requirements, evaluating the design against the requirements, revising the design as needed, and repeating the process with increasing detail to ensure that the requirements are complete and that the system and its components will meet all of them. Important features of the process are its emphasis on ensuring that all components work together, on special studies of the entire system's ability to meet requirements, and on rigorous control of the technical information used in the process. Systems engineering is essential for the success of the program because it provides the means for identifying and controlling the many interfaces among the elements of the system; coordinating the multiple scientific and engineering disciplines involved in the program; and optimizing the design and operation of the system.

Use simple and proven designs and technologies. The use of simple and proven technologies, particularly those already licensed by the NRC, and the use of designs that approximate those of licensed facilities should facilitate licensing and increase cost effectiveness. This principle is applicable to an MRS facility, a repository, and a transportation system.

Provide external forums for the discussion of technical issues. The purpose of this principle is to ensure external peer participation in the resolution of technical issues. Peer review will be widely used in the program to provide technical oversight. It will be provided by the Nuclear Waste Technical Review Board, groups of independent experts, the technical experts of the States, and the National Academy of Sciences. Providing external forums for discussion of scientific and technical issues should add to the peer-review process and help to establish public confidence in the technical program. In addition, review by the NRC and its Advisory Committee on Nuclear Waste provides yet another level of external review.

Institutional principles

Provide for the involvement of affected parties in the decisionmaking process. As the organization charged with the development of the waste-management system, we have certain responsibilities that cannot be shared. One of these responsibilities is making technical and programmatic decisions. However, the views of affected and interested parties are essential to the decisionmaking process and will be actively solicited. The involvement of affected parties early in the decisionmaking process will facilitate the identification of emerging issues and alternatives, making issue resolution more

productive. It will also allow the program to benefit from the knowledge and experience of the affected parties.

Provide support to educational programs. Greater understanding of the health, safety, and environmental issues surrounding waste generation and management is key to the success of the program. It is also needed to help develop the skills necessary to meet the future human-resource needs of the program. This principle will be implemented by stimulating the teaching of science at the secondary, undergraduate, and graduate levels and developing curricula and instructional materials—both print and electronic—for primary, secondary, and undergraduate studies. A related effort will be to foster undergraduate and graduate studies for the public policy aspects of waste-management.

Continue to work cooperatively with affected parties. To foster productive links with affected parties, we will consult and cooperate with them and will seek to exchange information and ideas. Cooperative agreements will be used to bring additional groups into the program both for technical advice and for dissemination of information to their members.

In siting and designing waste-management facilities, consider potential benefits to the host states and communities. The Nuclear Waste Policy Amendments Act requires the Secretary of Energy, in siting Federal research projects, to give special consideration to proposals from States where a repository is located. Also, the Secretary of Energy is authorized to enter into a benefits agreement with the State of Nevada concerning a repository or with any state or Indian Tribe concerning an MRS facility. Such a benefits agreement would include specific benefits, including enhanced program participation, identified in the Nuclear Waste Policy Amendments Act. Other benefits to jurisdictions willing to host a repository or Monitored Retrievable Storage facility could be developed through the Nuclear Waste Negotiator, with DOE providing support in response to the Negotiator's requests.

3. PROPOSED ISSUES OF STRATEGIC IMPORTANCE AND POSSIBLE STRATEGIC PRINCIPLES

We have identified a number of issues of strategic importance for which strategic principles similar to those presented in Chapter 2 may need to be developed. We are seeking external input on these issues and plan to discuss them with affected and interested parties in two workshops focused on (1) protecting public safety and the environment and (2) stewardship of the resources made available to the program and effectiveness of operations.

The presentation of each issue includes background information, suggested options for initiating discussions, and factors to be considered in selecting an option or options for implementation. The suggested options are merely a means for initiating discussions; they do not represent policy or plans for action, and have not in any way been endorsed by us. We will appreciate suggestions for other options.

3.1 ISSUES RELATED TO THE PROTECTION OF PUBLIC SAFETY AND THE ENVIRONMENT

This section proposes 11 issues for which strategic principles may need to be developed. These issues have been divided into three groups:

Technical issues

- Cooling spent fuel before disposal.
- Designing waste packages to exceed the regulatory standard.
- Approach to the demonstration of performance.
- Using a demonstration facility to increase confidence.
- Timing and criteria for determining the suitability of the candidate site for a repository.
- Geologic disposal for wastes other than spent fuel and high-level wastes (greater-than-Class-C wastes).
- Risk assessment in selecting transportation modes and preferred routes.

Management issue

- Sharing of data on a timely basis.

This page has been intentionally left blank.

Institutional issues

- Timing and means for predecisional participation by affected and involved parties.
- Gaining public acceptance of waste transportation.
- Emergency-response planning and training.

TECHNICAL ISSUES

Almost all of the technical issues for which strategic principles may need to be established are focused on a repository, but, as noted in the discussions that follow, some are equally applicable to the entire waste-management system or to another system element.

COOLING SPENT FUEL BEFORE DISPOSAL

The waste that will be emplaced in a repository consists of spent nuclear fuel and high-level waste. Both types emit heat, but the spent fuel emits more heat than the high-level radioactive waste. The heat may affect the behavior of the host rock and the flow of fluids (both liquids and gases), which is the principal mechanism for transporting radioactive materials from the repository to the human environment. In theory, the heat may create flow patterns near the emplaced waste that differ significantly from the existing flow patterns, and these altered patterns may affect the system's ability to retain radionuclides. Our current strategy is based on exploiting the heat emitted by the waste to dry out the surrounding rock for more than 100 years and thus protect the disposal containers in which the wastes will be encapsulated.

However, the heat load in the repository—and the attendant uncertainties about long-term performance—can be significantly reduced by cooling the spent fuel for extended periods before disposal. Cooling may therefore facilitate licensing by simplifying the scope and difficulty of issues involved in the proof of performance. Cooling would also decrease the minimum distance between emplaced waste packages, reduce the unit volume of rock excavated per package emplaced, and decrease the costs of underground development and operation. The downside of cooling is that it requires prolonged storage on the surface and increases the costs of storage.

The cooling can be provided at reactor sites to the extent storage capacity is available or at an MRS facility.

Suggested options for initiating a discussion

Option 1. We could accept spent fuel at the repository directly from reactor pools (i.e., spent fuel cooled for at least 5 years).

Option 2. We could set a minimum cooling period longer than 5 years for acceptance at the repository from reactor sites.

Option 3. We could set a period for long-term cooling (e.g., 80 years) and provide facilities for storing the fuel during that period.

Option 4. We could establish a policy of accepting first the oldest fuel, which will be 40 years old on the average when a repository starts operations, with the proviso to take younger spent fuel to prevent reactor shutdowns.

Considerations in selecting options for implementation

Option 1 corresponds to our current approach. Our standard contract with the utilities specifies a minimum spent-fuel age of 5 years. However, after a repository starts accepting waste in 2010, most of the fuel accepted by the Federal system will be more than 10 years old. This option would not require the development of facilities exclusively for long-term cooling, but it would be compatible with an MRS facility, whose functions are not limited to cooling.

Option 2 would also be applicable to the waste-management system we are currently developing (a repository and retrievable storage for a limited quantity of spent fuel). To implement this option, we are conducting studies to determine the characteristics of spent fuel, the characteristics of the host rock, the design of a repository, the operation strategy for a repository, the operation strategy for an MRS facility, the storage mode chosen for an MRS facility, and efficiencies in transportation.

Option 3 is similar to the strategy followed in other countries. To implement this strategy, we would have to develop several MRS facilities to provide sufficient storage capacity.

In Option 4, eventually, as the waste backlog is worked off, the spent fuel arriving at a repository would be less than 40 years old.

DESIGNING WASTE PACKAGES TO EXCEED THE REGULATORY STANDARD

The waste package is defined by the NRC as "the waste form (spent fuel or high-level waste) and any containers, shielding, packing, and other absorbent materials

immediately surrounding an individual waste container." For the Yucca Mountain candidate site, the current conceptual design for the waste package consists of the waste form and a disposal container; it is the principal engineered barrier.

The waste package must meet various functional and regulatory requirements related to the operation of a repository and to the containment of radionuclides after a repository has been closed. Included in these requirements are the performance objectives of providing substantially complete containment for the waste for not less than 300 years to 1000 years and thereafter controlling the rate of radionuclide release from the engineered-barrier system. The demonstration that these objectives will be met is expected to be one of the most difficult technical challenges during licensing, and for this reason great importance is attached to the design of the waste package and to determining the conditions to which it will be subjected in a repository.

In the current reference design for the Yucca Mountain candidate site, the container consists of a corrosion-resistant metal selected to be compatible with the environment in a repository and with the geologic, hydrologic, and geochemical conditions expected to prevail in a repository over the long term. This design is expected to meet, but not necessarily exceed, regulatory standards for the life of the waste package.

Suggested options for initiating a discussion

Option 1. We could design the waste package to be compatible with the waste-emplacement environment and to meet, but not attempt to significantly exceed, the regulatory criterion for the life of the waste package. This design would be done in parallel with studies of the waste-emplacement environment, which are included in section 8.3.4.2.4 of the Site Characterization Plan.

Option 2. We could design a waste package that would exceed by a significant margin the regulatory criterion. This design would be done in parallel with studies of the waste-emplacement environment, which are included in section 8.3.4.2.4 of the Site Characterization Plan.

Option 3. We could pursue both options in parallel with studies of the waste-emplacement environment and other scientific studies during site evaluation. Once the results of the studies are available and a cost-benefit analysis has been performed, a single design path would be chosen.

Considerations in selecting options for implementation

Option 1 represents the current design approach. The current reference design is at a conceptual stage; alternative materials and design concepts would be evaluated in

the next, more-advanced design phase.

Option 2 would help to offset uncertainties that may exist about the performance of the natural system at the site. It might thereby help to demonstrate the long-term performance of a repository and contribute to public confidence in the safety of a repository.

To implement option 2, we would initiate a study to evaluate a range of low-probability potentially disruptive processes and events that could affect the performance of the waste package, to complete a functional analysis, and to establish performance requirements and criteria for a package that can exceed the current regulatory requirements. When these activities have been completed, we would develop alternative conceptual designs. These designs might include simple single-walled containers or complex multilayered packages consisting of different metals and nonmetals (e.g., ceramic liners, which are impervious to corrosion). In pursuing this option it is important to ensure that, in designing to a broader range of repository conditions, including unexpected events, compatibility with the expected conditions is maintained.

Option 3 would allow us to retain option 1 if scientific investigations ultimately indicate that the current design approach is adequate.

In considering the options for the waste package, the issue presented in the next section—allocating performance to natural and engineered barriers—should be included.

APPROACH TO THE DEMONSTRATION OF PERFORMANCE

In order to issue a construction authorization for a repository, the NRC must find that the site and the design of a repository comply with requirements specified in 10 CFR 60. These regulations require a demonstration of compliance with the standards promulgated for geologic disposal by the Environmental Protection Agency (EPA) in 40 CFR 191. Included in the NRC's requirements are performance objectives for the total repository system—that is, both natural barriers and engineered barriers—as well as each of the system elements.

In a regulatory strategy paper (SECY-88-285), the NRC identified several topics as requiring a rulemaking. One of these topics is demonstration of compliance with the EPA standards. We believe that rulemaking in this case is not appropriate and have advised the Commissioners that this is our position.

Suggested options for initiating a discussion

Option 1. We could petition the NRC to change its regulations by specifying only total-system performance objectives, without performance objectives for particular elements of the system.

Option 2. Without petitioning for a change in regulations, we could request the NRC to abstain from rulemaking on the topic of performance demonstration but to provide us with guidance through regulatory guides.

Option 3. We could hold further discussions with the NRC on the topic and evaluate alternative approaches.

Considerations in selecting options for implementation

The NRC's regulation is generally not prescriptive, recognizing that a repository has never been built and operated. The regulation states, for example, that, provided the overall system performance objective is satisfied, the Commission may approve or specify performance objectives other than those specified in 10 CFR 60.111, 112, and 113. We fully agree with this philosophy and believe it is prudent to retain the flexibility to propose alternative approaches to demonstrating compliance rather than being required to meet specific interpretations established by rule.

We feel that the topic of demonstrating compliance does not require a rulemaking because 10 CFR 60 will be revised to reflect the revised EPA standards. We also believe that to retain the necessary flexibility, regulatory requirements on the time of groun.. water travel, the waste-package lifetime, and limits on releases from the engineered-barrier system should be made guidelines instead. We also believe that in demonstrating compliance with the EPA site performance standard it would be particularly useful to allow credit in the regulatory analysis for an improved engineered-barrier system.

USING A DEMONSTRATION FACILITY TO INCREASE CONFIDENCE

As discussed in Section 3.2 under "Phased Licensing for a Repository," we are evaluating a step-by-step approach to repository development instead of attempting to site, design, license, and construct a repository on an aggressive schedule and then emplace considerable quantities of waste as soon as an operating license is received. Proceeding at a more deliberate pace and in smaller, but surer, steps might contribute significantly to confidence that a repository will perform safely over both the near and the long term. One way to implement this step-by-step approach is to develop and license a repository in phases (see page 3-22); another is to include in a repository-development process a demonstration project that would allow us to develop and

demonstrate disposal technology with real waste in a geologic setting that is the same as, or similar to, that of the proposed repository. Although we plan to construct an exploratory facility at the depth proposed for a repository, none of the tests conducted in that facility will use actual waste.

The objective of a demonstration project would be to increase confidence, thereby supporting licensing and gaining greater acceptance by the public. It would also significantly increase the amount of site information that is available for licensing.

The role that a demonstration project would play in increasing confidence depends on the type of facility that would be used, the tests that would be performed, and the time at which the demonstrations could be performed.

Suggested options for initiating a discussion

Option 1. We could perform the demonstration in the exploratory facility that will be built for site evaluation (see Chapter 4). We could start by constructing a ramp to the proposed depth of a repository, excavating repository-size drifts, and boring waste-emplacement holes in which tests would be performed.

Option 2. We could develop an underground research laboratory near, but separate from, a repository block. This research laboratory would be completed before the exploratory facility and would be used for prototype testing, demonstrating the suitability of the rock horizon proposed for a repository, and examining the spatial variability of the rock.

Option 3. We could develop at the Yucca Mountain candidate site a test-and-evaluation facility pursuant to Sections 211 and 305 of the Nuclear Waste Policy Act as amended. The Act authorizes the construction of such a facility for demonstrating the technology needed for geologic disposal and for tests related to site evaluation and the operational aspects of waste disposal. For these tests it allows the emplacement of up to 100 metric tons of spent fuel under continuing NRC review. This facility would be used for testing before the construction authorization is received. It would be used only if the Yucca Mountain site is determined to be suitable for a repository.

Option 4. Before proceeding to construct, license, and operate a full-scale repository, we could construct and operate a repository as a pilot-scale facility with limited waste emplacement and licensing in increments.

Considerations in selecting options for implementation

Option 1 is closest to our current plans. As described in Chapter 4, we plan to construct an exploratory facility to provide access to the horizon proposed for a

repository and to provide underground excavations for various tests needed to determine the suitability of the site. In principle, the tests that would be performed in demonstration facilities could be carried out in this exploratory facility. More underground excavation may be necessary to construct repository-sized drifts, and the scope of the testing may be increased.

To implement option 1—that is, to use the exploratory facility needed for site evaluation as a demonstration facility—a legislative amendment may be necessary since the Nuclear Waste Policy Act as amended (Section 113(c)) restricts the activities to be conducted during site evaluation to those considered "necessary to provide the data required for evaluation of the suitability of such candidate site.... ." And, as required by the Act, we would have to obtain the concurrence of the NRC before using radioactive materials. Since at least part of the exploratory facility will be incorporated into a repository, we would also have to ensure and demonstrate to the NRC that neither the development nor the testing in this facility would compromise the integrity of the site or affect the future performance of a repository. A demonstration project in the exploratory facility could allow us to resolve, before the license application is submitted, such issues as the variability of the host rock or the constructability of ramps, shafts, waste-emplacement boreholes, etc.

Because at least part of the exploration-and-demonstration facility would be incorporated into a repository, option 1 would allow some conservation of resources. On the other hand, using the exploratory facility for a demonstration project would cost more than using it as currently planned for site evaluation, and, if the site is later found to be unsuitable, significant resources will have been wasted. In addition, this option might contribute to the perception that we have already "selected" the site for a repository even though most of the site-evaluation program has not been conducted.

Option 2 could be implemented at the DOE's Engine Maintenance and Disassembly (EMAD) test facility. Being near, though not at, the Yucca Mountain candidate site, this facility would allow us to develop and demonstrate disposal technology under conditions analogous to those at the site. Separation from the repository would diminish concerns about affecting the integrity of the site. The use of existing Federal facilities to conduct tests relevant to the activities contemplated in a test-and-evaluation facility is authorized by the Act as amended. What is not clear is whether an underground laboratory constructed at the EMAD facility would be considered an "existing" facility and therefore eligible under Section 217 of the Act as amended. It is also not clear whether the tests in such a facility would entail the emplacement of significant quantities of radioactive material, and, if they did, whether the underground laboratory would become in effect a test-and-evaluation facility. If we do construct an underground laboratory, we will nonetheless have to later construct an exploratory facility at the site for site evaluation because an explorotary shaft facility is required by NRC regulations.

Under option 2, the demonstration could precede the construction of the exploratory facility, and less testing would be needed in the exploratory facility for candidate site evaluation. In addition, this option would avoid the perception that the site has been "preselected" and would allow technical issues to be separated from institutional ones. On the other hand, an underground laboratory would add to costs, and these costs would not be recoverable because the laboratory would not become part of a repository. And because of arguments about the representativeness of the data collected away from the site, it might be necessary to duplicate much of the work in the exploratory shaft facility.

Option 3 would allow us to test at an early phase the emplacement of waste in a repository and contribute to our understanding of the waste-package environment. It would require ensuring and demonstrating that the integrity of the site is not compromised, and it would require changes in the site characterization plan. And it may encounter opposition from the State.

In regard to option 3, most important are the restrictions on the time of construction in the NWPA as amended. Because of these restrictions, we would not be able to start constructing a test-and-evaluation facility unless site designation for a repository had become effective (i.e., unless and until the suitability of the site had been determined, the site had been recommended to the Congress, and the State had an opportunity to file a notice of disapproval—see Chapter 4); furthermore, we would not be able to begin constructing any surface facilities for such a project until the construction authorization for a repository has been received. These restrictions limit the usefulness of a test-and-evaluation facility.

Option 4 would contribute to a step-by-step approach to the development of a repository. However, as discussed in Section 3.2, under "Phased Licensing for a Repository," this option would not necessarily facilitate the licensing of a repository.

TIMING AND CRITERIA FOR DETERMINING THE SUITABILITY OF THE CANDIDATE SITE FOR A REPOSITORY

We have prepared plans for conducting a comprehensive program of scientific investigations to evaluate whether the Yucca Mountain candidate site in Nevada is suitable for a repository. This program will consist of both surface-based tests and tests conducted in an exploratory facility that includes at least one shaft and underground excavations at the depth proposed for a repository.

The surface-based tests are aimed at detecting as early as possible conditions that would be potentially adverse to the performance of a repository at the site. If such conditions are discovered and are shown to have unacceptable effects on performance,

then we will have to make a finding that the site is unsuitable and report to the Governor and the legislature of Nevada and the Congress of the United States.

The difficulty with site-suitability evaluations is the problem of demonstrating with any reasonable testing programs that possible potentially adverse conditions that do not affect site performance are not present. This problem is particularly severe for sites that have favorable characteristics for waste isolation: stability, low transmissibility for water and gases, and high retardation of the transport of contaminants present in very low quantities. These very properties make it difficult to conduct tests that examine much of the rock (low communication potential).

If no unacceptable conditions are found, we will complete the site-evaluation program and then evaluate the data to determine whether a repository at the site would safely contain and isolate the waste for thousands of years. This determination will be a formal finding that will serve as the basis for recommending the site to the President, who, if he agrees, will recommend to the Congress that the site be developed as a repository. This process is specified by the NWPA as amended.

Before making the formal determination, it may be advisable to make preliminary findings of suitability, and thus timing is an issue that must be addressed by the strategic principle developed for the determination of site suitability. In addition, this principle should address the criteria and method used in the determination.

Suggested options for timing

Option 1. We could make preliminary evaluations of suitability at regular intervals (e.g., every 24 months) on the basis of the available data.

Option 2. We could make preliminary evaluations of suitability at major program milestones (e.g., before starting to construct the exploratory facility).

Option 3. We could make all of these evaluations.

Considerations in selecting options for implementation

Option 1 could result in preliminary findings of limited meaningfulness and applicability. It would, however, allow us to make maximum use of information from early testing, including the ability to make early adjustments in our testing and design programs. If our investigations uncover conditions that would make the site unsuitable or licensing extremely difficult, then option 1 might lead to an earlier decision as to the prudence of investing more time and money in the site. In addition, periodic evaluations of suitability would provide a mechanism for keeping management and interested parties apprised of developments in our scientific investigations. And by

performing periodic preliminary evaluations we would gain useful experience for the formal finding of site suitability. For option 1 to be practical, we would have to conduct the preliminary evaluations in an expeditious manner without impeding the progress of the program.

Option 2 is very similar to option 1, but it would have the specific purpose of evaluating at major program milestones whether further investment in the site is warranted. Even though it would be preliminary, a formal finding at major milestones might also facilitate licensing. This option, however, would be time consuming.

Option 3 combines the characteristics of the other options.

Suggested options for suitability criteria

Techniques for evaluating the suitability of sites do exist. They involve the development of criteria for suitability (e.g., a limit of 10 percent on fractures that can transmit significant amounts of water), specifications of probability distributions or ranges of parameters that define the performance measures (e.g., density of connected fractures), sampling these distributions to produce distributions of the performance measures, the use of experimental techniques (e.g., boreholes) to determine the probability that the tests will detect the features associated with these performance measures, and then comparing the results of the tests to make comparisons against the criteria. Such techniques have been successfully applied to analyses of sites in Switzerland.

Option 1. We could apply those aspects of our siting guidelines (10 CFR 960) that are appropriate for evaluating a single site.

Option 2. We could revise the guidelines and use the NRC's licensing criteria in 10 CFR 60.

Option 3. We could revise the guidelines by changing generic guidelines to site-specific factors.

Option 4. We could revise the guidelines and use criteria developed by external parties.

Option 5. We could work together with affected parties to develop new site-specific suitability guidelines.

Considerations in selecting options for implementation

The selection of options for suitability criteria depends to a considerable degree on the timing of the evaluation. The DOE's siting guidelines call for a comprehensive evaluation of the suitability of the site at the conclusion of the site characterization program. This site-suitability evaluation must be completed before the site is recommended to the President for any repository development. The objective of these site-suitability evaluations is to identify any features that may provide early evidence that the Yucca Mountain site is not suitable, thus avoiding extended investment of time and resources should that be the case. We must decide how such early evaluations will proceed, what criteria and methodology will be used to make findings, and how the status of uncertainties will be evaluated and the testing program will evolve to address these concerns.

For an early evaluation of site suitability, it might be advisable to apply a different set of criteria than that used for determining that the site is indeed suitable. For an early evaluation, a set of "unsuitability" criteria might be more practical. These specific criteria must address: unsuitability in terms of evidence of potentially unacceptable performance of the repository system, which will be provided through quantitative and qualitative performance assessments; unsuitability in terms of evidence of potentially unacceptable changes in site conditions such as might be caused by tectonic or volcanic activity within the repository block; and unsuitability in terms of significant uncertainties that might require too great an investment of time, money, or effort to reduce to acceptable levels.

We are already initiating an intensive effort to develop a set of criteria for the early site evaluations and a methodology for applying these criteria. This effort will involve evaluation of the conditions specified in the siting guidelines of 10 CFR 960; performance assessments; and a series of expert panels to develop unsuitability measures and criteria in terms of those measures, methodology for applying those criteria, and a pilot study to test the feasibility of the approach. At the same time, independent efforts by the Electric Power Research Institute and by Golder Associates to develop a suitability methodology are underway, and we will compare and evaluate such independent approaches to develop the DOE strategy.

Another key issue relating to site suitability is the status of data and uncertainties and the testing program to address those uncertainties. We are prioritizing the surface-based and in-situ testing programs to address these concerns.

The guidelines referred to in options 1 and 3 were generic guidelines developed in response to a requirement in the NWPA. They were used in evaluating the nine potentially acceptable sites for the first repository, in nominating five sites as suitable for characterization, and recommending three sites for characterization. They are

based on, and closely similar to, the NRC's siting criteria in 10 CFR 60. The development of these guidelines included broad involvement by the affected parties, comment by the public, and concurrence by the NRC. The application of the guidelines might not be practical for early evaluations since for a number of guidelines establishing that a qualifying condition is met may require extensive data from underground testing.

Option 2 is similar to option 1 because the guidelines are derived directly from the NRC's technical criteria.

Options 3 and 4 are similar, except that the latter involves criteria developed independent of us. If either of these options is chosen, it may be necessary to develop two sets of criteria: those to be used early in the process (i.e., before the construction of the exploratory facility) to make sure that no disqualifying conditions are present at the site (i.e., "unsuitability" criteria) and those to be used after site evaluation to determine whether the site is suitable. Alternatively, we could use a set of "unsuitability" criteria, developed by us or another party, for the early determinations and the siting guidelines for the suitability evaluation at the end of the site-evaluation program.

Option 5 would expand opportunities for input from affected parties, but would also increase the difficulty of reaching a timely conclusion.

GEOLOGIC DISPOSAL FOR WASTES OTHER THAN SPENT FUEL AND HIGH-LEVEL WASTE (GREATER-THAN-CLASS C WASTES)

The NRC has defined three classes—A, B, and C—of low-level radioactive wastes in order of increasing radiation hazard and longevity. Wastes that exceed the radioactivity concentrations permitted for Class C are known as "greater-than-Class-C wastes." They come from a wide variety of sources, including the operation and decommissioning of reactors, medical activities, and research. They vary in their physical characteristics, composition, and radioactivity. At present, these wastes are kept in storage at the sites where they are generated.

The actual quantities and characteristics of greater-than-Class-C wastes are very uncertain at present, but it is known that a significant portion of these wastes are "mixed wastes"—that is, wastes that contain both radioactive materials and hazardous chemical substances as defined in the Resource Conservation and Recovery Act (RCRA) of 1976. We are currently conducting a comprehensive study directed at determining the quantities and characteristics of these wastes.

The Department of Energy, through DOE's Office of Environmental Restoration and Waste Management, is responsible for the disposal of greater-than-Class-C wastes

under the Low Level Waste Policy Amendments Act of 1985. (Management of greater-than-Class-C wastes is not covered under the Nuclear Waste Fund established by the NWPA.) In the past, DOE has proposed providing for such waste special "intermediate-level" disposal—that is, disposal at depths on the order of 100 feet below the surface. Such disposal would provide greater isolation than do low-level-waste sites but would be much less costly than a repository.

Responsibility for classifying wastes and determining which wastes require geologic disposal rests with the NRC. The NRC has not determined that greater-than-Class-C wastes require geologic disposal. However, in its rule on the disposal of low-level wastes, 10 CFR 61, the NRC proposed geologic disposal for these wastes "unless proposals for the disposal of such waste in a disposal site licensed pursuant to (10 CFR 61) are submitted to the Commission for approval." We have encouraged the NRC to resume the effort of redefining the classes of radioactive wastes, distinguishing between greater-than-Class-C wastes that require geologic disposal and those that do not require such costly disposal.

Suggested options for initiating a discussion

Option 1. We could complete the characterization of greater-than-Class-C wastes. We should then evaluate how much space these wastes would require in a repository, how they might affect licensing, and how they might affect the performance of the repository.

Option 2. We could petition the NRC to develop specific performance criteria for the packaging and emplacement of these wastes, regardless of the method of disposal. We should also petition the NRC to identify the greater-than-Class-C wastes, if any, that should be isolated in a repository.

Option 3. We could petition the NRC to develop specific regulations for the disposal of greater-than-Class-C wastes.

Option 4. We could start planning to accept some greater-than-Class-C wastes in the first repository.

Option 5. DOE's Office of Environmental Restoration and Waste Management could start planning to develop special "intermediate-level" facilities for these wastes.

Option 6. We could defer planning for the disposal of these wastes until the decision on the need for a second repository is made. We could then plan to emplace all these wastes in a second repository if one is needed.

Option 7. We could plan to provide interim surface storage for these wastes.

Considerations in selecting options for implementation

The first part of option 1 should be implemented regardless of what other options are selected because planning for the management and disposal of these wastes is not possible without reliable estimates of quantities and characteristics. Option 2 should also be implemented. Although the NRC, in response to a request from us, is evaluating requirements for packaging and emplacement, their evaluation is based on geologic disposal, which may preclude other options. Option 3 would be necessary if DOE decided to develop special intermediate-level facilities for these wastes (option 5).

The decision to emplace greater-than-Class-C wastes in the first repository (option 4) could substantially affect the planning and design of the repository. This judgment cannot be made until the quantities and characteristics of the wastes have been defined. It would also be necessary to establish whether the statutory loading limit for the first repository (no more than 70,000 metric tons of heavy metal may be emplaced until the start of waste acceptance at a second repository) pertains to greater-than-Class waste.

Other factors that need to be evaluated in considering option 4 include the following:

1. Determining how the receipt of these wastes would affect the design of the surface facilities of a repository since these wastes would be in a different configuration than spent fuel and high-level waste, because they would require packaging into uniform containers, and because in some instances they might require supplemental shielding.

2. Determining how these wastes would affect the operational safety of a repository, both for repository workers and the public.

3. Determining the mode of emplacement: should a separate area be designated for these wastes; should the containers of these wastes be inserted into boreholes, like spent fuel and high-level waste; should they be placed on the floors of the disposal rooms and access tunnels after a repository has been filled with spent fuel and high-level waste.

4. How would the emplacement of these wastes affect the retrievability of all wastes should retrieval be necessary?

5. Determining whether and how the presence of chemicals and organic substances in these wastes would affect the performance of a repository through the

generation of gases, interactions with other waste materials, interactions with ground water and the host rock, etc.

6. Determining how the emplacement of these wastes would complicate the licensing of a repository because of the considerations stated in item 5 above.

7. Determining how the need to comply with the RCRA would complicate the demonstration of regulatory compliance.

8. Determining how the factors listed above would affect the repository schedule.

Before implementing option 4, it would be necessary to develop a fee structure for wastes from sources other than commercial nuclear reactors and a method for paying the fee. Unless this is done at an early stage of planning, complaints from the contributors to the Nuclear Waste Fund and State public utility commissions are to be expected.

Option 4 also has institutional implications, and is likely to complicate further our difficulties in obtaining the environmental permits needed for site evaluations.

Option 5, the "intermediate-level" facilities mentioned in the introduction to this issue, would provide the required isolation in facilities less expensive than a repository. It would require the siting of a separate facility, which is a difficult task at best.

Option 6 would be attractive if it is determined that a second repository is needed. (The NWPA as amended requires us to advise the Congress on the need for a second repository between the years 2007 and 2010.) It would allow ample time for study, preparation, and planning. It would also allow us to benefit from the experience of the first repository and hence to be better prepared in resolving licensing and regulatory-compliance issues specific to "greater-than-Class-C" wastes. And it would obviate the need for siting a third waste-management facility—a facility for the disposal of greater-than-Class-C wastes.

Option 7 is premature at present. It should be considered only after these wastes have been completely characterized and requirements for their disposal have been established.

RISK ASSESSMENT IN SELECTING TRANSPORTATION MODES AND PREFERRED ROUTES

We are taking various steps to ensure the development of a comprehensive program for the assessment and management of transportation risks. These steps include the development, enhancement, or evaluation of various computer models,

including models based on well-established probabilistic techniques of risk assessment. To support these models, we are also developing a transportation data base; this includes the preparation of a standard reference document for transportation assumptions, the collection of data on accident rates for rail and road transport, and the development of risk factors for national transportation network analyses.

We have kept the Nuclear Waste Technical Review Board (NWTRB) informed regarding our work in the development or revision of computer models and codes, and the Board has responded with comments and suggestions. We anticipate a similar working relationship with the NWTRB regarding the development of plans for the application of these models and codes.

The methods and models used for risk assessment could be applied to the selection of transportation modes (truck or rail) and preferred transportation routes. We have not yet made a final determination about transportation modes. However, it is currently our intent to ship waste by rail where possible. For shipments from the MRS facility to the repository, we currently plan to use dedicated trains.

Suggested options for initiating a discussion

Option 1. We could use risk assessment as the primary method of selecting transportation modes.

Option 2. We could use risk assessment as the primary method of identifying preferred transportation routes.

Option 3. We could use risk assessment as a tool in supporting decisions on transportation modes and routes.

Option 4. We should not use risk assessment in these transportation applications.

Considerations in selecting option to be implemented

Generally, the transportation mode selected will depend on waste quantities, distance, routing, economics, and overall logistics as well as rail access at the facilities from which waste is to be accepted. Risk assessment may not be essential for purely technical purposes as the primary method of selecting modes (option 1) because the selection can be based on simpler methods and readily available data on rail and truck accidents. However, risk assessment may nonetheless be useful as the primary method of selecting modes because it is a tool that clearly establishes the basis for decisionmaking, clarifies selection criteria and thereby facilitates communication with external parties, and can serve to enhance public confidence in the program.

One problem with option 2 is that risk assessment may not be useful as the exclusive or primary means of identifying preferred routes. The risks associated with transportation are very low, and the uncertainties in the analysis are considerable because the model used in the assessments makes generic assumptions about certain conditions, such as the population density in rural and urban areas. The results would therefore not be useful discriminators among routes. In selecting routes, safety will be the primary consideration. Still, as above, the use of risk assessment could serve to improve decisionmaking, communication, and public confidence.

Option 3 would afford us the benefits of using risk assessment as a supporting measure for decisions on modes and routes. It would be necessary to determine what weight it should be given as a decision factor and how it relates to other factors, but this could augment decisionmaking, communication, and public confidence.

Option 4 would deny us the use of a tool that can be useful as a supporting measure, with a potentially negative impact on decisionmaking, communication, and public confidence. However, this would conserve resources that might otherwise be committed to risk assessment.

MANAGEMENT ISSUES

SHARING OF DATA ON A TIMELY BASIS

It is our intention to make the technical data collected in our program available to any and all concerned parties, including the affected States, local governments, and Indian Tribes; the NWTRB and any other oversight entities that might be established; the Nuclear Waste Negotiator; and the NRC. To share the data on a timely basis we must implement a system for data management that allows access to data in an efficient and effective manner.

Suggested options

Option 1. We could make raw data and supporting information available to all concerned parties as soon as is practical after data acquisition.

Option 2. We would release data only after they have been processed, reduced, and analyzed.

Option 3. We could release data along with analyses and conclusions as formal published reports.

Considerations in selecting options for implementation

In regard to options 1 and 2, it must be remembered that in the collection and treatment of data the ultimate purpose of the data will be to support an evaluation of site suitability and, if the site is suitable, in preparing a license application to the NRC. As such, the control and assurance of the quality of the data must remain paramount in the management and dissemination of data to interested parties. While access should not be restricted to any data, we must be able to certify those data to be used in determining suitability and in the license application and to justify the dismissal of data not used, whether suspect for technical or quality-assurance reasons.

Also, scientific investigators consider that they have the right to present or publish data, analyses, and interpretations, and the premature release of data jeopardizes this right. The publication and presentation of project data and results in peer-reviewed journals and at professional conferences by scientific investigators also contributes to the credibility of the project. For these reasons, we should allow examination of the data as they are acquired, but limit dissemination of data until such time as the investigators and we are satisfied with its quality and initial analyses and interpretations are complete.

On the other hand, predecisional data release demonstrates our spirit of cooperation and is necessary to those organizations with oversight roles. Decisions regarding system and site suitability, in particular, will rest on consensus in the interpretation of the data by both oversight organizations and DOE.

INSTITUTIONAL ISSUES

TIMING AND MEANS FOR PREDECISIONAL PARTICIPATION BY AFFECTED AND INVOLVED PARTIES

Success in our waste-management program requires the participation and involvement of external parties. The external parties include both potentially affected parties, such as States, local governments, and Indian Tribes, and involved or interested parties, such as the utilities or public-interest groups. Since their involvement and participation are required by law, affected parties have a special status in the program.

Secretary Watkins has repeatedly made clear his intention to establish a DOE culture that is open and responsive to the concerns of interested and affected parties. He has begun to deliver on his promises by involving external parties extensively in planning for the cleanup of DOE sites and the national energy strategy. We have made similar commitments.

In order for external-party involvement truly to build consensus and lend expertise

to the program, we need to go beyond information sharing through publications, information offices, electronic data bases, and speeches and briefings. We must implement fully the new policy of external participation in our programs, by actively seeking out and providing opportunities for meaningful participation. The issue is the form of that participation.

Suggested options for initiating a discussion

Option 1. We could attempt to establish a partnership in which Federal, State, and local governments jointly develop decision alternatives for the program in consultation with the public.

Option 2. We could establish mechanisms for predecisional dialogue.

Option 3. We could limit involvement to postdecisional dialogue.

Considerations in selecting options for implementation

Option 1 would mean that external parties would be involved in the earliest stages of policy development and would be equal partners in decisionmaking. To implement this option, a mechanism would have to be found for integrating affected parties into the program. Although participation by affected parties is mandated by law, responsibility for the program remains ours. Furthermore, in view of the controversial nature of our program, direct, integrated involvement would interfere with the independence of the affected parties in their oversight role.

In option 2, we would discuss alternatives with affected parties before making decisions and use their input. This would allow external parties the opportunity to present information at an early stage of the decision making process. Such a dialogue could be established through informal workshops held after we provide the external parties with advance copies of our predecisional papers.

In option 3, we would maintain a dialogue with external parties, requesting comments and issuing comment-response documents. This option would limit opportunities for meaningful involvement and ability to influence decisions.

GAINING PUBLIC ACCEPTANCE OF WASTE TRANSPORTATION

Although the shipment of radioactive materials in the United States has an outstanding safety record, concern about the transportation of radioactive waste remains a dominant issue. To allay these concerns, we are communicating to the general public information about the safety features of our transportation program, including the characteristics of the shipping casks; the safety procedures to be

implemented for every shipment; and our commitment to compliance with all applicable Federal regulations. Furthermore, before starting any shipments, we expect to be able to learn from the transportation of wastes to the DOE's Waste Isolation Pilot Plant in New Mexico.

Suggested options for initiating a discussion

Option 1. We could continue with the current interactions under way in both the technical and institutional elements of the transportation program.

Option 2. We could increase those activities in our program that are directed at demonstrating the safety of transportation.

Option 3. We could increase public information and interaction efforts on a much larger scale, increase the opportunities for meaningful involvement by affected and interested parties, and increase awareness of the efforts undertaken.

Considerations in selecting options to be implemented

The options listed above are not mutually exclusive, and all three in combination are needed to achieve the stated goal. The effort to increase public acceptance of transportation could involve initiatives related to option 1, such as increased opportunities for external participation in planning the development and operation of the transportation program; initiatives related to option 2, such as full-scale testing of the ability of shipping casks to retain their integrity under severe accident conditions; and initiatives related to option 3, such as widespread public education about measures used to ensure that waste transportation will not pose any significant hazard to public health or safety.

EMERGENCY-RESPONSE PLANNING AND TRAINING

We are developing a program plan and policy to implement the requirements in Section 180(c) of the NWPA as amended, which requires us to provide technical assistance and funds to States for training the public-safety officials of local governments and Indian Tribes through whose jurisdictions waste shipments will pass. The plan will incorporate issues raised by the regional groups overseeing our transportation activities. It will address both routine transportation and assistance for accidents requiring emergency response.

The major issue related to our responsibilities under Section 180(c) is the timing of assistance for training in emergency response.

Suggested options for initiating a discussion

Option 1. We could start assistance 3 to 5 years before shipments begin.

Option 2. We could start assistance immediately.

Considerations in selecting options to be implemented

For emergency-response training to be successful in the many States through which waste shipments will pass, the resources allocated to this activity should be used judiciously. Timing is very important in this regard. Our current plan is to implement option 1, which we believe allows sufficient time for public-safety personnel to receive adequate training. For shipments from reactor sites to an MRS facility, this means starting assistance between 1993 and 1995. Starting assistance immediately, as in option 2, would be premature, and a considerable number of the trainees might not stay in positions warranting the training.

3.2 ISSUES RELATED TO THE STEWARDSHIP OF RESOURCES AND THE EFFECTIVENESS OF OPERATIONS

Of the strategic issues that have been identified, eight are related to the stewardship of resources and the effectiveness of operations. As shown below, three of these issues are technical, and the rest are in the management category.

Technical

- Development of dual-purpose casks for transportation and for storage.
- Contingency planning for the event that the Yucca Mountain site is found to be unsuitable for a repository.
- Phased licensing for the repository.

Management

- Roles of utilities and the Federal Government in the management of spent fuel before disposal.
- Private-sector involvement in the development and operation of an MRS facility.
- Use of the Nuclear Waste Fund for storage.
- Use of peer reviews.

- Alternative means of managing the waste-management program.

TECHNICAL ISSUES

DEVELOPMENT OF DUAL-PURPOSE CASKS FOR TRANSPORTATION AND FOR STORAGE

A dual-purpose cask is a vessel that can be used for both transporting and storing spent fuel. It is much like the metal casks currently used for dry storage. Its use for the dual purpose of transporting and storing has not been certified by the NRC, and some certification issues remain to be resolved. However, Virginia Power, the Electric Power Research Institute, and a cask vendor (NAC) are currently involved in obtaining an NRC certification for a dual-purpose cask.

We are considering the use of dual-purpose casks for the first phase of an MRS facility. These casks would allow earlier waste acceptance because they could be shipped to an MRS site and stored in a simple storage yard. Since the fuel shipped in them does not need to be unloaded or handled in any way, they would permit waste acceptance before the waste-handling building of an MRS facility is completed. However, these casks are not at present included in our program to develop casks for transportation from reactor sites. Our decision on the use of dual-purpose casks will be based on their safety, cost effectiveness, usefulness in the waste-management system, feasibility for the intended use, the use of these casks by utilities, and regulatory issues. We expect to make our decision in 1991.

Suggested options for initiating a discussion

Option 1. We could abstain from including any dual-purpose casks in our shipping-cask fleet.

Option 2. We could include a limited number of dual-purpose casks in our cask-development program for the initial phase of MRS operations.

Considerations in selecting options for implementation

Option 1 represents our current cask-development program: it does not include dual-purpose casks.

Option 2 could be used to provide early acceptance for a limited amount of spent fuel at an MRS facility. It raises several issues that we are evaluating. We will first consider the overall system costs and benefits. We will also examine the issues associated with safety and NRC certification in particular. If these issues cannot be resolved quickly enough to permit us to acquire a sufficient number of the casks by

1998, then there will be no advantage in developing these casks. If these issues are satisfactorily resolved, we will determine if cooperative projects with industry should be funded to further develop and utilize dual-purpose casks.

CONTINGENCY PLANNING FOR THE EVENT THAT THE YUCCA MOUNTAIN CANDIDATE SITE IS FOUND TO BE UNSUITABLE FOR A REPOSITORY

As discussed in Chapter 4 (see page 4-2), we are evaluating whether the Yucca Mountain candidate site in Nevada is suitable for a repository. To complete this evaluation we plan an extensive program of testing both from the surface of the site and underground, at the depth proposed for a repository. Issues related to the determination of suitability have been discussed earlier in this chapter.

We were directed to evaluate the Yucca Mountain candidate site by the NWPA as amended. This law also specifies that if the Yucca Mountain site is found to be unsuitable, then we must notify the Governor and the legislature of the State of Nevada and recommend to the Congress, within 6 months, actions that should be taken to ensure safe disposal. We are inhibited from making site-specific recommendations by the NWPA, which prohibits us from continuing any investigations at, or any studies of, other sites that had been included in the repository program. Thus, we would not be able to recommend specific alternatives to the Yucca Mountain candidate site, but we have identified a number of actions we can take.

Suggested options for initiating a discussion

Option 1. We could abstain at present from specific actions to prepare for the possibility that the Yucca Mountain site might prove to be unsuitable, other than responding to requests from the Nuclear Waste Negotiator.

Option 2. We could increase our participation in international scientific investigations of disposal to be better prepared for considering host rocks other than the volcanic tuff present at Yucca Mountain.

Option 3. We could change our approach to the development of the waste package: instead of developing a design specific to the Yucca Mountain candidate site, we could develop waste-package designs suitable for a variety of potential host rocks.

Option 4. We could identify, on the basis of available information from our earlier activities and data from international programs, host rocks and areas that might provide potentially suitable sites for a repository.

Considerations in selecting options for implementation

In option 1, we would do nothing in the way of contingency planning at present. If the Yucca Mountain candidate site is found to be suitable, this option would represent the best use of resources. Should the site prove to be unsuitable, we would support a process by the Nuclear Waste Negotiator to locate a volunteer host with a technically suitable site. We would be prepared to provide any support the Negotiator may request. For example, we would be ready to provide to the public information on the design, operation, and long-term safety of a repository. We would conduct socioeconomic analyses to answer concerns that may be raised during negotiations with potential hosts. And we would prepare, at the request of the Negotiator, an environmental assessment of any site that is the subject of negotiations.

Options 2, 3, and 4 are not mutually exclusive. They represent opportunities to improve our position if the Yucca Mountain candidate site is found unsuitable and the Congress directs us to investigate other sites. Option 3 might give us a significant advantage in terms of readiness for repository development at other sites. It is, however, costly; furthermore, there is a possibility that a generic approach would result in a waste package with inferior performance in comparison with a site-specific design.

PHASED LICENSING FOR THE REPOSITORY

As specified in the NRC regulations in 10 CFR 60, the licensing of a repository will include authorization to construct a repository; a license to receive and possess radioactive waste at the site, to be issued after the repository is constructed; and an amendment of the license permitting the repository to be decommissioned and permanently closed. One reason for phasing the licensing in this manner is to allow the NRC to evaluate additional information about the expected safety performance of the repository.

Since a repository is a first-of-its-kind facility, its licensing, especially the first phase, is expected to be the most difficult challenge of the repository program, and the information included in our license application may be deemed insufficient for a favorable finding. To increase the probability that we will be able to provide the information required for licensing we are evaluating a number of options, including several that are based on licensing the repository in phases.

Suggested options for initiating a discussion

Option 1. If the site is determined to be suitable, we could seek to obtain a construction authorization for a full-scale repository, as assumed in our current plans.

Option 2. Instead of attempting to obtain a construction authorization for a full-scale permanent repository, we could attempt to first license pilot-scale facilities at a repository site. These pilot-scale facilities would be used to obtain information needed

to complete and refine the design of a repository and a waste package, and to conduct tests in order to collect more data for the next licensing phase. They would be eventually scaled up to a repository subject to additional licensing.

Option 3. We could petition the NRC to divide the licensing process into two distinct phases. In the first phase we would seek to receive a construction authorization, under 10 CFR 60, for a temporary storage facility in the underground repository. This facility would not be licensed as a repository. In the second phase, which would occur years later, we would seek a license for a repository.

Option 4. We would seek to license a repository, but we would use the approach of incremental licensing for individual blocks of underground waste-emplacement areas, using waste-acceptance procedures and criteria agreed upon by the NRC.

Considerations in selecting an option for implementation

Except for option 1, none of these options precludes the use of demonstration facilities or of improved engineered barriers, which were discussed in Section 3.1.

Option 1 represents the approach we have been following since the NWPA. The licensing of a repository, a first-of-a-kind undertaking with unprecedented requirements, represents one of the greatest challenges in the program.

Option 2 would involve developing and licensing a repository in steps. It differs from the current approach only as to scale. It is not clear, however, whether the demonstrations possible for a pilot-scale facility will be sufficient to obtain a license. This option allows an extended evaluation of repository performance with actual spent fuel. Unless the performance is satisfactory, the facility would not be converted to a repository.

Option 3 would require an amendment to 10 CFR 60. The first phase of licensing, for the storage facility, would not involve any demonstrations of long-term performance; it would be concerned only with operational safety in the receipt, handling, and emplacement of waste. Eventually, after the waste has been emplaced and monitoring has indicated that the performance of the repository and the waste package is as expected, we would seek a license for the repository. This license would be concerned only with the long-term performance of a closed repository since all active repository operations would have been conducted in the first phase.

Option 4 represents a novel approach to the licensing of a repository, but not to its development. We currently plan to develop a repository in blocks, with waste emplacement beginning in one block while another block is being excavated. Licensing waste emplacement in blocks would have some of the advantages of a demonstration

project, with the NRC evaluating the performance of a filled block before allowing waste emplacement to begin in another block. This approach resembles the pilot-plant approach of option 2. It might help increase public confidence in the safety of a repository because of the cycle of limited waste emplacement and regulatory evaluation.

Options 2 and 3, and possibly option 4, would require legislative amendments.

MANAGEMENT ISSUES

ROLES OF UTILITIES AND THE FEDERAL GOVERNMENT IN THE MANAGEMENT OF SPENT FUEL BEFORE DISPOSAL

This issue concerns the appropriate and effective distribution of responsibilities between the Federal Government and the utilities in the management of nuclear fuel before disposal in a repository.

Suggested options for initiating a discussion

Option 1. Utilities are responsible for the storage of spent fuel until the fuel is transferred to the Federal Government. Transfer occurs when the spent fuel is loaded into government-owned transport casks and leaves the reactor site for a Federal waste-management facility.

Option 2. Utilities store spent fuel and also prepare it for further storage or disposal in a Federal waste-management facility in order to facilitate the operation of Federal facilities. Two variations are available for implementing this option: (1) the utilities retain title to the spent fuel and perform the waste preparation under contract to us or (2) they transfer title to us before preparing the fuel.

Option 3. Utilities are responsible for providing for spent-fuel storage until we pick up the fuel. However, for storage after 1998 we would pay with monies from (1) the Nuclear Waste Fund or (2) general revenues.

Option 4. After a specified date, we assume responsibility for, and take title to, spent fuel at the reactor sites. Until transferred to a Federal facility, the fuel would remain in storage at the reactor site in (1) a utility storage facility or (2) a storage area controlled by us.

Option 5. Utilities are directed to collect and store spent fuel at a small number of commercial-reactor sites as (1) part of Federal waste management, with costs paid from the Nuclear Waste Fund, or (2) at their own expense.

Considerations in selecting options for implementation

The most important consideration in the choice of these options will be ability to start shipping waste to a central storage facility, such as an MRS facility, in 1998. If spent-fuel transfer to a central facility cannot begin as currently planned, it will be necessary to develop substantial additional capacity for storage at all or some reactor sites. Furthermore, options 3, 4, and 5 would be considered only if timely transfer is not feasible.

Option 1 is consistent with current planning for the Federal waste-management system and the existing institutional, contractual, and legal structure. However, if the schedule linkages between an MRS facility and a repository are not changed and we therefore cannot start accepting spent fuel in 1998, this option could lead to a substantial requirement for additional at-reactor storage and a potential proliferation of alternative storage technologies, which could complicate the transfer of spent fuel to the Federal system.

Option 2 is like option 1 except for the waste-preparation operations. The preparation could consist of consolidating spent-fuel rods into tighter arrays, loading spent fuel into canisters, or even encapsulation into disposal containers suitable for emplacement in a repository. If properly coordinated, the decision to prepare waste at reactor sites could lead to standardization, such as the use of uniform canisters. This would simplify spent-fuel transfer to the Federal system and preclude the proliferation of different storage and waste-packaging technologies. However, such operations do raise concerns about liability and the potential for disrupting the operations of the reactor plant. Furthermore, requirements for disposal packaging will remain unclear until the design of waste packages for permanent disposal has been completed and licensing issues have been resolved.

Options 3 and 4 would require changes in the contract and legislation. Option 3 may raise concerns that our controlling or managing storage at reactor sites would interfere with the operations of the reactor plants.

Option 5 would require legislation or an initiative by the utilities. If it is considered, liability for activities that may disrupt the operations of the host reactor site would be of concern.

PRIVATE-SECTOR INVOLVEMENT IN THE DEVELOPMENT AND OPERATION OF AN MRS FACILITY

Discussions and descriptions of an MRS facility have been based on the assumption that, like other DOE facilities, an MRS facility would be owned by the Federal Government and operated by a contractor. However, the private sector could be

responsible for the development and operation of the facility.

The issue here is the privatization of the MRS facility, and four options have been identified. A closely related and important issue is funding for the commercial facility, which is presented later (see page 4-7). If the Nuclear Waste Fund cannot be used for its development, the facility will not be supported by the utilities.

Suggested options for initiating a discussion

Option 1. The MRS facility should continue to be a federally owned facility operated by a contractor.

Option 2. A storage facility could be sited, constructed, and operated by private industry. The utilities would contract directly with the owner of the facility for spent-fuel storage.

Two variations are possible for option 2:

1. The facility could be developed by private industry, as in option 1, but, we, instead of the utilities, would purchase storage space and services. The utilities would deal with us.

2. We would lease storage space from the private developers of an MRS facility and hire a contractor to operate the facility for us.

Considerations in selecting options for implementation

Option 1 represents current plans for the development of an MRS facility. Option 2, a facility developed by private industry, would have similar benefits as option 1 for waste management. For example, if fully used, privately developed facilities could reduce the potential for the proliferation of different storage technologies at reactor sites. The use of various storage technologies could complicate for the receipt and handling of spent fuel at a repository. A fully used commercial storage facility would lead to standardization of design.

The siting of a commercial facility may be easier because the private sector may have more latitude in negotiating with a potential host and is not subject to the negative perceptions associated by many with the Federal Government. Nonetheless, we recognize that the siting of a commercial facility for radioactive waste storage may be as controversial as that of Federal facilities.

With a commercial storage facility, waste acceptance and transportation will be the responsibility of the facility operator or the utility. This may entail additional costs for

the utilities, and transportation by private contractors or the utilities may elicit more opposition than transportation by the Federal Government. And it is not clear that the Congress would authorize funding from the Nuclear Waste Fund, especially if the commercial facility would service only a limited number of utilities. In any case, the use of funds from the Nuclear Waste Fund will require new authorities and will raise questions of equity.

Privatization would not contribute to the development and operation of the Federal waste-management system. As explained in Chapter 4, the currently envisioned Federal MRS facility would be fully integrated into the waste-management system, and its development is expected to bring considerable benefits to the whole system as well as to demonstrate that the Federal Government can successfully address the waste problem. These benefits would not be provided by privately developed storage facilities.

USE OF THE NUCLEAR WASTE FUND FOR STORAGE

If an MRS facility is developed as an integral part of the waste-management system and the acceptance priorities for spent fuel are based on the current contract with the utilities, then there seems to be no question that the Nuclear Waste Fund should be used to pay for its development and operation. However, as discussed in the preceding sections, a number of other options for providing storage could be used, and the means for paying for their costs should be determined.

Suggested options for initiating a discussion

Option 1. An MRS facility is developed as an integral part of the Federal system. All of the costs of this option are paid from the Nuclear Waste Fund.

Option 2. An MRS facility is developed as an integral part of the Federal system. The costs of MRS development are paid for from the Fund, but the utilities using it for storage pay for the incremental operating costs of storage from the start of waste acceptance, assumed to be in 1998, to the start of operations at a repository.

Option 3. An MRS facility is developed to provide storage for utilities needing additional capacity. The full costs of development and operation are borne by the users.

Option 4. The Fund is used to develop and operate commercial storage facilities or facilities provided at selected reactor sites.

Considerations in selecting options for implementation

Option 1 represents our current plan. Option 2 differs from option 1 in that the

incremental costs of storage are paid for by the utilities using the facility. Because of the systemwide benefits of the MRS facility, its development is paid for from the Nuclear Waste Fund.

Option 3 is essentially the user-funded MRS facility recommended by the MRS Review Commission in its report to the Congress.** Under this option, an MRS facility would be developed solely for the purpose of providing additional storage for utilities that need additional storage capacity after 1998, prefer not to develop it at their reactor sites, and are willing to pay for it. Such a facility would not be a part of the Federal waste-management system, and it is unlikely that a sufficient number of utilities would commit themselves to funding such a facility. If they did, the Department might consider buying it from them for use as part of the Federal system after the repository starts operating.

Option 4 would require changes in the Nuclear Waste Policy Act as amended. It may also elicit opposition on grounds of equity and cost effectiveness.

USE OF PEER REVIEWS

A peer review is a documented critical review performed by persons who have technical expertise in the subject matter of concern but are not directly involved in the analysis, study, or plan under review. Peer reviews are management tools for interpreting and verifying or validating assumptions, plans, results, or conclusions critical to the success of a program. Although the following discussion is directed at the Yucca Mountain project, peer reviews will be used as appropriate in other parts of our program.

Since our program has traditionally relied on peer reviews, the issue here is not instituting peer reviews as a new practice. Rather, it is a question of establishing guidelines for the use of peer reviews.

Suggested options for initiating a discussion

Option 1. Conduct special peer reviews as necessary on high-visibility issues of critical importance to ensure that the best available resources are mobilized for key decisionmaking.

Option 2. Institute regular peer reviews in the routine conduct of the program such as the certification of data, comment on research conclusions, etc.

**Report of the MRS Review Commission, November 1989.

Considerations in selecting options for implementation

Peer reviews yield multiple benefits. The expert appraisal of plans, methods, analyses, and results bolsters technical confidence, and the use of recognized independent authorities strengthens our credibility. Peer reviews may also generate fresh ideas and approaches to problems. However, peer reviews are generally limited in scope and duration, and they may not be sensitive to regulatory, institutional, and management concerns. In responding to their results, we must consider these other factors and communicate their role in the response.

The benefits and costs of a peer review should be compared before the review is initiated. Furthermore, the use of peer reviews should be viewed in the context of other review mechanisms that are present. For example, plans, procedures, and reports receive extensive internal technical reviews by the national laboratories and participating contractors, by our project offices, and by other DOE organizations. These reviews may carry a document through several cycles of qualified technical review. In addition, reviews are performed by the NRC staff, the NWTRB, and affected parties (e.g., the State of Nevada).

Beyond the completion of the review, we must make a commitment to respond to the recommendations of the review and incorporate those deemed appropriate into our plans and operations.

ALTERNATIVE MEANS OF MANAGING THE WASTE-MANAGEMENT PROGRAM

Several alternative approaches to managing the program were identified and evaluated in response to the requirements of the Nuclear Waste Policy Act by an advisory panel that submitted its report to the Secretary of Energy in December 1984.*** The panel's report was reviewed by a senior DOE group.

The panel identified several options for managing the program, but its preferred option would have required amending the NWPA. Because spokespersons for both the States and the utilities had advised strongly against attempting any amendments to the Act at that time, the DOE review group concluded that no major organizational changes should be initiated until several significant program milestones had been completed. Furthermore, the DOE review group concluded that most of the problems faced by the program were inherent in the nature of radioactive-waste management and the NWPA and could not be solved by changing the nature of the organization or

---

***Report of the Advisory Panel on Alternative Means of Financing and Managing Radioactive Waste Facilities, December 1984.

management.

Suggested options for initiating a discussion

The following options for managing the program were identified in 1984 by the advisory panel:

Option 1. The present management structure is retained.

Option 2. An independent Federal agency or commission is established to manage the program.

Option 3. A mixed public-private corporation is established.

Option 4. A private corporation is established.

Considerations in selecting options for implementation

The panel concluded that several organizational forms would be more suited than the DOE for managing the construction and operational phases of the program. The option preferred by the panel was the creation of an independent Federal corporation. The panel also concluded that no modification of the DOE/OCRWM organization would provide adequate stability and continuity.

The issues identified by the panel have since been repeated by other parties. Most often cited are the DOE's credibility problems, lack of internal flexibility, and lack of cost-effective management. It was partly in response to such comments that the Secretary undertook a comprehensive reassessment of the program in 1989 and implemented a number of initiatives directed at enhancing the management of the program. They included direct-line reporting from the Yucca Mountain project office to the OCRWM Director, the appointment of a permanent OCRWM Director, consolidation of contracts, and an independent review of the management structure and procedures. Additional initiatives for improving management systems, including a reorganization of the OCRWM, have since been implemented by the OCRWM Director. Further improvements, expected in the near future, include signing a contract with a management-and-operating contractor.

4. BACKGROUND INFORMATION

This chapter presents background information on the waste-management system and the program for its development. It discusses waste types and quantities; our plans for a geologic repository, an MRS facility, and a transportation system; protection of public health and the environment; potential socioeconomic effects and benefits; the involvement of affected and interested parties; and management.

WASTE TYPES AND QUANTITIES

Most of the waste accepted by the Federal waste-management system will be spent fuel from the commercial generation of electricity by nuclear reactors. The spent fuel from the nation's 112 reactors, which produce about 20 percent of our electric power, is accumulating at a rate of about 2000 metric tons of heavy metal per year. (One metric ton is equal to 1.1 English tons, or 2200 pounds.) The quantity of spent fuel discharged through 1989 is about 19,500 metric tons. Using realistic estimates, this total is projected to grow to 40,000 metric tons by 2000, 58,000 metric tons by 2010, and 84,000 metric tons by 2036, when the last of the licenses for the current generation of U.S. reactors is scheduled to expire.

Most of the remainder of the waste planned for Federal acceptance and disposal is high-level waste, which results from the reprocessing of spent fuel for national defense purposes. A small amount of high-level waste was generated at a commercial fuel processing facility, but practically all high-level waste will come from defense sources. For planning purposes we estimate that, by the year 2030, defense activities will generate the equivalent of about 9000 metric tons of high-level waste requiring deep geologic disposal. In 1985, President Reagan determined that defense high-level waste should be disposed of in a repository along with civilian waste.

THE NUCLEAR WASTE POLICY ACT

The Nuclear Waste Policy Act authorized the construction of one geologic repository and specified in detail the process for siting that repository, including the scientific evaluation (characterization) of three potential sites. In addition, it specified the process for siting a second repository, authorized the development of a waste transportation system, and required us to submit a proposal to construct one or more MRS facilities; this proposal was to include a Federal program for the siting, development, construction, and operation of MRS facilities. The Act also included provisions for the participation of States and affected units of local government and Indian Tribes in the waste-management program. Finally, the Act established the Nuclear Waste Fund to ensure that the full costs of waste-management and disposal are recovered from the owners and the generators of the waste.

The Nuclear Waste Policy Act Amendments Act of 1987 (the Amendments Act) streamlined the program. It specified that only one site, rather than three, was to be evaluated (the Yucca Mountain site in Nevada) and only one repository was to be developed at present, and it authorized the siting, construction, and operation of an MRS facility subject to certain conditions. In addition, it established the Office of the Nuclear Waste Negotiator, whose primary role is to attempt to find a State or Indian Tribe willing to host a repository or an MRS facility at a technically qualified site on reasonable terms, and the Nuclear Waste Technical Review Board, appointed by the President to evaluate the technical and scientific validity of our activities.

A GEOLOGIC REPOSITORY

A repository is a system for permanently isolating radioactive wastes deep beneath the surface of the earth, in a suitable rock formation. To perform its functions before closure, a repository will consist of surface and underground facilities connected by shafts and ramps.

The surface facilities would be used to receive the waste, prepare it for disposal, and emplace it underground. They would be equipped with fail-safe devices designed to protect the health and safety of the repository workers and the general public. The waste emplaced underground must be retrievable for a period of up to fifty years, until the NRC determines that the repository is indeed performing as expected. We would then decommission the surface facilities and apply to the NRC for an amendment to the license to permanently close the underground repository.

An underground repository would be developed much like a large mine consisting of underground passageways and rooms. It would consist of horizontal passageways, or drifts, that would be excavated parallel to one another and would serve a number of waste-emplacement areas, or panels. Spaced within each emplacement panel would be a number of access drifts. Holes would be drilled into the floors or walls of the emplacement panels, and the waste containers would be emplaced in them. (Both vertical and horizontal emplacement is being considered.)

Waste-emplacement would begin before all of the underground repository has been excavated: it would begin in one panel as soon as two of the waste-emplacement panels had been completely developed. This approach would allow underground development and waste-emplacement to proceed essentially in parallel, with the development of the underground repository continuing for many years. To isolate the underground construction workers from waste handling activities, sufficient separation between development and emplacement operations would be provided.

To provide the required isolation, a repository would have multiple barriers, both natural and engineered, against the migration of the radioactive material in the wastes.

The natural barriers would be the host rock in which a repository is constructed and the surrounding rock formations. The engineered barriers would be a repository (i.e., various underground structures and components, such as the rock with which the tunnels and underground disposal rooms would be filled up before a repository is closed) and the waste packages.

The waste package would consist of the waste, the disposal container in which the waste is encapsulated, and any other materials or features designed to separate the waste from the host rock. It will be designed to meet various functional and regulatory requirements, including maintaining the option to retrieve the emplaced waste.

The reliance that is placed on the waste package in waste containment and isolation is one of the issues of strategic importance proposed in Chapter 3. A related issue is the allocation of performance to natural and engineered barriers in demonstrating the performance of the total repository system.

The process for repository development

As mandated by law, the process for the development and operation of a repository is a sequence of activities that begins with site screening and selection for further study and the development of preliminary designs for a repository and a waste package as a basis for evaluating the potential safety performance of a repository. For the Yucca Mountain candidate site, these steps have been completed.

The next major activity is site characterization—a comprehensive program of scientific evaluation that will examine the geologic and other pertinent characteristics of the site and conduct analyses to determine whether the site is suitable. The determination of site suitability is one of the issues for which we are proposing to develop strategic principles.

If the results of site evaluation show that the site is suitable, the Secretary of Energy would recommend to the President that the site be selected for a repository. As part of the basis for that recommendation, an environmental impact statement would be prepared and submitted to the President. If the President agrees, he will recommend the site to the Congress, at which time the State of Nevada may submit a notice of disapproval, which can be overridden only by a majority vote in both houses of the Congress. If no notice of disapproval is submitted or if the notice is overridden, the process of site selection would be completed. If the site is selected for a repository, then a license application would be prepared and submitted to the Nuclear Regulatory Commission, including the environmental impact statement proposed to support the recommendation of the site, designs for the repository and the waste package, and the results of safety assessments. If the Commission approves the application, it will grant a construction authorization, and the Department will start constructing the

repository. When the surface facilities have been constructed and the underground excavations are sufficient for waste-emplacement to begin, an updated application to receive and possess radioactive waste at the site would be submitted to the NRC. If this application is approved, the repository can begin to receive waste.

If, however, site evaluation shows that the site is not suitable, then the Department must stop all work at the site, notify the Governor and the legislature of Nevada, and recommend to the Congress the actions that should be taken to provide permanent disposal for the waste. One of the issues for which we are seeking to develop a strategic principle is the course of action to be followed in such an event.

Evaluation of the Yucca Mountain site

The Yucca Mountain candidate site is in southern Nevada, in Nye County, approximately 100 miles by road northwest of Las Vegas. It is in a region with very little rainfall, sparse vegetation, and a low population density. At Yucca Mountain the host rock for the proposed repository is the volcanic rock called tuff. This rock formed from volcanic eruptions occurring between 8 and 16 million years ago. Information about the geologic history and conditions in the region surrounding Yucca Mountain has been collected since the early 1900s. Since late 1977 geologic and hydrologic information about the region and the site has been collected specifically for the repository program.

However, we need to collect much more information before we can determine whether the site is suitable. This information will be collected during the site-evaluation program, which is expected to last several years. To ensure that all the required information will be collected and available when needed for design or performance assessment, we prepared and issued in 1988 a site characterization plan. The activities planned for site evaluation consist of surface-based studies, underground tests and studies to be conducted in an exploratory facility at the depth of a proposed repository, laboratory studies, and mathematical modeling of the geologic system.

The Department will focus first on features of the site that can be investigated through surface-based testing, which includes drilling from the surface. The objective is to obtain early information about conditions that have the potential to so adversely affect performance that the site may not be able to meet the regulatory requirements and would therefore be unsuitable for a repository.

To evaluate underground conditions, we will construct an underground exploratory facility at Yucca Mountain. This facility will allow us to characterize the host rock at the depth proposed for waste-emplacement.

Approach to developing confidence in achieving timely disposal

The licensing of a repository will be a first-of-a-kind undertaking with the unprecedented challenge of demonstrating safe waste isolation for 10,000 years. To be successful, it will require well-documented evidence from many sources.

Many issues remain to be resolved concerning the demonstration of compliance with EPA and NRC regulations. We believe that licensing will be facilitated if we, as the agency responsible for implementing disposal, take the initiative in stimulating the resolution of these uncertainties and in developing the approach for demonstrating compliance. We recognize, however, that success in the implementation of this strategy will depend on close interactions with the NRC staff to identify and resolve issues. We are conducting a study of alternative licensing strategies in order to identify, evaluate, and compare potential alternatives to the current licensing strategy described in the site characterization plan. The major objective of this study is to ultimately recommend a licensing strategy that results in the most efficient, scientifically-based development of a repository.

We have proposed for the development of strategic principles several issues that are directly or indirectly related to the licensing of a repository. They include long-term cooling of the waste before disposal, the use of demonstration facilities, and phased repository licensing and waste-emplacement.

AN MRS FACILITY

An MRS facility is needed to meet the objective of timely and adequate waste acceptance. It will receive and inspect spent fuel shipped from reactor sites and store the fuel temporarily at or near the surface, in specially designed casks or vaults. When a repository starts operating, the MRS facility will continue receiving spent fuel and will ship it to such repository. From the MRS facility the spent fuel would be shipped in large-capacity casks and by dedicated trains; the net effect would be to reduce the total shipment miles and the number of shipments received at the repository. The MRS facility will be an "integral" facility--that is, a part of a waste-management system in which all elements are optimized as part of a single system focused on achieving the strategic objectives of the program.

Authorization

The Amendments Act authorized us to site, construct, and operate an MRS facility, subject to certain constraints, including the following licensing conditions:

- Construction may not begin until the NRC has authorized the construction of the repository.

- Construction or waste acceptance at an MRS facility is prohibited if the repository license is revoked or the construction of the repository ceases.

- The quantity of waste present at the MRS site at any one time may not exceed 10,000 metric tons of heavy metal until the repository starts accepting waste and 15,000 metric tons thereafter.

The Amendments Act established an MRS Review Commission to provide an independent assessment of the need for an MRS facility. As stated in its report dated November 1989, the Commission found that "cumulatively the advantages of an MRS would justify the building of an MRS if: (1) there were no linkages between the MRS and the repository; (2) the MRS could be constructed at an early date; and (3) the opening of the repository were delayed considerably beyond its presently scheduled date of operation" (i.e., considerably beyond 2003, the year scheduled for the start of repository operations at the time the MRS Review Commission held its deliberations).

The Commission recommended that the Congress authorize the construction of a Federal emergency storage facility with a capacity limit of 2000 metric tons, authorize the construction of a user-funded interim storage facility with a capacity limit of 5000 metric tons, and consider the need for additional interim storage in the year 2000.

Secretary's decision

The report of the MRS Review Commission was written while the Secretary was conducting a reassessment of the program, which showed that the start of waste acceptance at the repository would be delayed by 7 years, from the year 2003 to 2010. To allow timely and predictable acceptance of spent fuel, the Secretary announced an initiative to develop an integral MRS facility, with the objective of beginning the acceptance of spent fuel in 1998.

Siting the MRS facility

Technically suitable sites for the MRS facility can probably be found throughout the continental United States. The Amendments Act authorizes a dual approach to siting and specifies that these are two independent approaches. One approach is for the Secretary of Energy to conduct a survey and evaluation of potential MRS sites. The other approach, which we prefer, is to site through negotiation with a State, Indian Tribe, or community that can offer a technically suitable site on reasonable terms. The Amendments Act created the Office of the Nuclear Waste Negotiator for this purpose.

MRS development

The MRS facility envisioned in our current plans could start accepting waste by 1998 if the statutory schedule linkages between the repository and the MRS facility are changed. The statutory linkages could be changed if the volunteer host for the facility is willing to negotiate a change and incorporate it into the proposed agreement that would be signed between the United States and the proposed host. The agreement then would be submitted to the Congress for enactment into law.

As in other aspects of MRS development, we will solicit through the Nuclear Waste Negotiator the views of the potential host and will consider them in selecting the design of the MRS facility and the storage technology. Among the available options are metal storage casks, concrete casks, horizontal modular units, and modular vaults. Each of these technologies has been or is being reviewed by the Nuclear Regulatory Commission for use at reactor sites.

Another technology that could be considered is the dual-purpose cask, which can be used for both storage and transportation. The use of such casks is one of the strategic issues proposed for consideration in Chapter 3.

Licensing strategy

We plan to submit a single license application for the MRS facility, and a single formal adjudicatory hearing is expected to cover the full scope of the MRS facility design. Before submitting the formal license application, we will submit design packages to the NRC staff for review. If particular topics can be addressed separately from, and earlier than, the formal application, we will also submit topical reports for review by the NRC staff.

To facilitate licensing, we intend to analyze, define, and help clarify regulatory requirements. We also intend to identify and resolve regulatory, technical, and institutional uncertainties that will simplify licensing. And before formally submitting the license application, we will submit to the NRC relevant information to facilitate the review of the license application.

We will continue to examine strategies to expedite the licensing of an MRS facility.

Funding and charges for the MRS facility

An MRS facility will add to the cost of the Federal waste-management system, but these costs will be partially offset to some extent. Some utilities and others have stated that the allocation of MRS costs to all utilities would not be equitable because the

MRS facility will not be able to accommodate spent fuel from all utilities. Several options for funding could therefore be considered, and this issue is one of those proposed in Chapter 3 for the development of a strategic principle.

Private-sector involvement

In concert with the Negotiator, we plan to examine opportunities for private-sector involvement in the development of the MRS facility and are proposing several options for consideration in Chapter 3. We will also examine possible opportunities for third-party provisions of MRS services that can be leased or purchased to meet the needs of the Federal waste-management system.

TRANSPORTATION

The transportation of radioactive materials, including spent fuel, over the Nation's highways and railroads has an excellent record of safety, and yet it causes widespread concern in the public. Recognizing these concerns, we are conducting a transportation program aimed at protecting public safety and gaining public confidence.

In order to provide safe transportation, we are developing a fleet of special shipping casks. Support systems and facilities will also be provided. And before any waste is transported, we, together with affected and interested parties, will need to resolve a number of institutional issues.

Transportation casks and modes

Transportation casks are rugged containers for shipping spent fuel and high-level radioactive waste. They are designed to protect the public, the transportation workers, and the environment by providing shielding from radiation and containing their contents under both normal and accident conditions. The designs of these casks will have to be certified by the Nuclear Regulatory Commission, which will require evidence that they comply with standards promulgated for the protection of public health and safety. In order to be certified, the casks will have to pass a series of tests representative of the forces imposed on casks for normal transportation conditions and during accidents.

Several modes can be used for shipping the waste, including dedicated trains or regular train service, intermodal shipments (e.g., truck to rail, barge to rail), shipments in legal-weight and overweight trucks, and shipments in heavyweight rail casks. The mode to be used will depend on the weight of the cask and the facilities and equipment available at individual reactor sites (e.g., railspurs and heavy-duty cranes).

Plan for development

The transportation system will be able to start shipping to an MRS facility as early as 1998. This capability can be developed to serve a variety of scenarios for the acceptance of spent fuel.

To service the first phase of an MRS facility, we are considering the use of transportable storage systems, such as dual-purpose casks. These systems would be designed to minimize the handling of spent fuel during the transfer from storage at reactor sites to the MRS facility.

Since a fleet of transportation casks will be needed over the operating life of an MRS facility and a repository, we are undertaking a major effort in cask development. Four distinct types of casks are under consideration:

- Casks suitable for shipping spent fuel from reactor sites either to an MRS facility or a repository, e.g., legal weight truck, rail/barge, and dual-purpose casks.
- Casks for shipping from an MRS facility to a repository.
- Casks for shipping nonstandard fuel and non-fuel-bearing waste.
- Casks for shipping high-level waste.

To be ready for transportation, we are concentrating on the development of the casks for shipping from reactor sites to a repository or an MRS facility. At present, both a legal-weight truck cask and a rail-and-barge cask are being developed, and a limited number of these casks will be available in 1998. The need for other types of casks will be determined between 1991 and 1993.

The design of the facilities needed to support transportation operations will be coordinated with the development of the cask system. A cask-maintenance facility will be used for the inspection of casks and their seals, routine maintenance, and decontamination. Such a facility could be built at the site of an MRS facility, the site of a repository, or a third location.

The development of other transportation support facilities will proceed as functional requirements are made specific.

Resolution of issues

A guiding principle in the development of the transportation system is the need for the early resolution of technical and institutional issues. The resolution of these issues

requires communication and interaction with a large number of diverse affected and interested parties. An issue of strategic importance is training for emergency response; it is presented in Chapter 3.

PROTECTION OF THE PUBLIC HEALTH AND SAFETY AND THE ENVIRONMENT

The protection of public health and safety and the quality of the environment is a fundamental policy of the waste-management program. All waste-management activities—including the siting, construction, and operation of the facilities needed for waste-management and disposal—will be conducted in a manner that provides this protection.

In addition to requirements to comply with regulations governing the repository, the MRS facility, and the transportation system, the Secretary of Energy has established policies that demonstrate the DOE's commitment to environmental protection. These include his 10-point initiative, announced on June 27, 1989, to ensure that all DOE activities are carried out in full compliance with environmental statutes and regulations and his notice (SEN-15-90) of February 5, 1990, on compliance with the National Environmental Policy Act of 1969. To fulfill our commitment to environmental protection, we will meet or exceed all applicable environmental laws and regulations.

Each element of the system—a repository, an MRS facility, and transportation operations—will comply with the pertinent specific regulations governing the protection of public health and safety.

In the case of a repository, requirements for the protection of public health and safety are specified in regulations developed by the NRC in 10 CFR Part 60. The NRC regulations also implement and enforce the environmental standards issued by the Environmental Protection Agency (EPA) as 40 CFR Part 191.* The objective of the regulations is to provide reasonable assurance that the repository will isolate the waste for at least 10,000 years without posing undue risk to public health and safety.

The MRS facility must meet the requirements of 10 CFR Part 72, "Licensing Requirements for Independent Spent Fuel Storage Facilities." This regulation has been recently revised by the Nuclear Regulatory Commission to accommodate an MRS facility. Included in the requirements of 10 CFR Part 72 are the environmental standards promulgated by the Environmental Protection Agency in Subpart A of 40

*Subpart B of 40 CFR Part 191 has been vacated and remanded to the Environmental Protection Agency, which is preparing to issue a revised regulation for comment.

CFR Part 191 for the management of spent fuel and high-level wastes.

Regulations for the safety of radioactive waste transportation have been issued by the Department of Transportation (49 CFR Parts 171-179) and the Nuclear Regulatory Commission (10 CFR Parts 71 and 73).

POTENTIAL SOCIOECONOMIC EFFECTS AND BENEFITS

Both adverse and favorable socioeconomic effects may be associated with waste-management. They would generally result from the employment that is created, the resulting direct and indirect population growth, and local expenditures for materials, equipment, and services. Adverse effects result when the demands on government and community facilities and services (e.g., schools, wastewater treatment, medical care) exceed local resources; when the inflow of people increases demands on scarce resources like water, land, and housing; and from the disturbance of local lifestyles and social structures. Favorable effects are related to the availability of more jobs, greater county or municipal revenues, development of improved education systems, expanded recreation facilities, and the inflow of money into local businesses.

A framework for addressing potential adverse effects is provided by the Act as amended. The Act as amended specifies a process and requirements for avoiding, minimizing, or mitigating socioeconomic effects to the maximum extent practicable; these requirements go beyond provisions in the National Environmental Policy Act of 1969. It also makes specific provisions for financial assistance to affected parties. In addition, the Act as amended provides for payments-equal-to-taxes. And it provides for other financial benefits under certain conditions.

INVOLVEMENT OF AFFECTED AND INTERESTED PARTIES

The Nuclear Waste Policy Act of 1982 recognized the importance of public participation and involvement in the waste-management program. Meaningful participation by affected and interested parties is indispensable to a program that accommodates diverse interests while earning general public confidence and acceptance.

The original Act included extensive provisions for the involvement of State and local governments and Indian Tribes, and the general public. These provisions require us to provide, through specific mechanisms, information about major program decisions and actions; to provide opportunities for participation through public hearings and public comments; to consult and cooperate with affected parties and seek to develop formal agreements with them; and to avoid or mitigate significant adverse impacts. The Act also required the provision of financial assistance necessary for States and Indian Tribes to exercise their rights to participation and oversight.

The Amendments Act of 1987 further articulates and expands on the original law's commitment to meaningful public involvement by, for the first time, providing for direct funding assistance to affected units of local government; by providing for a benefits agreement and a review panel; by creating the Nuclear Waste Technical Review Board, an independent oversight body; and by establishing the Office of the Nuclear Waste Negotiator, who is empowered to find volunteer States or Indian Tribes willing to host a repository or an MRS facility. A negotiated agreement could further extend opportunities for participation.

The scientific evaluation of the Yucca Mountain site has been reprogrammed to evaluate key suitability issues early, so that early results can guide the scope of later investigations. This initiative responds directly to comments received from several external review groups, including the State of Nevada, the Nuclear Regulatory Commission, and the Edison Electric Institute.

In the case of an MRS facility, we intend to rely on the efforts of the Nuclear Waste Negotiator to identify and reach agreements with a volunteer host; we are actively working to identify, collect, and analyze the types of technical, financial, and institutional information that the Negotiator may need to interact effectively and collaboratively with a prospective host. This information may be important in structuring an agreement that is broadly supported by all potentially affected and interested parties.

To enhance the involvement of affected and interested parties in the development of the transportation system, we actively seek the development of cooperative agreements with various national and regional organizations. These organizations study national and regional transportation issues and formulate recommendations to us.

Before starting to transport any waste, we will meet certain institutional obligations. The most prominent among them is the requirement of the Amendments Act to provide technical assistance and funds to States for the training of public-safety officials in local governments and Indian Tribes through whose jurisdictions the waste may be transported. The method and timing for implementing this assistance will be developed in consultation with affected parties.

Another obligation is the early resolution of transportation issues. This requires communication and interaction with a large number of diverse affected and interested parties, including the many Tribal, State, and local governments through whose jurisdictions the shipments will pass; other Federal agencies; technical associations; the transportation industry; utilities; and the public.

As the waste-management program evolves, so will participation by affected and

interested parties. Representatives from the affected States, Indian Tribes, and local governments may be involved in the designation of alternative routes, the coordination of shipping arrangements, and the clarification of responsibilities for transportation activities.

MANAGEMENT

Organization and structure

The Office of Civilian Radioactive Waste-Management (OCRWM) in the Department of Energy is responsible for developing the waste-management system. To perform the technical work of the program, we have retained the Nation's best scientific and engineering expertise in waste-management and disposal. Under our direction, this expertise is provided by the U.S. Geological Survey, certain of the Department's National Laboratories, and specialized contractors who supply technical support and assistance. In addition, we use outside experts to support or improve program analysis, management, and administration and to support or improve the operation of management systems.

Management initiatives

In his 1989 Report to the Congress on the reassessment of the program, the Secretary announced a number of initiatives to improve the management of the program. First, he announced the imminent nomination of a new OCRWM Director, who was approved by the Senate in April 1990.

Second, the Secretary established direct-line reporting from the Yucca Mountain Project Office to headquarters. Under the previous management structure, multiple lines of authority existed. Direct-line reporting from the Yucca Mountain Project Office to headquarters brings together for the first time program authority and responsibility and facilitates coordination and communication.

Third, the Secretary directed that an independent assessment of the program's management be conducted by a private management-consulting company. This assessment covered the management structure and processes; management systems; contractual arrangements, including the numbers, types, and purposes of contracts; and the authorities, responsibilities, and accountabilities of the major participants in the program.

Since his appointment, the OCRWM Director has identified and taken a number of actions to implement and strengthen the Secretary's initiatives. They are focused on developing a strategy for managing spent fuel; establishing a national consensus on that strategy; developing effective working relationships with parties who have a stake in the

program; ensuring that methods and criteria for demonstrating compliance with regulatory requirements are developed and ready when needed; focusing actions on goals and essential activities; and improving cost effectiveness and accountability. Accomplishments to date include a reorganization of the OCRWM and the development of a management systems improvement strategy. Detailed implementation plans will be given in an amendment to the OCRWM Mission Plan.

Oversight and review

Independent oversight of the technical work is provided by the Nuclear Waste Technical Review Board and the State of Nevada. In addition, we seek peer review from the National Academy of Sciences, groups of independent experts, and other DOE organizations and their consultants. Major program plans and documents are reviewed by the NRC staff and their consultants as well as the NRC's Advisory Committee on Nuclear Waste.

Quality assurance

Quality assurance consists of all the planned and systematic actions necessary to provide adequate confidence that a structure, system, or component will perform satisfactorily in service. An effective quality-assurance program is essential for ensuring the achievement of high-quality performance in the pursuit of our mission and is required for demonstrating compliance with regulatory standards in licensing. We are therefore implementing a quality-assurance program for the entire waste-management system.

Our quality-assurance program is designed not only to satisfy NRC requirements but also to be completely integrated into every technical activity in the waste-management program. In addition, it should help to establish public confidence in the technical quality of the program.