DOE/RW-0311P

A Monitored Retrievable Storage Facility: Technical Background Information

July 1991

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

Available from:

U.S. Department of Energy
Office of Scientific and Technical Information
Post Office Box 62
Oak Ridge, TN 37831

DOE/RW--0311P

TI91 016704

A Monitored Retrievable Storage Facility: Technical Background Information

July 1991

U.S. Department of Energy
Office of Civilian Radioactive Waste Management
Washington, DC 20585

CONTENTS

	Page
Note to the Reader	v
The Purpose of an MRS	1
The Functions of an MRS	7
The Process for Developing the MRS	11
Federal, State, Indian Tribal, and Local Roles in MRS Siting, Development, and Operation	17
The Environmental Effects of an MRS: Radiological	21
The Environmental Effects of an MRS: Nonradiological	25
The Socioeconomic Effects of an MRS	29
The Transportation Program	35
The Transportation Effects of an MRS	41

NOTE TO THE READER

The U.S. Government is seeking a site for a monitored retrievable storage facility (MRS). Employing proven technologies used in this country and abroad, the MRS will be an integral part of the Federal system for safe and permanent disposal of the nation's high-level radioactive wastes. The MRS will accept shipments of spent fuel from commercial nuclear power plants, temporarily store the spent fuel above ground, and stage shipments of it to a geologic repository for permanent disposal.

The law authorizing the MRS provides an opportunity for a State or an Indian Tribe to volunteer to host the MRS. The law establishes the Office of the Nuclear Waste Negotiator, who is to seek a State or an Indian Tribe willing to host an MRS at a technically-qualified site on reasonable terms, and is to negotiate a proposed agreement specifying the terms and conditions under which the MRS would be developed and operated at that site.

This agreement can ensure that the MRS is acceptable to—and benefits—the host community. The proposed agreement must be submitted to Congress and enacted into law to become effective.

This technical background information presents an overview of various aspects of a monitored retrievable storage facility, including the process by which it will be developed. While each section treats a different topic, some sections are closely interrelated, and cross references are provided where appropriate. The sections are as follows:

Section 1:
The Purpose of an MRS

An integral part of the Federal waste-management system, an MRS will temporarily store spent fuel shipped to it from commercial nuclear power plants and will stage shipments of the spent fuel to a geologic repository for permanent disposal. This section explains what spent fuel is, the nature of the Federal waste-management system, and the role the MRS will play in that system.

Section 2:
The Functions of an MRS

This section explains the functions the MRS will perform and describes the technologies that can be used to perform these functions safely and reliably.

Section 3:
The Process for Developing an MRS

This section explains the multiple statutory and regulatory safeguards that further ensure that the MRS will perform safely and reliably, to the satisfaction of the host, the U.S. Nuclear Regulatory Commission (NRC), and the U.S. Department of Energy (DOE).

Section 4: Federal, State, Indian Tribal, and Local Roles in MRS Siting, Development, and Operation

This section summarizes the statutory provisions that define the roles of the parties to the negotiated siting process and the extensive rights of the MRS host.

Section 5: The Environmental Effects of an MRS: Radiological

This section describes the potential radiological effects of an MRS. These effects are projected to be minimal and well within regulatory standards for protection of human health and safety.

Section 6: The Environmental Effects of an MRS: Nonradiological

This section explains how environmental effects will be assessed and what they may be. Potentially adverse effects will be carefully avoided where possible. Those that are unavoidable will be closely managed and monitored, so that they are minimized and mitigated and kept well within regulatory standards for environmental protection.

Section 7: The Socioeconomic Effects of an MRS

This section discusses the positive and potentially adverse socioeconomic effects that may be associated with an MRS. Potential adverse effects are expected to be minimal. They will be carefully monitored and managed within a framework agreed upon by the host and the Federal Government through the negotiated siting process. The siting process also provides the host with the opportunity to negotiate additional benefits.

Section 8: The Transportation Program

This section describes the development of the nationwide transportation system that will ship spent fuel to and from the MRS, how shipments will be made, how shipping routes will be selected, the rigorous safety standards shipping casks must meet, and special provisions for emergency-response procedures.

Section 9: The Transportation Effects of an MRS

Transporting spent fuel to and from the MRS will result in additional truck and rail traffic in the vicinity of the facility. This section explains the potential effects of such shipments.

1. THE PURPOSE OF AN MRS

An integral part of the Federal waste-management system, an MRS will temporarily store spent fuel shipped to it from commercial nuclear power plants and will stage shipments of the spent fuel to a geologic repository for permanent disposal. This section explains what spent fuel is, the nature of the Federal waste-management system, and the role the MRS will play in that system.

SPENT FUEL REQUIRES SAFE STORAGE AND PERMANENT DISPOSAL

Roughly 20 percent of our nation's electricity is generated by commercial nuclear power plants. Most of these plants use nuclear materials in the form of uranium fuel pellets encased in metal fuel rods. After the energy has been released from the fuel rods, they remain as a solid, highly-radioactive waste termed "spent fuel." Quantities of fuel and spent fuel are measured based on the amount of uranium they contain. These quantities are expressed in terms of metric tons of uranium (MTU).

To date, about 20,000 MTU of spent fuel have accumulated at commercial nuclear reactor sites. By the year 2000, this amount will have doubled. By the time the last U.S. Nuclear Regulatory Commission (NRC) license for the current generation of nuclear reactors expires, an estimated total of 87,000 MTU of spent fuel will have been generated.

To ensure that radioactive materials are safely handled, their use is closely regulated by the Federal Government. In conformance with NRC safety regulations, spent fuel is currently stored in stainless steel-lined pools of water at over 70 reactor sites, and in dry storage at three spent-fuel storage installations at reactor sites.

While spent fuel is safely stored now, it will remain radioactive for thousands of years. To ensure that it will remain isolated from human beings and the accessible environment for so long a time, the United States and other nations are developing permanent means of disposing of it. The concept favored for many years by the United States, a number of other countries, and the international scientific community is geologic disposal. Geologic disposal involves placing wastes in special containers deep underground in a mined facility called a repository.

A WASTE-MANAGEMENT PROGRAM IS AUTHORIZED BY FEDERAL LAW

In this country, the waste-management system that will permanently isolate spent fuel is authorized by the Nuclear Waste Policy Act (NWPA). The NWPA assigns the Secretary of Energy responsibility for developing and operating the system and specifies its components:

- The Secretary must develop a geologic repository for permanent disposal of spent fuel from commercial reactors. A 1985 Presidential decision determined that high-level radioactive wastes from defense activities will be

disposed of in the repository as well. The Secretary is to study the Yucca Mountain site in Nevada to determine if it would be suitable for a repository.

- The law authorizes a monitored retrievable storage facility as an integral part of the waste-management system. The MRS is to accept shipments of spent fuel from commercial nuclear reactors, store the spent fuel temporarily above ground, and stage shipments of it to the repository for permanent disposal. The Secretary of Energy has chosen to develop an MRS because of the substantial benefits it can contribute to the overall waste system.

- The Secretary is to develop a transportation system for shipping waste from the sites where it is stored to the MRS and to the repository. He is to rely to the extent practicable upon the private sector for transportation services.

The law specifies a process for developing the waste-management system and assigns extensive rights to States, Indian Tribes, and units of local government affected by the program. It provides for funding to support their participation in the program.

While the Department of Energy (DOE) is responsible for developing and operating the system, certain responsibilities are assigned to other Federal agencies and other entities. Notably, the repository and the MRS must be licensed by the NRC and the design of casks used to transport the waste must be certified by the NRC. Shipments of radioactive wastes are subject to regulation by the U.S. Department of Transportation, under existing law. The U.S. Environmental Protection Agency must establish generally applicable standards for protection of the environment from radioactive releases. The Nuclear Waste Technical Review Board, a group of eminent scientists and engineers nominated by the National Academy of Sciences and appointed by the President, independently reviews the DOE's technical activities and reports to Congress and the Secretary of Energy on them.

The costs of managing and disposing of commercial spent fuel and the high-level radioactive waste from defense activities are to be borne by the parties that generate and own them: nuclear utilities and the DOE.

To obtain a site for an MRS, the law provides for two siting paths. The Secretary of Energy is authorized to survey and evaluate potentially suitable sites and to select a site. Alternatively, a Nuclear Waste Negotiator, appointed by the President and confirmed by the Senate, is to seek a willing State or Indian Tribe with a technically qualified site and is to negotiate a proposed agreement on reasonable terms. The agreement must be approved by Congress. The Negotiator's appointment was confirmed in August of 1990 and his search for a host is under way.

The DOE believes that the efforts of the Negotiator offer the best opportunity to solicit interest in and negotiate an agreement to site the MRS with a volun-

teer host. The DOE's near-term role is to support the Negotiator, as requested. However, DOE will develop a contingency plan for siting the MRS and will closely follow the progress of the Negotiator's efforts.

The legislation authorizing the MRS includes certain constraints: the amount of spent fuel it could store at any one time would be limited and the schedule for its development would be tied to the schedule for developing the permanent repository. The Federal Government is committed to starting waste acceptance at an MRS in 1998 or soon thereafter. Because an MRS linked to the repository schedule could not start operating that soon, the President's National Energy Strategy legislative proposal includes a provision to repeal the schedule linkages. Alternatively, a negotiated agreement could include terms that differ from the current statutory schedule linkages.

AN MRS WILL PERFORM FUNCTIONS INTEGRAL TO THE WASTE-MANAGEMENT SYSTEM

An MRS will accept and store spent fuel above ground under closely monitored conditions. When the repository opens, the spent fuel that has been stored at the MRS will be shipped from the MRS to the repository; additional spent fuel stored at reactor sites will be shipped to the MRS and then on to the repository. All shipments from the MRS will be made by dedicated trains—trains carrying only spent fuel.

Because the underground repository will be a technically complex, first-of-a-kind facility, prudent planning must assume that its operations may from time to time be interrupted. By serving as a flexible coupling between at-reactor waste management operations and repository operations, an integral MRS can provide significant benefits to the Federal waste-management system. By facilitating an orderly transfer of spent fuel to the Federal system, independent of the ability to emplace spent fuel in the repository, the MRS will increase the reliability and efficiency of the total waste system. By providing both buffer storage and a central staging area for waste shipments to the repository via large-capacity, dedicated trains, the MRS may enhance transportation efficiency.

An MRS will reduce utilities' needs to expand on-site storage of spent fuel. When the NWPA was passed in 1982, it was assumed that the repository could begin operating in 1998. However, ensuring that the repository can be safely developed is a complex undertaking. The repository schedule must allow ample time for a thorough scientific investigation of the candidate site to determine if it is suitable. The schedule must also allow ample time for interested and affected parties to participate in the development of the waste-management system. The start of repository operations is now projected for 2010.

Meanwhile, reactors continue to operate, their inventory of spent fuel continues to grow, and their available storage capacity continues to shrink. In 1983, the Federal Government contracted with utilities to accept their spent fuel, and the utilities are depending on the Federal Government to begin removing their

spent fuel in 1998, so that they will not have to continue expanding their spent-fuel storage capacity at reactor sites. With the start of repository operations now deferred, the Federal Government will have to ship spent fuel from reactors to an interim storage facility in order to start accepting spent fuel by 1998. The MRS will provide this storage.

Because early acceptance of spent fuel at a temporary MRS will be an important step toward permanent disposal at a repository, it will serve important environmental and energy-policy goals as well: it will demonstrate our nation's commitment to solving the nuclear waste problem instead of passing it on to future generations.

By law, the MRS can only store spent fuel temporarily; permanent disposal must occur at the repository. Accordingly, the NRC license for the MRS will expire after 40 years. If necessary, the DOE would seek a license renewal consistent with the terms of the negotiated agreement. The NRC would then have to approve the DOE's application for a license renewal. When its license expires, the MRS will be decommissioned and the site will be restored as nearly as possible to its former condition.

THE CONCEPT OF MONITORED RETRIEVABLE STORAGE IS WELL-ESTABLISHED

The concept of an MRS as an integral part of a system for managing and disposing of spent fuel is well-established in this country. Other countries with significant nuclear reactor capacity have or are planning to develop storage facilities. These facilities will serve as integral components of waste-management systems that will include geologic repositories for permanent disposal of spent fuel and high-level radioactive waste. For countries that reprocess spent fuel, storage facilities are, or will be, located at reprocessing facilities. France, Sweden, and the United Kingdom already operate storage facilities, while Germany, the Netherlands, Spain, and Switzerland are among those countries planning for them.

The concept was introduced in this country in the early 1970's and has evolved through various studies and legislative initiatives. The original NWPA directed the Secretary of Energy to study the need for and feasibility of an MRS and to submit to Congress a proposal for construction of one or more MRS facilities.

In 1985, the DOE completed a preliminary needs-and-feasibility analysis and concluded that an MRS that served as a central receiving and temporary storage station for spent fuel from commercial reactors, and that prepared spent fuel for permanent disposal by consolidating and packaging it, could be an integral component of the overall waste-management system and could enhance its development and performance. In 1987, the DOE submitted a proposal to Congress for an MRS to be constructed in Tennessee.

The 1987 Amendments to the 1982 Act annulled the DOE's 1987 proposal,

but authorized the inclusion of an integral MRS in the waste-management system. As noted above, the Secretary of Energy has chosen to develop an MRS.

Systems studies performed for the DOE in 1988-89 confirmed the usefulness of an MRS to the system, as did the 1989 study conducted by the independent Monitored Retrievable Storage Review Commission created by Congress, although the Commission's specific recommendations differed from the DOE's with respect to storage capacity and source of funding.

Under the DOE's current plans, the spent-fuel consolidation and pre-disposal packaging originally envisioned to be performed at the MRS would become optional functions that might be added later, if they were determined desirable and the host agreed to them.

2. THE FUNCTIONS OF AN MRS

This section explains the functions the MRS will perform and describes the technologies that can be used to perform these functions safely and reliably.

AN MRS WILL PERFORM SIMPLE FUNCTIONS

An MRS will perform simple spent-fuel acceptance, storage, and transfer functions. A number of technologies and combinations of technologies could safely perform these functions. The exact design of the MRS will be determined in part by the technologies selected. It is expected that the MRS host may want to participate in decisions affecting MRS technologies and design. Whichever technologies are selected, the basic operations of the facility will be generally as described below.

At reactor sites, spent-fuel assemblies will be loaded into transportation casks specifically designed to provide safe transport, given a final inspection, and shipped to the MRS by rail or truck. When the casks arrive at the MRS, they will undergo another thorough safety inspection.

With the exception of transportable storage casks (described below), the transportation casks will then be prepared for unloading and will be transferred to spent-fuel handling facilities that are appropriately shielded and ventilated. There, spent-fuel assemblies will be removed from the transportation casks using proven robotic and remote-manipulation equipment to protect workers from exposure to radiation. The assemblies themselves will be inspected. They will then be placed in storage. Storage may consist of massive concrete containers or modules that provide the necessary radiation shielding. The spent fuel will be monitored during storage to ensure that safe conditions are maintained.

The exact rates at which spent fuel will be accepted at the facility have yet to be determined, but the facility will be tested and brought on line in a controlled manner so that safety can be evaluated, all functions can be fully tested, and personnel can be trained during a prescribed training program.

When the repository starts accepting waste, the MRS will also serve as a staging facility for shipments of spent fuel to the repository. These shipments will be made by dedicated trains—trains carrying only spent fuel. Spent fuel that is already in storage at the MRS will be retrieved from storage and transferred to large-capacity rail casks for shipment. Some spent fuel shipped from reactors to the MRS may be immediately transferred to such casks for shipment.

Included with the MRS may be a cask-maintenance facility for maintenance of shipping casks and their components. Ancillary buildings at the site will house laboratories for environmental monitoring, and administrative and security offices. Functions related to safely packaging and preparing spent fuel for permanent disposal may be included in the basic design,

or could be added later if they were determined to be beneficial to the total waste-management system and if the host and the DOE jointly agree to include these functions. The addition of any functions, after Congressional approval of the original proposed agreement between the Federal Government and an MRS host, would be subject to the agreement of the host and the DOE and, if necessary, complete review by the NRC leading to an amendment to the initial license.

THE MRS WILL RESEMBLE AN INDUSTRIAL PARK

Resembling an industrial park, the MRS site will occupy about 450 acres of land, including a large buffer zone between the facility itself and the perimeter of the site. To enhance safety, access to the MRS will be limited to authorized personnel; the site will be enclosed by high-security perimeter fences and monitored by a well-qualified security force. The entire site will constitute a "controlled area."

The design of the facility will be tailored to the physical features of the site and any particular requirements negotiated by the host. The visual effects of an MRS will depend a great deal upon its location: its visibility will depend upon topography and vegetation, and the location of nearby roads and residential areas. Visual effects will also depend upon the technology selected for the facility.

Whatever technology is selected, the facility will be an unobtrusive, low-rise structure. The DOE and the host can work together to determine how landscaping can minimize the visual effects of the facility and enhance the site.

THE MRS WILL RELY UPON PROVEN TECHNOLOGIES DEMONSTRATED TO BE SAFE

The primary focus of all activities associated with the handling and storage of spent fuel is to preclude any release of radioactive material and to control exposure to radiation emitted by the spent fuel. For many years, utilities in this country and abroad have been safely storing spent fuel at reactor sites. In this country, nuclear reactor storage practices are regulated by the U.S. Nuclear Regulatory Commission (NRC). Spent-fuel storage at an MRS will likely be accomplished with technologies similar to those now used for dry storage of spent fuel at several reactor sites.

NRC regulations are designed to ensure safe handling and storage. The NRC will not issue a license permitting the Secretary of Energy to construct and operate an MRS unless NRC requirements for protection of public health and safety and the environment are fully met. To meet NRC requirements and simplify NRC licensing, the MRS will employ, to the extent practicable, technologies that have already been licensed and that have proven reliable through actual operating experience. Simplicity of design and of maintenance, and reliance upon well-established operating procedures will add to confidence in the technology. Site facilities, fences, and the required distance to the perimeter of the buffer zone

will be designed to ensure that the radiological dose at the boundary of the site will be less than the regulatory limit prescribed by the NRC.

Safety precautions will include massive concrete or metal shielding of equipment used during handling and storage operations; extensive shielding of the spent fuel itself and of operating areas; remote handling of spent fuel by manipulators or robots; air-tight sealed transfer areas or devices; features that dissipate heat naturally; confinement and filtration of air from areas in which spent fuel will be handled; a generous buffer zone between MRS facilities and the perimeter of the site; procedures and equipment for monitoring the facilities in which spent fuel is handled and the casks in which it is stored; careful design, construction, and testing of double-sealed casks used to transport and to store spent fuel, and of equipment used to handle it; built-in safety systems and redundant or diverse back-up systems; and emergency response plans.

All of these precautions are designed to meet NRC licensing requirements that protect the public and environment in the unlikely event of an accident due to natural events or human error.

While the MRS will be designed to meet NRC licensing requirements that limit radiological exposure of the public and workers, every reasonable effort will be made to maintain radiation exposures and potential releases of radioactive materials from the facility at levels even lower—as low as reasonably achievable.

STORAGE AND TRANSFER TECHNOLOGIES UNDER CONSIDERATION

The storage and transfer technologies the DOE is currently evaluating for the MRS all share the common safety goal of minimizing the potential for radiological releases and exposures to workers and the public. Among these technologies are the following:

Multiple-element storage canister

The multiple-element storage canister would be loaded with spent fuel at reactor sites. The canister, fabricated from welded stainless steel, would be loaded into transportation casks and shipped to the MRS. At the MRS, the canister would be transferred by a shielded mechanism from the transportation cask into a bunker-like concrete module in a storage field.

Modular vault dry storage

Modular vault dry storage uses steel and concrete modules to store spent-fuel assemblies. At reactors, spent-fuel assemblies would be loaded directly into transportation casks and shipped to the MRS. At the MRS, a shielded fuel-transfer mechanism would transfer the spent-fuel assemblies from the transportation casks directly to vertical steel storage tubes arrayed in the modules. These modules would provide ready access to the fuel assemblies, and additional modules could be easily added to expand storage capacity.

Simplified hot-cell transfer facility

A hot cell is a thick-walled concrete structure that provides a shielded area in which radioactive materials can be handled safely by manipulators and robotic equipment. At reactors, spent-fuel assemblies would be loaded into transportation casks. At the MRS, the casks would be placed in the hot cell. Within the hot cell, spent-fuel assemblies would be transferred from their transportation casks into massive concrete storage casks that would then be placed in a storage field. This design can also be arranged to provide storage in the form of multiple-element storage canisters placed in bunker-like concrete modules in a storage field.

Cask-to-cask transfer

Cask-to-cask transfer would involve a shielded fuel-transfer mechanism. At the MRS, an incoming transportation cask would be positioned adjacent to a storage cask within an enclosure building. Positioned above these casks would be a shielded fuel-transfer mechanism that could remove spent-fuel assemblies from the transportation cask and place them in the storage cask. This system would be designed to prevent the fuel assemblies from being released until they were properly positioned so that they could not be dropped or damaged during transfer.

Transportable storage casks

One technology being evaluated is different from those described above. The transportable storage cask, also termed a "dual-purpose cask," would serve to both ship and store spent fuel. Current designs of dual-purpose casks provide for large capacity and a handling weight of over 100 tons when loaded with fuel. This weight could only be handled at reactor sites with heavy cranes and rail access. Unless fuel were to be consolidated, packaged, or transferred to repository shipping casks at the MRS, no handling of the fuel would be required there. The cask would be loaded at reactor sites and would be shipped to the MRS, where it would be stored unopened. The MRS would therefore essentially serve as a parking area for these casks.

To be manufactured in accordance with designs approved by the NRC for transportation, these casks must withstand a series of stringent tests, including drop and fire tests. If these casks were used, the MRS would include technologies necessary to provide the means to handle any malfunction or deterioration of the casks during the storage period.

3. THE PROCESS FOR DEVELOPING THE MRS

This section explains the multiple statutory and regulatory safeguards that further ensure that the MRS will perform safely and reliably, to the satisfaction of the host, NRC, and the DOE.

THE MRS WILL EMPLOY MULTIPLE PROTECTIONS

The MRS will employ multiple physical protections to safeguard human health and the environment. Similarly, multiple procedural protections are built into the process by which the MRS will be developed and operated. Coupled together, they form a comprehensive statutory and regulatory framework that ensures that the MRS will be sited, designed, constructed, operated, and decommissioned in accordance with stringent safety standards, under the scrutiny of oversight bodies and public review.

Among the key protections are an early review of whether a site is technically suitable, reviews of the potential environmental and socioeconomic effects of an MRS, Congressional review of a proposed agreement, U.S. Nuclear Regulatory Commission (NRC) licensing of the facility, and continued NRC monitoring of MRS operations.

Equally important, the MRS will not be sited without the host's consent, and the host can negotiate for itself an active role in MRS development and operations. By participating in decisionmaking and by exercising rigorous oversight of MRS activities, the host can assure itself that the MRS performs to its satisfaction, meets community standards, and serves community goals.

The stages of MRS development, and the protections built into each stage, are described below.

POTENTIAL SITES FOR AN MRS MUST PROVIDE FOR SAFE STORAGE

The MRS will be a relatively simple facility that could be sited at many locations throughout the continental United States. However, each potential MRS site must be evaluated to determine whether it has certain characteristics that indicate that an MRS facility located at that site will comply with Federal regulations that protect human health and the environment. From these Federal regulations, the U.S. Department of Energy (DOE) has compiled "Preliminary Site Requirements and Considerations for an MRS Facility." These preliminary site requirements and considerations are based on NRC regulations that include "Siting Evaluation Factors" and "General Design Criteria" and on Federal environmental and land-use regulations. The draft preliminary site requirements and considerations can help interested parties, the Negotiator, and the DOE use available information to identify tech-

nically suitable sites without conducting extensive analyses.

A site will have to meet requirements based on environmental, health, and safety concerns. Only sites that meet these preliminary requirements will be considered for further discussions and negotiation. The site considerations can be used to identify favorable attributes of a potential site that, if present, would make it easier to demonstrate compliance with applicable regulations. Successively more rigorous investigations—starting with obtaining data for an environmental assessment and culminating in detailed site characterization for the safety analysis report, environmental impact statement (EIS), and license application that will be required for NRC licensing—will ensure that the MRS has been sited at a safe location.

POTENTIAL HOSTS MAY CONDUCT THEIR OWN FEASIBILITY STUDIES

States, Indian Tribes, and units of local government may obtain Federal grants to assess the feasibility of hosting an MRS at a site within their jurisdictions. Grantees can design their feasibility studies to satisfy their own concerns about the effects and the benefits of hosting an MRS.

NATIONAL ENVIRONMENTAL POLICY ACT REQUIREMENTS MUST BE MET

The National Environmental Policy Act (NEPA)—as well as NRC regulations and the DOE's own regulations—calls for extensive review of a project to identify its potential environmental and socioeconomic effects, with opportunities for public participation in the review process. The purpose of this review is to help decisionmakers identify potentially adverse effects, find ways to avoid them, and devise measures to minimize or mitigate those adverse effects that cannot be avoided. This ensures that potential effects are well understood before major decisions are made.

The Nuclear Waste Policy Act (NWPA) calls for a two-step NEPA review process that involves the preparation of two documents: an environmental assessment (EA), which must accompany the proposed negotiated agreement submitted to Congress; and an environmental impact statement, which must accompany the DOE's application for an NRC license.

These documents will examine the potential socioeconomic and environmental effects of the MRS facility itself, and of the transportation system that supports it. (Potential environmental, socioeconomic, and transportation effects are discussed in other sections; the EIS is described below.)

Upon the request of the Negotiator, the DOE will prepare an EA for a potential site. Before preparing the EA, the DOE will hold public hearings to present information about the MRS to the public and to receive comments and recommendations about what specific issues and concerns the public wants addressed in the EA. Analysis of existing data about a site is required for preparation of the EA. The DOE will consult closely with the host in preparing

the document and the host will have the opportunity to review and comment on the EA before it is issued in final form. The host may choose to play an even more active role in the development of the EA and of the EIS by participating in the collection of data and analysis of potential effects.

THE SITING PROCESS IS DESIGNED TO PROTECT THE HOST'S INTERESTS

Only sites that meet technical criteria for suitability will be considered for negotiations. Additionally, feasibility studies and the results of the assessment of potential environmental and socio-economic effects will provide important information that will support the decision of whether or not to pursue a negotiated agreement. Beyond this substantive information, the statutory provisions that govern the negotiated siting process ensure that the host's concerns must be addressed to its satisfaction. These provisions are described in the section titled, "Federal, State, Indian Tribal, and Local Roles in MRS Siting, Development, and Operation."

A NEGOTIATED AGREEMENT MUST BE APPROVED BY CONGRESS

If negotiations are successful, the Negotiator will submit the proposed agreement to Congress, along with the EA prepared for the site. Congressional review of the proposed agreement will provide yet another forum for the expression of any public concerns.

For an agreement to take effect, Congress must approve it.

ONCE SITED, THE MRS MUST BE LICENSED BY THE NUCLEAR REGULATORY COMMISSION

For many years, utilities in this country and abroad have been safely storing spent fuel at reactor sites. In this country, nuclear reactor storage practices are regulated by the NRC. The NWPA makes the NRC also responsible for regulating spent-fuel storage at an MRS: the DOE cannot construct and operate an MRS until it has obtained a license from the NRC.

Spent-fuel storage at an MRS will essentially apply the kind of technology now used for spent-fuel dry storage at reactor sites to an away-from-reactor, stand-alone facility. Through a public rulemaking process, the NRC has developed regulations for an MRS, 10 CFR Part 72. A materials license granted under these regulations will authorize the DOE to receive, possess, and transfer spent fuel. Included in the license is the authorization to construct the MRS.

To obtain an NRC license, the DOE must demonstrate that MRS siting, design, construction, and operations will meet NRC standards; that is, that the technologies used to handle and store spent fuel, the procedures by which those functions are carried out, and the procedures by which personnel are certified are all adequate to protect health and safety and the environment.

To do this, the DOE must submit a license application to the NRC. Because spent-fuel storage at an MRS is a simple operation, a one-step licensing procedure is provided that requires one license application, including one safety analysis report. Therefore, all information submitted must be complete before a license can be issued. The safety analysis report will include an analysis demonstrating that the site is safe for an MRS facility, an emergency plan, procedures for quality assurance and quality control, a physical security plan to restrict access to the site, a contingency plan for safeguarding nuclear materials from theft, a personnel training program, proposed terms and conditions for the NRC license, the final physical design of the MRS, technical specifications for facility operations, and a decommissioning plan.

Another document that must accompany the license application is the EIS required by NEPA. To be prepared by the DOE, the EIS will ensure that all potential environmental and socioeconomic effects are well understood and are considered by decisionmakers. The EIS will be more comprehensive than the EA, and its preparation could require some additional scientific investigation of the site itself. As with the EA, the potential host will be able to participate in preparing the EIS. The DOE will hold scoping hearings to solicit the public's views on what should be included in the EIS. The DOE will then issue a draft EIS for public comment, hold public hearings on it, review comments, and make appropriate revisions before issuing the final EIS. After reviewing the license application, NRC staff will prepare a safety evaluation report. The Advisory Committee on Nuclear Waste, a review panel created by statute, will review this report and provide its evaluation to the NRC. The NRC's Atomic Safety Licensing Board will hold a licensing hearing to examine issues raised by parties to the proceeding. This hearing will be open to the public, and the host and any other affected parties will be allowed to participate under procedures specified by NRC regulations. After the hearings, the Board will issue a decision as to whether or not to grant a license to the DOE to construct and operate the MRS. The initial decision will become effective after it has been reviewed and approved by the NRC Commissioners, who will then direct the Director of Nuclear Material Safety and Safeguards to issue a materials license.

MONITORING AND OVERSIGHT WILL CONTINUE THROUGHOUT THE LIFE OF THE PROJECT

Once the NRC license is granted, construction of the MRS will begin. From that point forward, throughout the construction, operation, and decommissioning of the MRS, monitoring and oversight by the NRC will continue.

With respect to environmental and socioeconomic effects (discussed in other sections), during construction and operation of the MRS, the DOE will monitor for potential adverse effects; will implement measures to avoid them; and

will attempt to minimize, mitigate, or provide compensation for those that cannot be avoided.

With respect to safety, the NRC will periodically inspect, audit, and oversee the facility during construction and operation to ensure that the conditions of the license are being met.

The host will exercise whatever oversight role is defined in the negotiated agreement approved by Congress. Congressional authorization and appropriations committees will continue to exercise broad oversight of MRS operations.

OTHER PROTECTIONS WILL ALSO APPLY

Environmental protections are discussed in another section. They include U.S. Environmental Protection Agency (EPA) standards for nonradiological releases to the environment that will be enforced by the EPA or by the State agencies to which the EPA has delegated its authority.

Nonradiological protection of workers will be provided by Federal, State, and local regulations enforcing occupational safety. These regulations will be observed during construction, operation, and decommissioning of the MRS. They include those of the U.S. Department of Labor's Occupational Safety and Health Administration (OSHA). Safety codes governing the fabrication, installation, and operation of equipment will be applied to all elements of the MRS facility.

All applicable Federal, State, and local environmental, safety, and health laws and regulations will be strictly observed during both construction and operation of the MRS. Further, the process by which agencies exercise their permitting and approval responsibilities will provide many opportunities for public involvement and for public review of key program documents.

4. FEDERAL, STATE, INDIAN TRIBAL, AND LOCAL ROLES IN MRS SITING, DEVELOPMENT, AND OPERATION

This section summarizes the statutory provisions that define the roles of the parties to the negotiated siting process and the extensive rights of the MRS host.

PROVISIONS OF THE NUCLEAR WASTE POLICY ACT

While the Nuclear Waste Policy Act (NWPA) authorizes the Secretary of Energy to select an MRS site, Congress expressly provided an alternative method for obtaining an MRS site, through negotiations between the Federal Government and potential hosts. This method may enable the Federal Government to obtain a site more quickly and operate the MRS more effectively through a voluntary partnership with a willing host. Such a partnership can provide a sound and equitable basis for siting a facility that will serve the national interest while benefitting the host community.

Negotiations between the Federal Government and potential hosts are intended to serve the following purposes:

- To enable potential hosts to assess the effects of hosting an MRS and explore the benefits an MRS could offer.
- To enable the parties to jointly structure a partnership that will serve the interests of each, and to conclude an agreement that Congress will approve, so that the nation can develop an integrated high-level radioactive waste-management system in a timely manner.

PARTICIPANTS

The development of an MRS through a negotiated process will involve four key parties—the Nuclear Waste Negotiator, potential hosts, the U.S. Department of Energy (DOE), and Congress. Their roles are as follows:

The Nuclear Waste Negotiator

- The Negotiator, appointed by the President and confirmed by the Senate, is to seek a State or Indian Tribe willing to host an MRS at a technically qualified site on reasonable terms. He is to attempt to reach a proposed agreement with the potential host specifying the terms and conditions for the host's acceptance of an MRS.
- The Negotiator is independent of the DOE and other Federal agencies. He may call upon them for assistance, as needed, during the siting process.
- In addition to negotiating with potential hosts, the Negotiator will consult with any State, unit of local government, or Indian Tribe that may be affected by the siting of a facility, and may include in any proposed agreement terms and conditions relating to the interests of such parties.

Potential hosts

- A State, Indian Tribe, or unit of local government may obtain information from the Negotiator about the MRS and about the negotiated siting process, and may apply for grants to assess the feasibility of hosting an MRS.

- A proposed agreement may be negotiated by the Governor of a State, the governing body of an Indian Tribe, or any person or entity authorized by State law to negotiate a proposed agreement under the NWPA. It is expected that the community in which the site is located will play a critical role in these negotiations and that substantial Federal benefits will flow to that community.

- The siting process will provide opportunities for participation by the general public, as well.

The U.S. Department of Energy

- During the siting process, the DOE is responsible for providing support requested by the Negotiator. At the Negotiator's request, the DOE will conduct an environmental assessment (EA) of a proposed site. To do so, it will hold hearings to obtain the views of the public, it will collect and review data about the site and the local community, it will consult with the potential host, and it will prepare an EA. The Negotiator will submit the EA to Congress along with a proposed negotiated agreement.

The U.S. Congress

- After the Negotiator submits the proposed agreement and EA to Congress, Congress will review it. The agreement will take effect only if Congress approves it.

After the agreement is enacted, the DOE and the host will proceed to implement the terms of the agreement. Congress will continue to exercise oversight of the waste-management system, including the MRS.

THE SITING PROCESS WILL PROTECT THE HOST'S INTERESTS

The Secretary of Energy may provide grants to States, Indian Tribes, and units of local government that want to explore the feasibility of hosting an MRS. The studies they conduct will help them determine whether they want to proceed to negotiations, and to define the terms of the agreement they want to negotiate.

The site-negotiations process is expected to be based on the following elements:

- The terms upon which a site is obtained will be agreed upon through negotiations between the Nuclear Waste Negotiator and a State or Indian Tribe willing to host the MRS.

- Only if a State or an Indian Tribe expresses interest in hosting the MRS

will the Negotiator consider any sites under their jurisdiction.

- A State or Indian Tribe that wants to explore the possibility of hosting an MRS is under no obligation to conclude an agreement. Any potential host may withdraw from the process at any time prior to Congressional approval of an agreement.

- If a State, Indian Tribe, or unit of local government wants to explore the possibilities for hosting an MRS, the Negotiator will provide information on a variety of subjects. These could include:

  - Federal grants that potential hosts can use to assess the feasibility of hosting an MRS.

  - The role a potential host can play in the negotiated siting process.

  - Technical requirements and considerations for evaluating a potential MRS site.

  - The effects an MRS might have on the host community—health and safety, environmental, transportation, and socioeconomic.

  - MRS design and technology options under consideration.

- Examples of terms that might be the subject of negotiations include:

  - Measures to avoid or minimize any adverse effects of the MRS.

  - Options for mitigation and compensation for any adverse effects.

  - Mechanisms for a decisionmaking partnership between the Federal Government and the host during MRS design, construction, operation, and decommissioning.

  - Mechanisms for the exercise of oversight by the host.

  - Measures to enhance the economic benefits provided by the MRS, such as Federal commitments to local hiring and local procurement of goods and services.

  - The co-location at the MRS of other facilities and activities that could provide economic benefits for the host, such as an operations center for the nationwide system necessary to transport spent fuel; a concrete-storage-cask fabrication plant; and scientific research and other technical activities associated with supporting the Federal radioactive-waste management system.

  - Additional incentives that may be desired by the potential host.

- In preparing the EA and the environmental impact statement required by the NWPA, the National Environ-

mental Policy Act, and DOE Orders, the Secretary of Energy must hold public hearings in the vicinity of the potential MRS site to provide information to local residents about the MRS and to obtain their comments.

- A State or an Indian Tribe will enter into an agreement in accordance with the laws of that State or Indian Tribe. A referendum or an act of the legislature of a State may disapprove a proposed agreement.

THE NEGOTIATED AGREEMENT MUST PRESERVE RIGHTS GUARANTEED BY THE NUCLEAR WASTE POLICY ACT

The NWPA requires that any proposed agreement between the Negotiator and a host State or Indian Tribe contain provisions necessary to preserve any right to participation or compensation of the State, affected unit of local government, or Indian Tribe provided under sections 116(c), 117, and 118(b) of the NWPA. The following briefly describes those provisions:

- The Secretary of Energy will provide an opportunity for the State, unit of local government, or Indian Tribe within whose jurisdiction the MRS site is located to designate a representative to conduct on-site oversight activities.

- The Secretary of Energy shall provide timely and complete information regarding determinations and plans, and prompt response to requests for information.

- The Secretary is to consult and cooperate with affected States and Indian Tribes in an effort to resolve their concerns regarding public health and safety, environmental, and economic effects.

- The Secretary is to attempt to enter into binding written consultation and cooperation agreements with affected States and Indian Tribes covering a wide range of topics, including procedures for notifications, information sharing, interactions, resolution of concerns, review of DOE plans and decisions, independent host monitoring and testing, and other issues.

- Participation grants may be provided to affected governments for reviewing DOE activities and determining effects; developing impact assistance requests; monitoring, testing, and evaluation; providing information to residents; and requesting information from, and providing comments to, the DOE.

- Financial and technical assistance may be provided to affected governments to mitigate facility effects, after submission of requests for assistance; and the Secretary is to attempt to enter into binding agreements governing such assistance.

- Payments-equal-to-taxes (PETT) will be provided to affected governments.

5. THE ENVIRONMENTAL EFFECTS OF AN MRS: RADIOLOGICAL

This section describes the potential radiological effects of an MRS. These effects are projected to be minimal and well within regulatory standards for protection of human health and safety.

NRC LICENSING ENSURES SAFETY

Since spent fuel is radioactive, an obvious concern among members of the public is whether an MRS is going to be safe; that is, what its radiological effects will be. A number of measures, described in other sections, will ensure that these effects will be minimal. Studies conducted by the Nuclear Regulatory Commission (NRC) of the radiological effects of existing spent-fuel storage facilities that are similar to an MRS confirm that effects are minimal.

In this country, the civilian use of nuclear materials is closely regulated by the Federal Government, through the NRC. Under this regulatory oversight, the scientific and medical communities, public utilities, and a variety of industries throughout the United States have been using nuclear materials safely in a variety of ways for many years, and the application of protective measures to the handling of these materials has become standard practice.

The handling and storage of radioactive material at the MRS will utilize NRC-licensed spent-fuel storage technologies and practices already employed by several utilities. The MRS and the cask-maintenance facility, if located at the MRS site, will be designed to meet NRC licensing requirements that limit radiological exposure of the public and workers, and every reasonable effort will be made to maintain radiation exposures and potential releases of radioactive materials from the facility at levels even lower—as low as reasonably achievable.

RADIOLOGICAL RISKS WILL BE VERY LOW

Actual radiological risks from the MRS will be very low, because radiation emitted from spent fuel is easily controlled by means of shielding. And the MRS will be equipped with other safety devices, such as filters. Thus, any radioactive materials that may be released during handling can be collected and treated appropriately. The NRC license for the MRS will include specific provisions to ensure continuing compliance with regulatory requirements. Compliance will be verified by monitoring actual facility performance, including measuring radiation levels and radionuclide concentrations both at the site and off the site. Further, the NRC's regulatory responsibilities extend throughout the operating lifetime of the MRS through its shutdown and decommissioning. Throughout construction and operation, the NRC will conduct periodic inspections and audits of the MRS.

The potential for an accidental release of radionuclides is also very low, for several reasons. The fuel itself is in a solid form that is not readily dispersible.

Conditions required for the release of any significant quantities of radioactive materials (for example, high temperatures) will not be present at the MRS. Fuel will have been cooled for at least 5 years before it reaches the MRS, which makes it less radioactive. Handling of spent fuel at the MRS will occur in shielded facilities using remote handling equipment. Finally, the buffer zone between the boundary of the site and the fuel-handling, transfer, and storage areas (at least 330 feet) required by the NRC will afford additional protection.

STUDIES AND EVALUATIONS OFFER DATA

The magnitude of radiation doses that members of the general public and MRS workers may receive can be gauged from studies of MRS designs that the DOE considered in the past, and from the NRC's evaluations of several dry-storage facilities operated by utilities using storage methods similar to those that will be used at the MRS facility. It is important to note that these estimates may vary depending on site-specific factors—such as the facility layout, the amount of spent fuel in storage, the storage technology, and the proximity of members of the public. Safety analyses of the MRS itself will be conducted to ensure that the MRS will not expose the public or workers to amounts of radiation greater than those allowed by Federal regulations and standards.

Radiological doses to individuals are commonly measured in units called "rem" (roentgen-equivalent-man), or millirem (one thousandth of a rem.) In 10 CFR Part 72, the NRC applies a 25-millirem annual dose limit to radiation exposure under normal operations, and a 5,000-millirem dose limit to accidents. The National Council on Radiation Protection and Measurements (NCRP) estimates that an average person in the United States receives 360 millirem a year from all sources of radiation, including natural sources such as the sun, and from medical procedures such as x-rays (NCRP Report No. 93).

One study that describes the potential radiological effects of an MRS is the environmental assessment (EA) of a conceptual MRS facility that the DOE prepared in 1986. For the three sites then considered for the MRS, the largest annual dose from normal operations to the nearest resident was estimated to be approximately 0.4 millirem, less than 2 percent of the 25-millirem NRC regulatory limit. The dose that the nearest resident would receive from the worst accident was estimated to be 22 millirem, which is a very small fraction of the 5,000 millirem accident-dose limit in 10 CFR Part 72.

NRC evaluations of dry storage facilities that it has licensed include those located at the H. B. Robinson site in North Carolina, the Surry site in Virginia, and the Oconee site in South Carolina. As a result of normal operations at the H. B. Robinson site, the NRC estimated the annual dose to the nearest individual, located three-tenths of a mile away from the boundary of the controlled area, to be about 0.4 millirem, almost the same as the DOE's 1986 estimate. For the Surry site, the NRC estimated a maximum

annual dose commitment of 0.00006 millirem to the nearest individual, located 1.5 miles away. This is less than 0.0003 percent of the 25-millirem annual dose limit in 10 CFR Part 72. For the Oconee site, the NRC estimated a maximum annual dose of 0.03 millirem to the nearest individual, located one mile away.

As a result of potential accidents, the doses that members of the public could receive at the H. B. Robinson, Surry, and Oconee facilities were also estimated to be a small fraction of 5,000-millirem accident-dose limits in 10 CFR Part 72. Based on conservative assumptions, which tend to overestimate the severity of the consequences, the dose from a postulated accident was estimated to be 1.2 millirem at the boundary of the H. B. Robinson controlled area, and the dose to the nearest resident was estimated to be 0.4 millirem. For the Surry site, the corresponding dose estimates are 4 and 0.24 millirem. For the Oconee site, the corresponding dose estimates are 197 and 115 millirem.

The occupational exposure of workers at the MRS facility will be strictly controlled in accordance with NRC requirements in 10 CFR Part 20. Although the exposure will depend on the specific facility design, the degree of automation, and various operational factors, previous estimates for facilities which the MRS is likely to resemble suggest that occupational exposures will be low compared with exposures at nuclear power plants. For example, the collective occupational dose from the dry storage facility at the Surry site was estimated to be only 1 to 2 percent of the dose from the reactors at that site.

Finally, the independent MRS Review Commission, established by Congress to evaluate the need for an MRS facility, evaluated the potential radiological doses to the workers and the public from the facility and from associated transportation activities. In its report to Congress, Nuclear Waste: Is There A Need For Federal Interim Storage? (November 1, 1989), the Commission also concluded that those doses are likely to be very low.

6. THE ENVIRONMENTAL EFFECTS OF AN MRS: NONRADIOLOGICAL

This section explains how environmental effects will be assessed and what they may be. Potentially adverse effects will be carefully avoided where possible. Those that are unavoidable will be closely managed and monitored, so that they are minimized and mitigated and kept well within regulatory standards for environmental protection.

PROTECTING THE QUALITY OF THE ENVIRONMENT

The MRS will be constructed and operated in an environmentally safe and sound manner. At the end of its operating lifetime, the MRS will be decommissioned and the site will be restored as nearly as possible to its former condition, consistent with any terms negotiated by the host and the Federal Government.

Construction of the MRS will be similar in scale to the construction of an industrial park and it is expected to affect the environment similarly. Operation of the MRS is not expected to have a significant effect on the environment. The DOE will identify environmental effects; will avoid or minimize and, if necessary, mitigate them; and will ensure that any effects fall within regulatory limits. The National Environmental Policy Act (NEPA), DOE regulations, and still other regulations described below ensure extensive review of environmental effects and provide opportunities for substantive public participation in the process of identifying and assessing them. (NEPA review is discussed in Section 3.)

To manage environmental effects, the DOE will develop an Environmental Regulatory Compliance Plan. This plan will identify all applicable Federal, State, and local environmental laws and regulations and will provide detailed information about how the DOE will comply with them. The Resource Conservation and Recovery Act, the Clean Air Act, the Clean Water Act, and the Safe Drinking Water Act mandate the development of programs to protect public health and safety by limiting the release of contaminants to the environment. The Environmental Protection Agency (EPA) administers some of these programs and delegates responsibility for others to the States.

MRS activities will be conducted in full compliance with the regulations that implement these laws; all necessary permits will be obtained and related inspections will be conducted.

Potential environmental effects on air quality

To predict the specific effects of the MRS on air quality, it is necessary to know what technologies the MRS will employ and where the MRS will be located, so that the existing quality of the

air and meteorological conditions in the vicinity of the site can be considered. However, even before a site and technologies are selected, some general effects can be predicted.

Any large construction project disturbs the land and adds to local traffic. This generates dust that, if not controlled, will affect air quality in the immediate vicinity of the project. The EPA defines and regulates the amount of such "fugitive dust" that can be emitted, by setting levels for the "total suspended particulates" that it considers "significant." Of special concern are particles that are small enough to be inhaled.

The EPA has delegated responsibility for monitoring air quality and enforcing air-quality standards to State and Indian Tribal air-pollution control agencies. While air-borne emissions will reach their peak during MRS construction, the DOE will implement dust-control measures and other controls to keep emissions within regulatory standards.

During operation of the MRS, emissions into the air could come from maintenance work performed on equipment at the MRS and from cask-maintenance facility operations; and from steam boilers and a cask-manufacturing plant, if they are included in the facility.

Trucks and trains carrying spent-fuel shipments will contribute the emissions common to air pollution in cities—nitrogen oxides, sulfur oxides, and carbon monoxide—and suspended-particulate emissions. Current planning assumptions about the capacity of spent-fuel shipping casks and the split between shipments by truck and rail indicate that about one train carrying three casks, and about 13 trucks will arrive at the MRS each week during peak operations. Once the repository is in full operations, about one dedicated train carrying about five shipping casks would leave the MRS each week.

Potential environmental effects on water use and quality

During MRS construction, water will be used primarily to control dust and to produce concrete to construct the facility. During operations, water will be used to wash down equipment, for sanitary sewage, and—if a cask manufacturing facility is included at the site—for the manufacture of concrete casks. Once a site has been identified, the estimated water-use rate will be compared with the flow rate of nearby rivers and other potential sources of water. This comparison will make it possible to identify which water source can be used with least effect.

Site-specific effects on water quality depend not only on the uses of the water, but on the sources of water and on what waters will receive the effluents from wastewater and sewage treatment. The MRS will be designed to meet EPA and State standards for water quality and to minimize the possibility of accidentally releasing any hazardous waterborne effluents. Wastewater and sanitary sewage will be treated to meet those standards.

Effluents that are routinely discharged will be monitored to ensure compliance with those standards.

Potential environmental effects: noise

The Occupational Safety and Health Administration (OSHA) noise standards will be enforced at the MRS to protect workers. Local jurisdictions will enforce their own noise standards for the public.

Not surprisingly, the highest noise levels will occur during construction, but they will be no more offensive or unsafe than the noise levels reached by other large construction projects. Most noise will come from heavy equipment, pile driving, and any blasting that may be required for site leveling. These sounds will be noticeable within a few miles of the site and could be annoying to some people within one mile of the site for short periods of time.

Noise levels during operation of the MRS will be considerably lower than during construction and will result primarily from exhaust fans in the facility, equipment, and vehicles. While the question of how much noise may be generated has not yet been studied in detail, studies of noise emissions from equipment similar to that planned for use at the MRS indicate that noise levels during MRS operation will be well within acceptable levels and will probably be inaudible at the boundary of the site.

Potential environmental effects: visual

The MRS will resemble an industrial park. Its visual effects will depend a great deal upon its location: its visibility will depend upon topography, vegetation, and the location of nearby roads and residential areas. Visual effects will also depend upon the technology selected for the facility. Whatever technology is selected, the facility will be an unobtrusive, low-rise structure.

Once a site has been approved and a technology selected, the DOE and the host will work together to determine how landscaping can minimize the visual effects of the facility and enhance the site.

Potential environmental effects: ecological

Wildlife and vegetation will be affected by construction and operation of the facility. During construction, some natural vegetation will be removed from a portion of the site, possibly resulting in the loss of habitat for some wildlife. Noise, lights, fences, and activity during construction and operation will also deter wildlife from using the area. During operation, wildlife and vegetation on the site could be subject to very small

amounts of radiation at levels of exposure well within regulatory limits.

No adverse effects to aquatic ecosystems will be caused by wastewater: it will be treated before being discharged so that it will meet State standards or EPA criteria that ensure protection of aquatic species and their habitat.

A potential site will be studied to determine if any threatened or endangered species are present. If they are, appropriate State and Federal agencies, such as the U.S. Fish and Wildlife Service, will be consulted to develop ways to avoid, minimize, or mitigate potential effects. Mitigation could include such measures as setting aside suitable habitat for the species in another area or moving individual members of the species to appropriate areas.

Potential environmental effects: land use

Depending on its design, the MRS facility and its buffer zone could require a total of 450 acres. Construction of the MRS will require installation of utilities and may require construction of new transportation routes. While access to the area occupied by the facility itself will be tightly controlled, the buffer zone could be available for limited public use; or it could be used to preserve natural resources within the boundaries of the site.

Potential environmental effects: archeological, cultural, and historical resources

Archeological and historic properties will be identified, evaluated, and protected as required by the National Historic Preservation Act and the regulations that implement it. Before construction begins, the DOE, the Federal Advisory Council on Historic Preservation, and State Historic Preservation Officers will sign an agreement that spells out how historic properties will be identified, how their significance will be evaluated, and how they will be protected.

Another concern will be identifying sites that have traditional religious or cultural significance to Native Americans, and avoiding, minimizing, or mitigating effects on these sites whenever possible. The DOE will work with local Native American communities in this effort.

7. THE SOCIOECONOMIC EFFECTS OF AN MRS

This section discusses the positive and potentially adverse socioeconomic effects that may be associated with an MRS. Potential adverse effects are expected to be minimal. They will be carefully monitored and managed within a framework agreed upon by the host and the Federal Government through the negotiated siting process. The siting process also provides the host with the opportunity to negotiate additional benefits.

ADDRESSING CONCERNS

The host community may experience a variety of socioeconomic effects from an MRS. Many of these effects may result in substantial benefits; others may be—or may be perceived as—adverse effects and may require mitigation. Potential effects will be assessed by all interested and affected parties in sufficient time to avoid, minimize, mitigate, or compensate for any adverse effects. Measures that will satisfy the community's concerns about these effects may be incorporated into a negotiated agreement.

The Nuclear Waste Policy Act (NWPA) provides funds for host participation in the planning and development of the MRS. The NWPA calls for assessing, monitoring, and mitigating potential adverse effects. Participation by the host—both during the development of a negotiated agreement and after a negotiated agreement is approved—can produce benefits that will contribute to community goals.

NATURE OF EFFECTS

Many of the socioeconomic effects and mitigation measures associated with an MRS will be similar to those associated with any development project. These effects will generally result from the employment that is created, the associated population growth, and project expenditures for materials, equipment, and services.

While the standard effects associated with development projects are known, the specific types and degrees of effects of the MRS will depend upon the specific design characteristics of the facility itself and the particular socioeconomic conditions of the host community.

Favorable effects will include more jobs, greater tax revenues, and the influx of money into local businesses. The kind of technology selected to perform the basic functions of the MRS will dictate the size of the workforce and the types of workers needed for the facility. Depending on workforce requirements and local labor availability, the negotiated agreement might provide for training to help and encourage local residents to obtain employment at the MRS.

Adverse effects should be minimal. They could result if increased demands on government and community facilities, housing, and services (such as schools, wastewater treatment, and medical care) exceed local resources; if increased demand for water and land places a burden

on scarce resources; and if the quality of life desired by the community is adversely affected. If so, these effects will be mitigated, or compensation will be provided.

While potential adverse effects can result from any large development project, the public may perceive special risks associated with facilities handling radioactive materials, despite the safety of these facilities. People who live near a site at which such a facility may be located may worry that their property values will decrease, that fewer tourists will visit, or that industries or businesses that might have moved to the area will be driven away. These concerns will be addressed, as well.

Assessing potential effects

To adequately address socioeconomic effects, assessments will have to be performed at various stages of MRS siting and development. The NWPA provides funding for potential hosts to conduct their own studies to assess the feasibility of hosting an MRS. If, after conducting feasibility studies, a State or an Indian Tribe decides to undertake negotiations for a proposed agreement to host an MRS, the DOE, upon the request of the Negotiator, will conduct an environmental assessment (EA), as required by the NWPA, the National Environmental Policy Act, and DOE Orders.

The EA will assess potential socioeconomic and environmental effects to ensure that they are well understood by all parties in advance of decisions about the MRS. Before preparing the EA, the DOE will hold public hearings to present information about the MRS to the public and to receive comments and recommendations as to what issues and concerns the public wants the EA to address. The DOE will consult closely with the potential host in preparing the document, and the host may wish to negotiate for itself an even more active role in developing the EA.

The Negotiator must submit the EA to Congress along with the proposed negotiated agreement. If Congress approves the agreement, the DOE will prepare the application it must submit to the Nuclear Regulatory Commission for a license to construct and operate the MRS. This application must be accompanied by an environmental impact statement (EIS) that presents a more detailed analysis of the potential environmental and socioeconomic effects of the MRS. Before preparing the document, the DOE will hold public scoping hearings to solicit the concerns of the public. After the EIS is issued in draft form for comment, the DOE will hold hearings on it. Public comments will be reviewed, and appropriate changes made to the EIS, before the document is issued in final form.

Additional analyses of socioeconomic effects may also be performed, as needed. Terms for conducting further analyses, and the role of the host and of the DOE in this process, can be addressed in the negotiated agreement. All analyses will need to be conducted in consultation with the host.

While these analyses will provide the DOE and the host with site-specific infor-

mation on the types of effects the host can expect, it is possible now to make some general predictions of effects. Experience with construction projects indicates that construction of the MRS could take one to three years and that the facility could provide several hundred long-term jobs to the community during its anticipated 40-year operating lifetime.

The specific effects of the MRS will depend upon the design selected for it, the functions it will perform, and the characteristics of the particular community in which it is sited. As the engineering plans for the MRS develop and as data about the host community becomes available, these effects can be assessed. Appropriate measures to avoid, minimize, or mitigate adverse effects can then be developed and implemented.

If, for example, it is determined that workers from outside the area are needed for the project, estimates can be made of the additional demands that they and their families could place on the community's schools, roads, water and sewer systems, and other facilities. Specifically, once the functions and design of the MRS are determined, the DOE will be able to make estimates of the following:

- The size of the workforce required for various project phases.
- Laborforce requirements by occupation for each phase.
- Estimated salaries and wages of the workforce.
- Total expenditures required to construct and operate the facility.

This information can then be evaluated in the context of the local and regional labor market and the community's facilities and services. To adequately assess effects, the DOE will need to work closely with the host government, local communities, and service providers to obtain community data. This data will include, but not be limited to:

- Geographic distribution of workers and their families;
- Availability and skills of local labor;
- Housing conditions;
- Land-use patterns;
- The nature and capacity of community facilities, services, and infrastructure;
- Community economic development plans; and
- Local government revenues and expenditures.

Monitoring, mitigating, and providing compensation for potentially adverse effects

Analyses conducted by the host and the DOE of potential adverse socioeconomic effects will provide the framework for determining how best to monitor and address them. The purpose of

monitoring is to determine whether estimates of effects are accurate and whether impact management strategies are effective, so that appropriate action can be taken.

To adequately address socioeconomic effects, the process of monitoring will continue throughout the life of the MRS project. The negotiated agreement may specify the roles of the DOE and the host in this process. Specific measures to address potential adverse effects can be modified as appropriate on the basis of what is learned through monitoring and evaluation of the effectiveness of those measures.

The NWPA provides for financial assistance to support the host's development of a request for impact assistance and the host's participation in the development of a process for assessing and managing effects. The Act also provides for funding to mitigate or compensate for adverse effects. Still other financial terms can be negotiated by a potential host and the Negotiator.

The analysis conducted by the host and the DOE will provide the framework for evaluating and selecting the most appropriate actions:

- Avoid or minimize effects. As a first priority, the DOE will attempt to avoid or minimize any potentially adverse effects. In consultation with the host, the DOE will develop and implement strategies to manage the construction and operation of the MRS in such a way as to avoid or minimize adverse socioeconomic effects. Such measures could include providing on-site housing for workers, providing buses to transport workers, and adjusting work schedules to minimize the effect on local traffic patterns.

- Mitigate effects. If potential effects cannot be avoided or minimized, the DOE will develop measures to mitigate them. By law, the DOE can provide the host and local communities with financial and technical assistance to develop facilities and services—such as additional educational or health care facilities—that are needed to mitigate potential adverse effects. To address any public perceptions of risk associated with a facility handling radioactive materials, the Federal Government will closely monitor for potential socioeconomic effects associated with these perceptions, and will work closely with the host to help build public understanding of the nature of MRS operations and of the low level of risk associated with them.

- Compensate the host for adverse effects. The DOE has the authority to provide funds to compensate the host for adverse effects that cannot be avoided, minimized, or mitigated—for example, acquisition of private property that is needed to provide an access route to the site.

- Provide incentives. By entering into a partnership with the Federal Government to provide a site for an

MRS, the host is contributing to important national environmental and energy-related goals. In recognition of this, the Federal Government is prepared to negotiate terms that can directly contribute to community goals.

8. THE TRANSPORTATION PROGRAM

This section describes the development of the nationwide transportation system that will ship spent fuel to and from the MRS, how shipments will be made, how shipping routes will be selected, the rigorous safety standards shipping casks must meet, and special provisions for emergency-response procedures.

THE TRANSPORTATION SYSTEM WILL ENSURE SAFE SHIPMENT OF SPENT FUEL

The Federal waste-management system must have the capability to ship spent fuel from commercial nuclear reactors to the MRS and from the MRS to the repository, and to ship high-level radioactive wastes from defense sites to the repository. In accordance with the terms of the Nuclear Waste Policy Act (NWPA), the DOE is now developing a transportation system that will perform these functions in accordance with U.S. Nuclear Regulatory Commission (NRC) and U.S. Department of Transportation (DOT) regulations governing the transportation of radioactive materials. These regulations ensure that the general public and transportation workers are adequately protected from any radiological hazards associated with routine transportation and potential accidents. The comprehensive transportation program the DOE is now developing builds on 40 years of experience on the part of the Federal Government and the private sector in shipping radioactive materials, and it will rely upon technologies and procedures that have been proven to be safe and reliable. As required by law, the DOE will rely upon the private sector for transportation services to the extent practicable.

Some of the physical and operational elements of the transportation program will include: shielded shipping casks for safe transport of spent fuel; procedures to ensure safe and efficient operations, including vehicle maintenance and inspection; training programs for transportation system personnel; criteria for designating shipping routes; and procedures for advance notification to States through whose jurisdictions shipments will be routed.

Another element of the transportation program is institutional: interactions with parties who may be affected by shipments of high-level waste and spent fuel. A major program effort will be the provision of technical assistance and funds to States for training the public safety officials of Indian Tribes and local governments through whose jurisdictions shipments will be routed. Before shipments begin, these officials will be trained in procedures for safe, routine transportation of radioactive materials and for dealing with emergency situations.

To facilitate the development and operation of the transportation system, the DOE has since 1986 been hosting Transportation Coordination Group meetings that involve a wide range of parties. This group meets periodically to define, analyze, and recommend resolutions for a wide range of technical and institutional issues. These issues

include such questions as how the assistance for emergency situations and routine transportation, mentioned above, should be implemented; what criteria should be applied to route selection; what procedures should be followed for advance notification of shipments; and what standards should apply to vehicle inspections. The MRS host will be invited to participate actively in the work of this group as the transportation program evolves.

In addition to addressing issues through the Transportation Coordination Group, the DOE has entered into cooperative agreements with regional, national, and professional groups to solicit additional involvement in developing the transportation system. These groups include the Western Interstate Energy Board, the Southern States Energy Board, the National Congress of American Indians, the National Conference of State Legislatures, the Midwestern Office of the Council of State Governments, and the Commercial Vehicle Safety Alliance. As the date for the start of waste shipments approaches, the DOE will interact directly with the governments these groups represent.

SPENT-FUEL SHIPMENTS: NUMBER AND KIND

When the MRS begins operations, the spent fuel stored at commercial reactors will be shipped to the MRS by truck or by train, in transport casks designed to carry it safely and efficiently. (Transport by barge could also be considered, if appropriate.) The cask designs will be certified by the NRC, as described below. Prior to each shipment, the casks will be thoroughly inspected at the reactor sites by utilities, and they will be inspected again upon arrival at the MRS by the DOE. Maintenance of the casks and their components will be performed at the cask-maintenance facility located at the MRS.

Whether trucks or trains are used to ship the spent fuel to the MRS may depend upon the reactor from which it is shipped. Because rail casks are larger and can carry more fuel than truck casks, their use will reduce the total number of shipments that must be made. Rail transport is therefore generally preferred. However, not all reactors can ship by rail; some lack rail lines and some do not have the capability to handle heavy rail casks. In those cases, truck transport will be used.

The number of spent-fuel shipments will depend upon how much spent fuel the transport casks can hold, how many shipments are made by truck and how many by rail, and how much spent fuel the MRS can accept at any given time. Current planning assumptions are that about one train carrying three casks and about 13 trucks will arrive at the MRS each week during peak operations.

Once the repository starts accepting waste, all spent fuel will be shipped from the MRS to the repository via dedicated trains—trains carrying only spent fuel. At full operations, about one train carrying five shipping casks would leave the MRS

for the repository each week. Large capacity, 100-ton rail casks will most likely be used for these shipments.

TRANSPORTATION ROUTES WILL BE SELECTED ON THE BASIS OF FEDERAL SAFETY CRITERIA

Highway routing

Because highway shipments travel on public roads, highway routing of radioactive materials is subject to Federal law in the form of DOT regulations. These regulations specify that spent fuel and other highly radioactive materials must be transported on "preferred routes." Preferred routes consist of the Interstate Highway System and/or alternative routes designated by State routing agencies. These agencies are defined by the DOT to include both State agencies and Indian Tribal authorities that have police powers to regulate and enforce highway routing requirements. These agencies must use DOT guidelines or equivalent criteria in designating routes. The guidelines identify the important factors to be considered in selecting routes that will minimize any risks to the public. If requested, the DOE will provide technical assistance to States and Indian Tribes for evaluating and designating routes.

DOT highway routing regulations also specify the only circumstances under which a carrier may deviate from a preferred route: emergency conditions, rest or refueling stops, or pickup or delivery. For pickup and delivery, DOT regulations provide specific guidance to the carrier in selecting the safest routes. In addition, before the shipment's departure, carriers must prepare a written route plan, and after the shipment they must submit this plan to the DOT, listing all actual deviations.

Contracts between the DOE and the transportation-service contractors who will carry the shipments will specify the requirements of DOT routing regulations and formally direct that all shipments be conducted on Interstate highways or on alternate routes designated by States and Indian Tribal governments. Carriers will select their routes on the basis of these specifications.

The DOE will identify potential routes in order to identify local governments and Indian Tribes that may receive assistance and/or training for safe, routine transportation and emergency response. (This assistance is discussed below). Identification of potential routes will also be needed so that the DOE can carry out technical studies for the environmental impact statement required by law. (This document is discussed in Section 3.)

Rail routing

Rail routing of radioactive materials differs from highway routing: because rail shipments travel on private railways owned and maintained by rail carriers, rail routing of radioactive materials is not currently regulated. If the DOT should publish rail-routing regulations in the future, the DOE will follow them. If not, the DOE, in consultation with the rail carriers and interested parties, will develop rail-route planning criteria for the waste-management system. The DOE

will hold public workshops to develop and discuss the procedures and will release them for public review and comment before they are issued in final form.

TRANSPORTATION CASKS WILL MEET STRINGENT SAFETY STANDARDS

Spent fuel will be transported from reactors to the MRS and to the repository in NRC-certified shielded shipping casks designed to protect the public and transportation workers—both during normal transportation activities and if an accident occurs. Very few NRC-certified casks are currently available for use in transporting spent fuel. Newer, more efficient truck and rail casks that will be able to transport larger amounts of spent fuel are now being developed. (The rail cask could also be used for transport by barge, if that mode of transport were used.) These larger-capacity casks will reduce the number of shipments required.

The NRC will carefully review cask designs, including the methods by which they will be fabricated, to ensure that they meet NRC safety standards. Only if NRC standards are met will the NRC issue the certificate of compliance that will permit the DOE to use these cask designs. The DOE must comply with annual NRC inspections thereafter to maintain certification.

As part of the NRC's cask safety requirements, a series of tests has been developed to simulate the environment that the cask would experience if it were subject both to normal conditions of transport and to a very severe accident. Transportation experience throughout the world has shown that these tests conservatively represent a potentially severe accident. NRC regulations authorize the following methods for determining the effect of these tests:

- Actual performance of the tests on a full-scale cask.
- Performance of the tests on a scale model of the cask.
- Performance of proper engineering evaluations and analysis to determine the probable results of the tests.

Among these tests, which are used not only by the NRC but by similar regulatory agencies in other nations, are the following:

1. Free drop test: The cask is dropped from a height of 30 feet onto a flat unyielding surface, striking the surface in a position in which maximum damage is expected. The unyielding surface requirement provides a highly conservative test condition in relation to actual accident events.
2. Puncture test: The cask is dropped from a height of 40 inches onto a rounded 6-inch diameter steel bar penetrator, striking it in a position in which maximum damage is expected.
3. Thermal test: The cask is exposed to an all-engulfing heat source of not less than 1475 degrees fahrenheit for not less than 30 minutes. The cask must be allowed to cool naturally and no artificial cooling is authorized after exposure to the heat source ceases. These tests must be carried out in

sequence in order to determine their cumulative effect on the cask. In addition, all casks are subject to an immersion test in which an undamaged cask is immersed under 50 feet of water for 8 hours.

The NRC has recently proposed changes to its regulations which reflect changes in regulations of the International Atomic Energy Agency. Under the proposed NRC regulations, undamaged spent-fuel casks would have to undergo an additional deep-water immersion test: the cask would be immersed to a depth of 656 feet to assure that its containment system would not rupture. This would provide still greater safety by ensuring that there would be no release of radioactive material if the cask were dropped into a deep river or coastal waterway. The DOE has required its current cask-design contractors to comply with this requirement, even though it is not currently in effect.

EMERGENCY-RESPONSE CAPABILITIES WILL BE CAREFULLY PLANNED

If, anywhere in the country, an accident involving a spent-fuel shipment does occur, ample resources will be available to respond. The MRS host community and surrounding communities will be among those jurisdictions receiving Federal assistance that will help them respond.

First on the scene will be local responders. State and local governments have primary responsibility for implementing measures at the accident scene to protect life, property, and the environment. These measures may include diverting traffic, extinguishing fires, and rescuing the injured.

An important adjunct to local and State responders is the array of Federal emergency-response capabilities located throughout the country, including eight DOE regional teams of radiological emergency-response experts. Upon the request of a State, this capability can be mobilized within two to eight hours of notification and can be dispatched to an accident scene anywhere in the continental United States. After the DOE's initial emergency-response assistance has been completed, responsibility for monitoring clean-up activities will be transferred to the Environmental Protection Agency.

Because local and State responders are responsible for the health and safety of their citizens, their training and preparation are the keys to effective emergency response. In addition to offering support, the Federal Government offers State, Indian Tribal, and local personnel numerous courses that train them to handle emergency-response situations involving radioactive materials. Among the Federal agencies offering such courses are the Federal Emergency Management Agency, the DOE, the Department of Transportation, and the Environmental Protection Agency.

Another resource is required by the NWPA: the DOE is to provide technical assistance and funds to States for training the public safety officials of units of local government and Indian Tribes through whose jurisdictions spent-fuel shipments

will be made. Training will cover procedures required for safe, routine transportation of radioactive materials and for dealing with emergency-response situations. Jurisdictions to receive assistance will be identified when shipping routes are identified.

9. THE TRANSPORTATION EFFECTS OF AN MRS

Transporting spent fuel to and from the MRS will result in additional truck and rail traffic in the vicinity of the facility. This section explains the potential effects of such shipments.

RADIOLOGICAL EFFECTS

Radiological effects of transportation resulting from both normal and accident conditions will be below limits outlined in Federal regulations governing the transportation of radioactive materials. The U.S. Nuclear Regulatory Commission (NRC) and the U.S. Department of Transportation (DOT) require that under normal and accident conditions the maximum radiation levels near a shipping cask be limited so that doses to transportation workers are below the occupational exposure limits established by the NRC and so that doses to members of the public will be very low. (The NRC regulations are contained in 10 CFR Part 71. The DOT regulations are in 49 CFR Parts 170 through 189.)

To obtain the NRC certificate of compliance required for transport casks, the DOE will have to demonstrate that its cask design will meet NRC limits under normal and accident conditions. At least once a year, each cask will be inspected to ensure continued compliance. Once in service, each cask will be inspected prior to each actual shipment to verify that radiation levels are within allowable limits.

Radiological doses to individuals are commonly measured in units called "rem" (roentgen equivalent man), or millirem (one thousandth of a rem.) The National Council on Radiation Protection and Measurements (NCRP) estimates that an average person in the United States receives 360 millirem a year from all sources of radiation, including natural sources such as the sun and the earth, and from medical procedures such as x-rays (NCRP Report No. 93).

The dose that any individual would receive from a routine shipment would depend on the specific conditions under which he or she were exposed, such as how near to the shipping cask that individual stood, and for how long. The DOE has calculated exposure rates for an individual living from 100 feet to a half-mile away from a shipping route: a shipping cask traveling at 15 miles per hour along that route would result in a dose to that individual of less than 0.001 millirem per shipment—an exposure far below the regulatory limits. The cumulative dose received by one individual would, of course, depend on how many shipments the individual was exposed to in a lifetime.

The NRC has very strict regulations concerning accident conditions. In the more than 25 years during which spent fuel has been shipped in this country, no deaths or serious injuries to the public or to transportation workers have ever occurred as a result of the radioactive

nature of a shipment. In fact, studies of accidents involving shipments of various hazardous materials indicate that accidents involving radioactive materials are less frequent than those involving other hazardous materials and that the primary risks from accidents involving shipments of spent fuel will be from nonradiological effects.

Because transportation accidents involving radioactive materials have not produced radiological effects, the scenarios used to predict exposures or damage are based on analyses and tests. These analyses and tests indicate that, in the event of a severe accident involving a shipment of spent fuel, the shipping cask might be somewhat damaged. While the truck or rail car carrying the cask may be severely damaged, in most cases the cask itself could be transported to its destination with no need for repair. If a release of radioactive material ever does occur, it is not likely to affect an area larger than that within several hundred feet of the release.

NONRADIOLOGICAL EFFECTS

Other transportation effects will result primarily from the kinds of accidents that shipments of any kind are subject to. During the 40-year operating lifetime of the MRS, it is estimated that approximately 12-16 traffic fatalities nationwide may be attributable to transportation of spent fuel. As noted above, studies indicate that accidents involving shipments of radioactive materials are less frequent than those involving other hazardous materials.

UNITED STATES
DEPARTMENT OF ENERGY
WASHINGTON, D.C. 20585

RW5.1