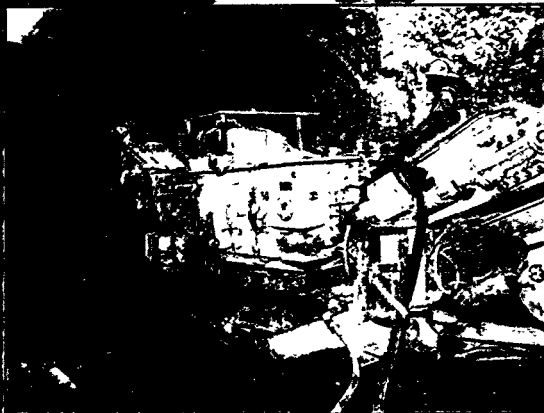


DOE/RW-0524
May 2000



Annual Report to Congress



1999

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



Printed with soy ink on recycled paper

OCRWM Performance in Brief

From the Secretary's Fiscal Year 1999 Performance Agreement with the President

1. ***Complete peer review of the total system performance assessment to provide formal, independent evaluation and critique.***

RESULTS: The peer review of the total system performance assessment was completed on May 26, 1999, and the Final Peer Review Report containing comment responses was completed on August 12, 1999. The review panel's recommendations have been factored into FY2000 and out-year planning.

2. ***Complete repository and waste package design inputs for use in total system performance assessment.***

RESULTS: Repository and waste package design inputs were completed on August 27, 1999 and will be used in the development of the total system performance assessment for the Yucca Mountain site recommendation.

3. ***Complete a draft environmental impact statement.***

RESULTS: The draft environmental impact statement was completed in July 1999 and a Notice of Availability was published on August 13, 1999 in the *Federal Register*.

DISCLAIMER

This report was prepared as an account of work sponsored by an agency of the United States Government. Neither the United States Government nor any agency thereof, nor any of their employees, make any warranty, express or implied, or assumes any legal liability or responsibility for the accuracy, completeness, or usefulness of any information, apparatus, product, or process disclosed, or represents that its use would not infringe privately owned rights. Reference herein to any specific commercial product, process, or service by trade name, trademark, manufacturer, or otherwise does not necessarily constitute or imply its endorsement, recommendation, or favoring by the United States Government or any agency thereof. The views and opinions of authors expressed herein do not necessarily state or reflect those of the United States Government or any agency thereof.

DISCLAIMER

Portions of this document may be illegible in electronic image products. Images are produced from the best available original document.

Contents

<i>From the Director</i>	v
<i>Executive Summary</i>	1
<i>Introduction - Why This Program Matters</i>	14
<i>Chapter One - Yucca Mountain Site Characterization Project</i>	19
Background on the Project	19
Preparing for the Determination on Site Recommendation	20
The Repository Safety Strategy	21
Performance Assessment	23
Peer Review	24
Core Science	24
Draft Environmental Impact Statement	41
The Regulatory Framework for Repository Development	42
Protecting Workers, the Public, and the Environment	44
Project Management	46
External Oversight	47
Relations with Affected Parties	49
Yucca Mountain Site Characterization Project Outreach	50
<i>Chapter Two - Waste Acceptance, Storage, and Transportation Project</i>	53
Acceptance of Commercial Spent Nuclear Fuel	53
Acceptance of DOE-Managed Materials	55
Baseline Management	56
<i>Chapter Three - Program Management Center</i>	57
Appropriation and Budget	57
Quality Assurance	58
Program Management and Integration	59
Staffing	64
External Interactions	66

Contents (continued)

<i>Chapter Four - Financial Management</i>	69
Program Funding	69
Managing Investments	72
Civilian Radioactive Waste Research and Development Account	72
 <i>Appendix A</i>	
Financial Statements	
 <i>Appendix B</i>	
Program Profile	
 <i>Appendix C</i>	
Program Drivers: Materials Destined for Geologic Disposal	
 <i>Appendix D</i>	
Key Federal Laws and Regulations	
 <i>Appendix E</i>	
Relations with External Parties	
 <i>Appendix F</i>	
Publications from OCRWM and Other Organizations	

From the Director

I have been impressed, since I became Director of the Office of Civilian Radioactive Waste Management (OCRWM) in December 1999, with the quality of the Program's work and the dedication of its people. Most of the work discussed in this report was completed before I took the helm, including several major actions that brought us closer to meeting the Nation's spent nuclear fuel and high-level radioactive waste management goals.

One important milestone was the issuance of the *Draft Environmental Impact Statement for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*. The draft environmental impact statement provides the background, data, and analyses that can help decision-makers and the public understand the potential environmental impacts of constructing, operating and monitoring, and eventually closing a repository at Yucca Mountain. Following the release of the document, we embarked upon a series of public hearings and provided an extended period for public comment. We will carefully assess the comments made during this process and will respond to them in the final environmental impact statement.

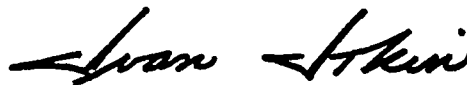
We have continued the scientific and technical work required to reduce uncertainties so that an informed, science-based decision will be made on Yucca Mountain. As some testing and analysis activities reached completion, we prepared technical documentation of our findings. This documentation will support the Secretary of Energy's decision on whether to recommend to the President that the site be approved for development as a repository.

The regulatory framework for evaluating the suitability of the Yucca Mountain site moved closer to final form. In November 1999, the Department published a proposed revision to its repository siting guidelines, reflecting a shift away from a generic approach that could apply to any site and toward a site-specific approach involving risk-informed, performance-based objectives. In Fiscal Year 1999, this same site-specific approach was taken by both the Nuclear Regulatory Commission (NRC) and the Environmental Protection Agency (EPA) in their proposed Yucca Mountain repository licensing regulations and Yucca Mountain radiological protection standards, respectively. The Department's siting guidelines base a site suitability determination on the Secretary's assessment of the site's likely ability to meet the applicable NRC and EPA regulations.

Over the past year, we have also continued to refine our design concept and to develop the conditions to be placed on its implementation. The enhanced repository design enables us to demonstrate better the expected performance of a repository at the Yucca Mountain site, while balancing such significant factors as long-term public safety, inter- and intra-generational equity, worker safety, and cost. The design provides flexibility to allow for changes based on new data or an evolution in national policy in the future.

These activities, with corresponding progress in other important areas, have kept the Program on track to complete the site characterization phase of our work. We are looking toward a decision in 2001 on whether to recommend the Yucca Mountain site to the President and then to the Congress. Our objectives are to provide the information necessary to support this process and to communicate our findings effectively to our stakeholders. A site recommendation would have to be supported by reasonable scientific assurance that a repository at Yucca Mountain will adequately protect public health and safety and the environment for thousands of years into the future.

The Civilian Radioactive Waste Management Program is on a sound course. The Administration continues to believe that the overriding goal of the Federal Government's high-level radioactive waste management policy should be the establishment of a permanent geologic repository. OCRWM is in the process of completing the scientific and technical work leading up to the national decisions supporting this goal.



Ivan Itkin, Director
Office of Civilian Radioactive
Waste Management

Executive Summary

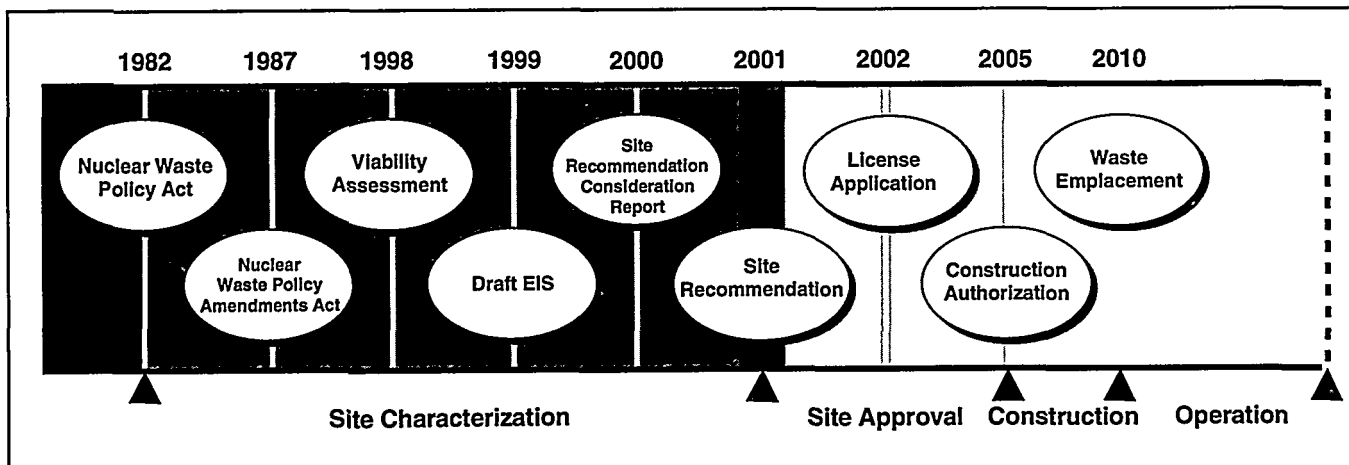
Site Characterization Meets Key Milestone; Waste Acceptance Issues Remain Open

Overview

During Fiscal Year 1999, the Office of Civilian Radioactive Waste Management (OCRWM) continued to make significant progress in its characterization of the Yucca Mountain, Nevada, candidate geologic repository site. Although OCRWM's appropriation for Fiscal Year 1999 was lower than requested, the Program accomplished all three success measures in the Secretary's Fiscal Year 1999 Performance Agreement with the President and completed important work in many other areas. Most of the Program's funding and activity centered on supporting the next major statutory milestone – a Secretarial determination whether to recommend Yucca Mountain for development of a repository for spent nuclear fuel and high-level radioactive waste. Many planning activities related to waste acceptance and transportation and some tasks related to preparing for a license application were deferred.

A key milestone was reached with the publication of the draft environmental impact statement for the potential repository. It is intended as a tool to assist with decision-making and provides public disclosure of information. Completed in July 1999, the draft presents the results of analysis of potential impacts associated with constructing, operating and monitoring, and eventually closing, a repository at Yucca Mountain and of transporting waste to Yucca Mountain from 77 sites across the United States. In general, the proposed action would cause minor, short-term public health impacts due primarily to the transportation of spent nuclear fuel and high-level radioactive waste to Yucca Mountain. We also began a series of 21 public hearings on the draft environmental impact statement. The Nuclear Waste Policy Act requires that a final environmental impact statement accompany a site recommendation.

The peer review panel we had convened in 1997 to provide a formal, independent evaluation and critique



Major Program phases

of our total system performance assessment methodology delivered its final report in February 1999. The panel, which included experts in all fields related to repository performance, evaluated all aspects of our analytical approach, reviewed supporting documentation, attended technical meetings, and examined documentation for the total system performance assessment as it was being prepared. The panel's findings and recommendations were factored into our work plans for Fiscal Years 1999 and 2000.

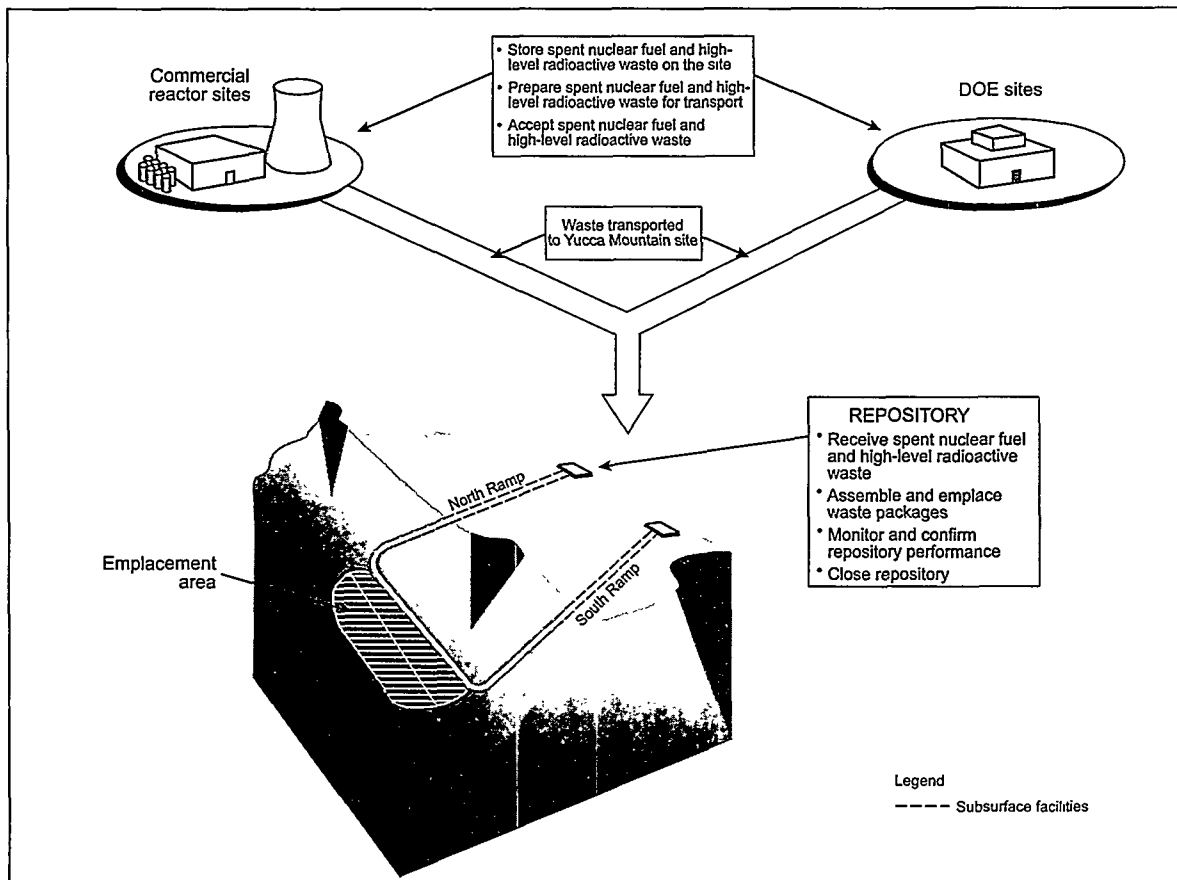
In April 1999, we completed enhanced repository and waste package designs for use in the total system performance assessment to support a site recommendation and potential repository license application. Based on a study we began in July 1998 to reduce uncertainties about repository system performance, the enhanced design will be the basis for the total system performance assessment prepared in

support of a determination whether to recommend the site. The enhanced design reduces thermal loading, which will make water movement near the waste packages easier to predict and model. The new design also uses a more corrosion-resistant waste package design and a drip shield to protect waste packages from water and possible rock falls.

Yucca Mountain Site Characterization Project

Preparing for the determination on site recommendation

Fiscal Year 1999 work focused on preparing for a Secretarial determination on site recommendation. Section 114 of the Nuclear Waste Policy Act requires that, before making this determination, the Secretary hold public hearings near the site. If a recommendation



Waste management system concept

is made by the Secretary, that recommendation must be accompanied by a comprehensive statement of the basis for the recommendation, and it must be provided to the public at the same time it is submitted to the President. We expect to release a Site Recommendation Consideration Report that will inform the public of the information and data underlying a possible site recommendation. It will include a description of the repository system and a preliminary evaluation of site suitability consistent with DOE's repository siting guidelines. It will inform local residents and solicit the comments of the Governor and legislature of the potential host State.

models that will provide the technical basis for site recommendation.

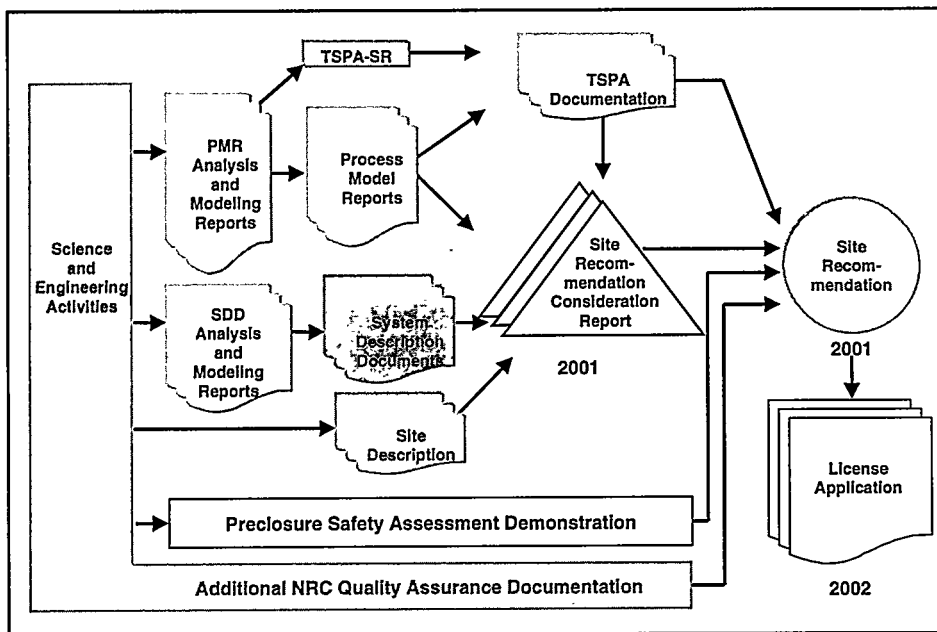
- **Reducing scientific uncertainties** – determining the range and variability of potential impacts of water movement on the engineered barrier system and of heat from radioactive decay on the natural barrier system.
- **Improving engineering designs** – adopting a repository design concept with a lower repository temperature, drip shields to help keep water from waste packages and use of

more corrosion-resistant materials in the waste packages. The enhanced design concept preserves flexibility that will permit future design enhancements and would allow future generations to determine when to close the repository.

- **Releasing the draft environmental impact statement** – publishing for public comment and holding hearings so that a final environmental impact statement can be prepared to accompany a site recommendation.

- **Proposing revised DOE repository siting guidelines (10 CFR 963)** – promulgating revised site-specific guidelines

that focus on how the total system of natural and engineered barriers would perform.



Documentation required for site recommendation and license application

Our Fiscal Year 1999 work to develop the Site Recommendation Consideration Report built on the *Viability Assessment of a Repository at Yucca Mountain* that the Secretary released in December 1998. To reflect information presented in the viability assessment, we refined the repository safety strategy that guides our site characterization studies. We placed additional emphasis on:

- **Strengthening total system performance assessment** – updating and documenting the

Strengthening total system performance assessment

In a major Fiscal Year 1999 initiative, we began developing two sets of reports describing in detail the bases of the performance assessment models that will support evaluation of site performance. These numerical models integrate data from site investigations and laboratory studies, expert judgment,

and information about engineered barriers designed to isolate waste. A total system model simulates how a repository at the site might perform under a range of conditions over thousands of years. The result is an estimate of the annual radiation dose a person might receive from radioactive waste emplaced within Yucca Mountain. If the repository is to be licensed, that dose cannot exceed the regulatory standards that are now being finalized.

The reports we are developing, which reflect the insights of peer reviewers, present technical information in a way that ensures that all data and references used in these assessments are accounted for, are transparent, and can be traced to their sources.

During the fiscal year, we continued to refine the performance assessment models used in the viability assessment to reflect new information from site investigations and laboratory studies, advances in modeling physical processes at the site, and the enhanced repository design. The scientific and engineering work reflected in these refinements is described below. Model refinement will be completed in Fiscal Year 2000, and an iteration of total system performance assessment will be conducted for the Site Recommendation Consideration Report.

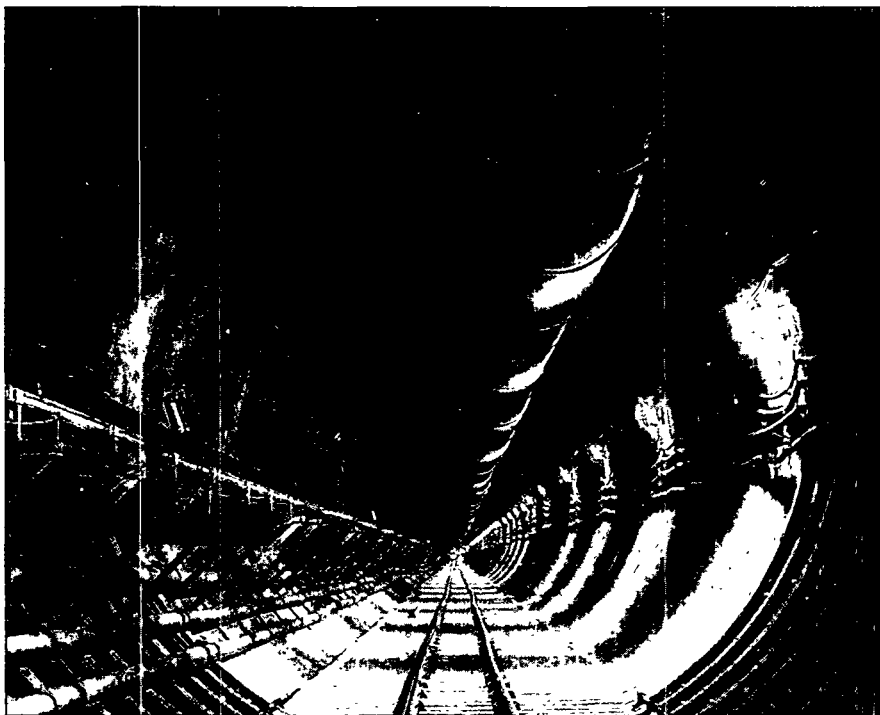
Reducing scientific uncertainties

Our scientific data collection and experimentation continued to focus on reducing uncertainty about the range of variability in the natural environment. As we reduce uncertainty, our models become more realistic.

Most scientific studies are carried out at facilities on the site, augmented by off-site

laboratory and field studies. The centerpiece is the underground Exploratory Studies Facility, the main loop of which is nearly 8 kilometers (5 miles) long. Transecting it is the cross-drift, a tunnel 2.8 kilometers (1.67 miles) long that provides direct access to the central and western portions of the proposed repository block. Alcoves and niches within these facilities are instrumented for testing. Other facilities include more than 350 boreholes drilled from within underground facilities; more than 450 boreholes drilled from the surface; the Busted Butte Test Facility, which gives us access to rock similar to that beneath the potential repository horizon; over 200 pits and trenches; monitoring wells; and Global Positioning System stations. These locations yielded data on geologic, geochemical, geomechanical, and hydrologic features and processes, and the coupled mechanical, hydrologic and chemical effects of heat on rock.

We are most interested in two areas: movement of water and the effect of heat on the host rock. These areas, which have been studied since the



Cross drift



Gathering data on rock characteristics in the cross drift

conditions, in what quantities, and at what rates water could seep onto waste packages. Studies of seepage and water flow helped us learn how water infiltrates the rock of the unsaturated zone. To further such studies, we began to construct facilities within the cross-drift, directly within repository host rock. Seepage tests were also performed within the main tunnel of the cross-drift. We will use the resulting data to verify and increase confidence in models of water flow from the surface to the repository. Results so far indicate that water does not flow uniformly through

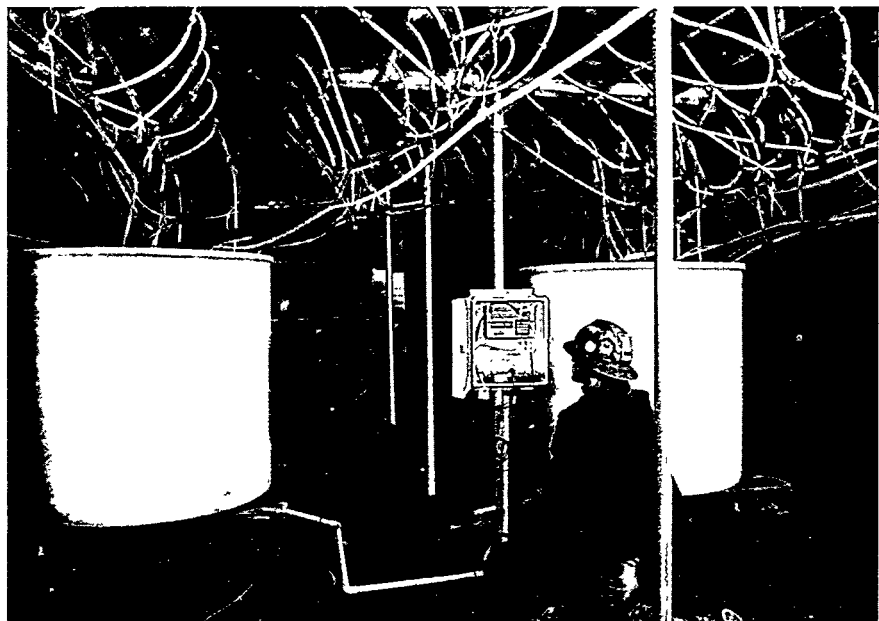
beginning of site investigations at Yucca Mountain, were identified once again in the viability assessment and raised as concerns by the Nuclear Waste Technical Review Board.

Water could seep from the surface of the site into the repository and onto waste packages, corroding them. This could result in the release of radionuclides that could eventually be transported through the unsaturated zone above the water table to the saturated zone and ultimately to the accessible environment. We are studying water movement through three zones: through unsaturated rocks from the surface to the repository, and then from the repository to the water table, and finally within saturated rocks below the water table.

Water seeping from the surface down approximately 300 meters (1,000 feet) to the repository is expected to be the primary source of waste package corrosion. We are continuing to investigate under what

the rock and that, under current climatic conditions, very little water flows through the repository horizon.

Eventually, waste packages will corrode, and water beneath the repository will carry



Conducting a seepage test in Alcove 1

radionuclides. We are studying the mechanisms and pathways by which, and rates at which, water could travel from waste packages down 300 meters (1,000 feet) to the water table. We are studying both water movement and the interactions of radionuclides with the host rock. At the Busted Butte facility, scientists studied how water travels through rock identical to that beneath the potential repository horizon. Sorption measurements at Busted Butte using surrogate radionuclides confirmed that transport data from laboratory tests are applicable to site-scale modeling.

Once radionuclide-bearing water reaches the water table, it can flow horizontally and could eventually reach the accessible environment. To understand how groundwater flows in the fractured aquifer below the repository and what the radionuclide sorption properties of the aquifer are, we monitored boreholes and conducted tracer testing at the C-Well complex. Wells drilled by Nye County, Nevada, also yielded valuable data on the saturated zone. Laboratory tests helped us better understand the radionuclide-sorption properties of the alluvium and volcanic aquifers. We used the data to develop estimates of groundwater travel time and to better understand how sorption of radionuclides could reduce radionuclide concentrations.

To more closely calibrate a regional hydrologic model to observations of actual conditions at the Yucca Mountain site, we continued our 5-year collaboration with the U.S. Geological Survey; the U.S. Fish and Wildlife Service; the U.S. Park Service; representatives from Nye County, Nevada, and Inyo County, California; and the Nevada State Engineer's Office. Fiscal Year 1999 tasks included field work to gather new data and refinement of the regional

hydrologic model. We also incorporated new data into our three-dimensional geologic model of the site.

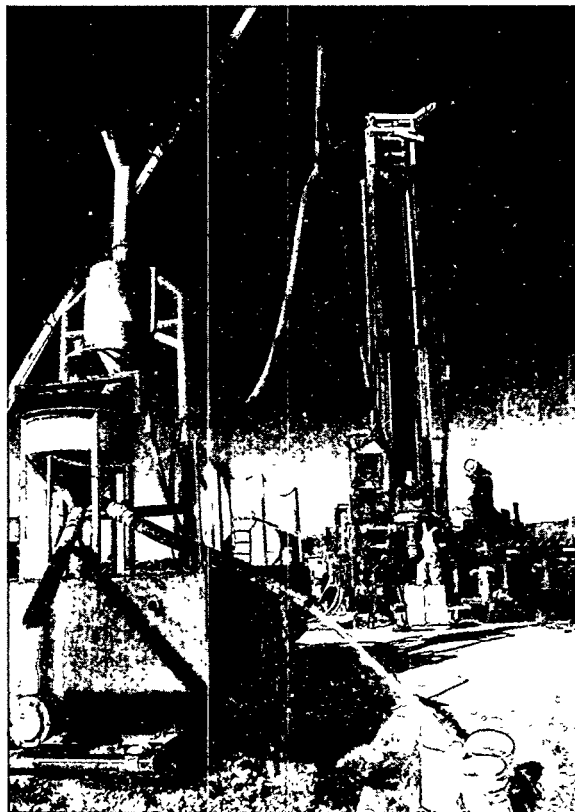
Heat generated by radioactive decay of the waste could alter the surrounding rock and affect the rate at which waste packages degrade and radionuclides are released. Three field heater tests and additional laboratory tests continued to generate valuable data. Results thus far include identification of conduction as the dominant heat transfer mechanism and the preliminary indication that rock pore water mobilized by the heat tends to drain by gravity to below the heated region, rather than staying perched above it.

Improving engineering design

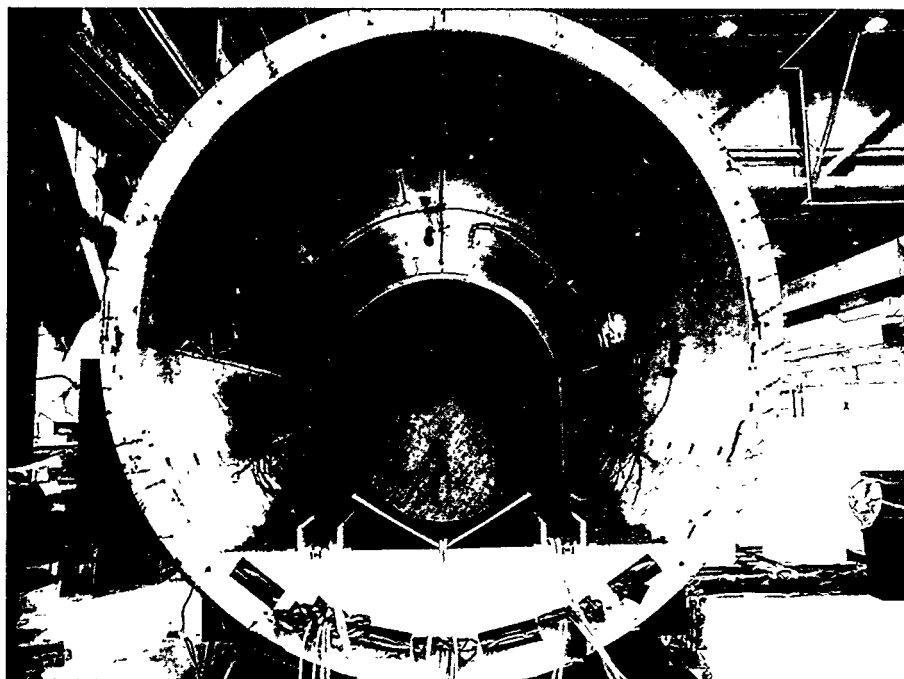
A major Fiscal Year 1999 accomplishment was the adoption of repository design enhancements for the total system performance assessment that will support the Secretarial determination on site recommendation. Some of the new features had been recommended by the Nuclear Waste Technical Review Board. A key

aspect is a lower repository temperature, achieved through a set of thermal management techniques, because the heat from radioactive decay may cause water to boil and condense, introducing uncertainties. The enhanced design also includes the use of drip shields to help keep water from waste packages and waste package materials with improved corrosion-resistance. The enhanced design concept preserves flexibility that will permit future design enhancements and would allow future generations to determine when to close the repository.

Another important task that will support the Site Recommendation



Nye County drilling program



Preparation for a pilot-scale drip shield test

analyses that can help government officials and the public understand the potential environmental impacts of actions that the Department may propose: constructing, operating and monitoring, and eventually closing, a repository at Yucca Mountain. It also examines the impacts of transporting waste from around the country to the repository.

To provide a basis for comparison with the proposed action, the draft EIS presents a No Action Alternative that analyzes the consequences of continued storage of spent nuclear fuel and high-level radioactive waste at current sites. The draft EIS states that the Department's preferred

alternative is to proceed with repository development, because analyses did not identify any potential environmental impacts that would be a basis for not proceeding with the proposed action.

Releasing the draft environmental impact statement

A series of 21 public hearings on the draft EIS was under way as the fiscal year closed. We also held periodic meetings to brief stakeholders on EIS-related issues. Comments and responses will be published in a comment response document that will be part of the final EIS, scheduled for release in Fiscal Year 2001.

In July 1999, we completed the *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada* (EIS). It provides the background, data, and

Proposing revised DOE repository siting guidelines (10 CFR 963)

In Fiscal Year 1999, the regulatory framework for evaluating the suitability of the Yucca Mountain site moved closer to final form. On November 30, 1999, the Department published a proposed revision to its repository siting guidelines. The proposed revised guidelines reflect a shift away from a generic approach that could apply to any site and that focused on individual technical criteria to a site-specific approach that relies on an overall systems evaluation of the expected performance of a repository at Yucca

Proposed Action Alternative (Preferred)	Non-Action Alternative
<ul style="list-style-type: none"> DOE proposes to construct, operate and monitor, and eventually close a repository at Yucca Mountain for the geologic disposal of SNF and HLW 	<ul style="list-style-type: none"> DOE will decommission and reclaim the Yucca Mountain site and continue to store SNF and HLW at existing commercial and DOE sites

Alternatives examined in the draft EIS

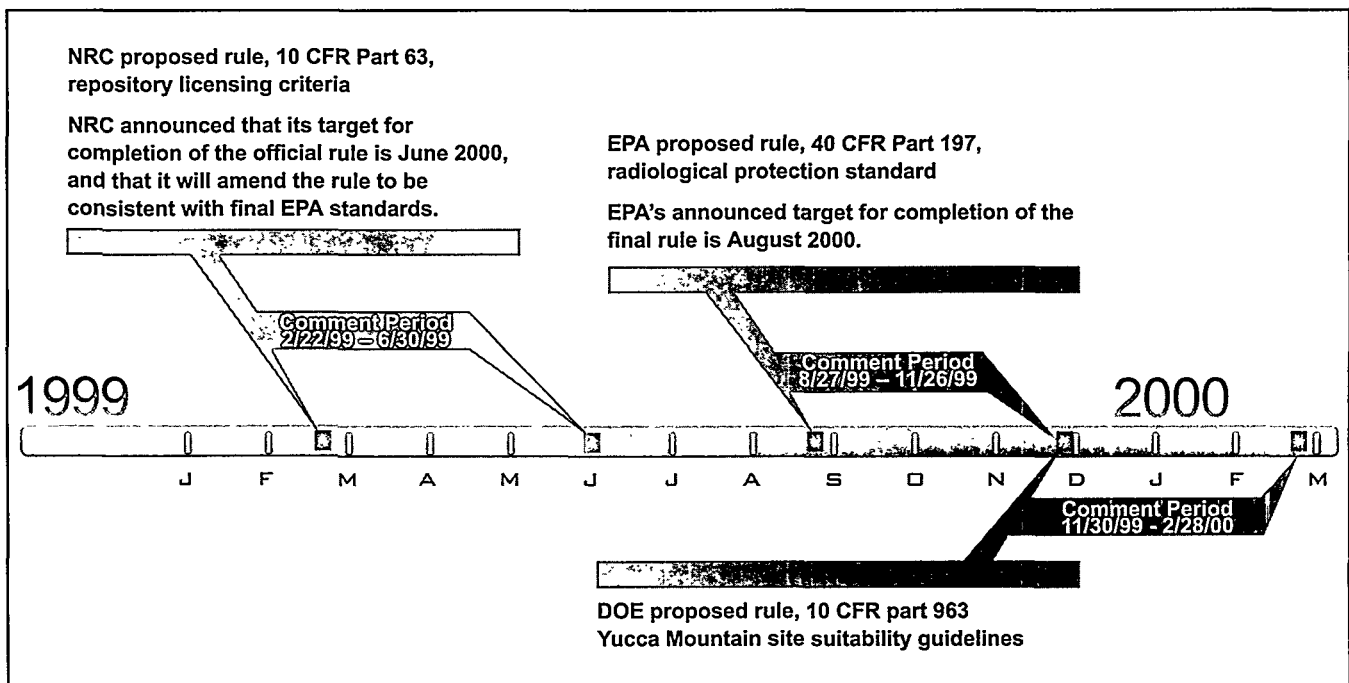
Mountain. This same approach had been taken by NRC in the proposed repository licensing regulations it published on February 22, 1999. The Department's proposed siting guidelines will result in an assessment of the site's ability to meet NRC's licensing regulations. On August 27, 1999, the Environmental Protection Agency (EPA) published proposed radiation protection standards for a repository at Yucca Mountain. NRC's regulations must implement EPA's standards. NRC has announced that it will, if necessary, revise its regulations once EPA's standards are finalized.

Waste Acceptance, Storage, and Transportation Project

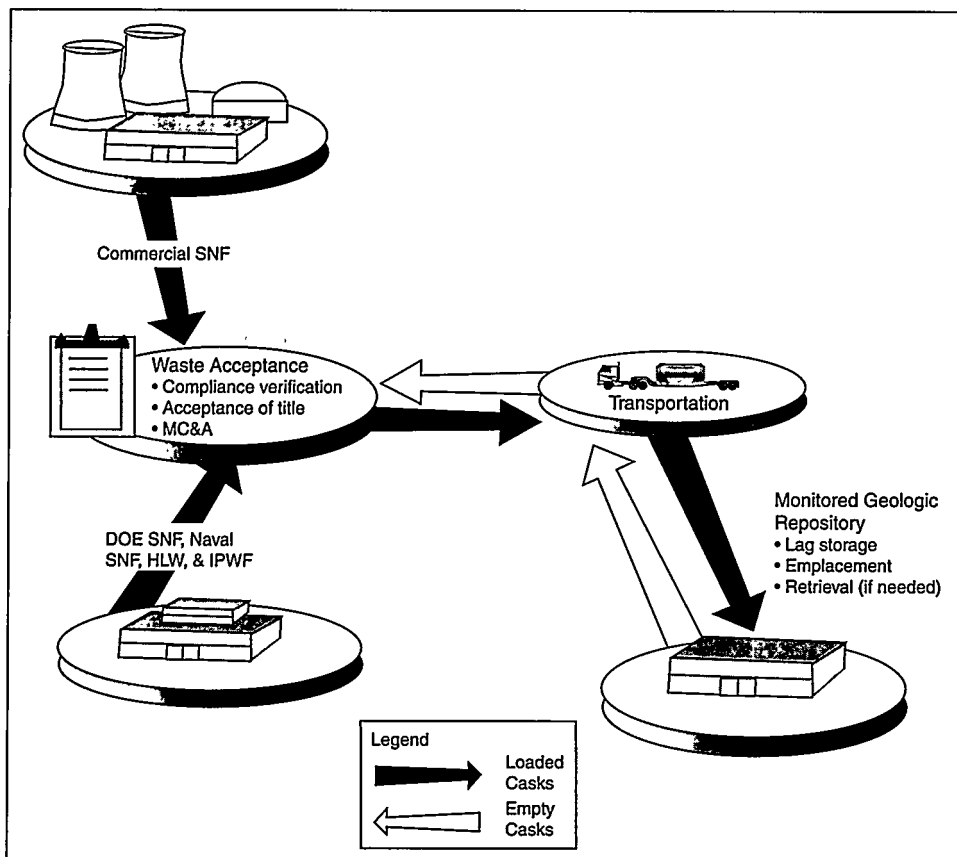
With funding for this Project at less than 1 percent of our Fiscal Year 1999 budget, work remained curtailed. We continued to manage the contracts we executed with utilities under the Nuclear Waste Policy Act and to gather the data about their spent fuel inventories that are required for waste acceptance.

Under these contracts, DOE was to start accepting spent nuclear fuel from utilities in 1998. With no Federal facility available to receive the material, utilities continued to pursue litigation to seek relief from hardships they allege as a consequence of the Department's inability to accept waste. In an effort to resolve this dispute, in March 1999 testimony before Congress, the Secretary proposed that the Department take title to utilities' spent nuclear fuel and manage it at their sites. Analysis of this option is still under way.

Some utilities are running out of "wet storage," in engineered pools of water where spent nuclear fuel assemblies are stored pending disposal. In October 1999, a successful demonstration of a prototype for a dry transfer system for spent nuclear fuel, which Congress had directed DOE to develop cooperatively with the nuclear utility industry, was concluded. The NRC issued its draft assessment of our Topical Safety Analysis Report in February 2000. A final report will be prepared after comments are received and reviewed.



Timeline for regulatory activities



Movement of waste to the repository

performance assessment to identify the activities with greatest impact on levels of confidence related to evaluations of site suitability and possible licensing. They examined whether that work was performed under appropriate QA requirements, whether requirements were fully understood, whether they were properly implemented, and whether compliance was adequately documented. For performance assessment, QA reviews focused on model validation, qualification of existing data, and software control. Deficiencies were evaluated and, if warranted, root causes were investigated. For each deficiency, a corrective action plan was developed, reviewed, and implemented. The result will be work

Throughout the fiscal year, OCRWM and DOE offices that manage nuclear materials slated for disposal in a repository continued to implement the terms of their memoranda of agreement and to otherwise coordinate planning for waste acceptance.

products that can withstand scrutiny and be used to support a possible site recommendation.

Program Management Center

Quality assurance

Headquartered in Las Vegas, OCRWM's Office of Quality Assurance (QA) used audits, surveillance, inspections, and participation in reviews of technical documents to examine the full range of quality-affecting activities performed by OCRWM, its contractors, and the organizations within DOE's Office of Environmental Management that interface with OCRWM.

QA personnel worked closely with technical personnel conducting scientific studies, design work, and

Program management and integration

Revision 2 of the *Civilian Radioactive Waste Management Program Plan*, issued in July 1998, describes Program objectives and outlines work scope, key milestones, and budgetary resources required to complete them. The fact that Congress appropriated significantly less funding than required to carry out planned work as scheduled resulted in a reprioritization of our efforts and a reassessment of near-term milestones. In Fiscal Year 1999, we began to update plans and schedules to reflect lower appropriations and build upon recent events, including DOE's issuance of the viability assessment, the draft EIS, and proposed revisions to DOE's repository siting guidelines; EPA's issuance of proposed site-specific radiation standards; and NRC's release of proposed new licensing regulations.

Consistent with Department-wide efforts to improve project management, we strengthened the planning and control that will ensure that the components of a waste management system are integrated, safe, reliable, and cost-effective. During Fiscal Year 1999, we analyzed alternative approaches to managing the construction phase of repository development, so that spending could remain relatively level through 2020. We also updated the *Design Basis Waste Stream Report*, which provides the reference inventory of spent nuclear fuel and high-level radioactive waste intended for disposal in the repository. The information will support the Site Recommendation Consideration Report and a potential license application.

Maintaining the integrity of the information generated by years of site investigations, engineering, and performance assessment and making it readily accessible remained a top priority. In Fiscal Year 1999, we consolidated information management functions under an Office of Information Management within the Yucca Mountain Site Characterization Office.

Y2K compliance proceeded smoothly. We met all DOE Y2K milestones for mission-critical and non-mission-critical systems ahead of the Secretary's stretch goals. The mission-critical systems were subsequently independently verified and validated, and we completed and tested our Y2K Business Continuity Plan. The transition to 2000 was problem-free.

A principal driver behind our application of information technology is the need to access information during a potential licensing proceeding. On December 30, 1998, NRC finalized its revision of requirements for an Internet-based Licensing Support Network that would provide an electronic means of supporting document discovery motions and permit electronic docketing of the license application itself. The rule changes the requirement for a large centralized database but retains the requirement to provide scanned images with associated bibliographic indexes and the capability to perform full text searches of each document related to licensing. We have continued to reprocess legacy records and process current records into the format required. At the end of Fiscal Year 1999, our system held a total of 917,200 legacy and current records.

To provide our managers and potential vendors with a useful roadmap for future acquisitions, in Fiscal Year 1999, we published an *OCRWM Program Business Plan* documenting our overall business and contracting strategy for managing acquisitions. For the short term, it focuses on the recompetition of a contract for management and operating services. If repository development is approved, the plan will guide acquisition of contractors to construct and operate the repository. The concepts and strategies presented are predicated on our receiving adequate funding and necessary approvals, as well as on other external factors. The plan has been designated a model for other DOE programs to follow in developing site management plans required by the Department.

External interactions

In Fiscal Year 1999, OCRWM's Acting Director and staff at headquarters and at the Yucca Mountain Site Characterization Office met with representatives of over 25 Federal agencies, environmental groups, technical and professional organizations, policy groups, and international organizations.

International efforts gained greater visibility when, in 1998, Secretary Richardson announced at the first International Atomic Energy Agency (IAEA) General Conference that the Department would convene an international conference to highlight global progress on management of nuclear materials and radioactive waste in geologic repositories. OCRWM was assigned lead responsibility, and we worked with other offices within the Department to coordinate planning in cooperation with the IAEA and the Organization for Economic Cooperation and Development/Nuclear Energy Agency (OECD/NEA). Hosted by the City of Denver, Colorado, the conference was held October 31 - November 2, 1999. Participants were invited to tour the Yucca Mountain site and the Waste Isolation Pilot Plant (WIPP) the next day. We coordinated the timing of the conference with the National Academy of Sciences' technical workshop on geologic disposal in Irvine, California, on November 4-5, 1999.

We met several times with officials of the Russian Federation's Ministry for Atomic Energy (Minatom) in

an effort to formalize an agreement for cooperative activities on geologic disposal of radioactive materials. In June 1999, senior Minatom officials met with us at DOE headquarters and the Yucca Mountain Site Characterization Office and visited the Yucca Mountain site. We established a joint working group on spent nuclear fuel to assess broader issues associated with the shipment, storage, direct disposal, and management of radioactive waste and spent nuclear materials.

OCRWM also continued its membership in the OECD/NEA, the IAEA, and the newly formed International Association for the Environmentally Safe Disposal of Radioactive Materials.

Conclusion

As the year closed, we were engaged in tasks that will culminate in a determination by the Secretary whether to recommend Yucca Mountain for development as a repository. Scheduled for Fiscal Year 2001, the determination will mark the end of the site characterization phase of our work, an 18-year, approximately \$4 billion effort that has produced a comprehensive understanding of the Yucca Mountain site and of what is required to design a repository that would perform safely in that setting.

How geologic disposal would work at Yucca Mountain

If Yucca Mountain is approved for development as a repository, waste materials, all in solid form, would be placed into robust containers called waste packages. These containers would be emplaced in tunnels, termed *drifts*, excavated deep within the mountain, at a depth of approximately 300 meters (1,000 feet) below the surface and approximately 300 meters (1,000 feet) above the water table.

A combination of natural and engineered barriers would contain the waste for thousands of years, thereby minimizing the amount of radioactive material that would eventually be released and transported to the human environment. The natural barriers include the semiarid environment at Yucca Mountain, which is favorable for long-term waste isolation. The engineered barriers would include robust, long-lived waste packages and other design features of a repository, described in Chapter 1.

Scientists believe that water is the primary means by which radionuclides could be transported and that four key attributes of a repository in this geologic setting would protect public health and the environment for thousands of years:

- Limited water would contact waste packages.
- Waste packages would last a long time.
- Once waste packages were breached, radionuclides would be released slowly.
- The concentration of radionuclides would diminish as they are transported toward the human environment.

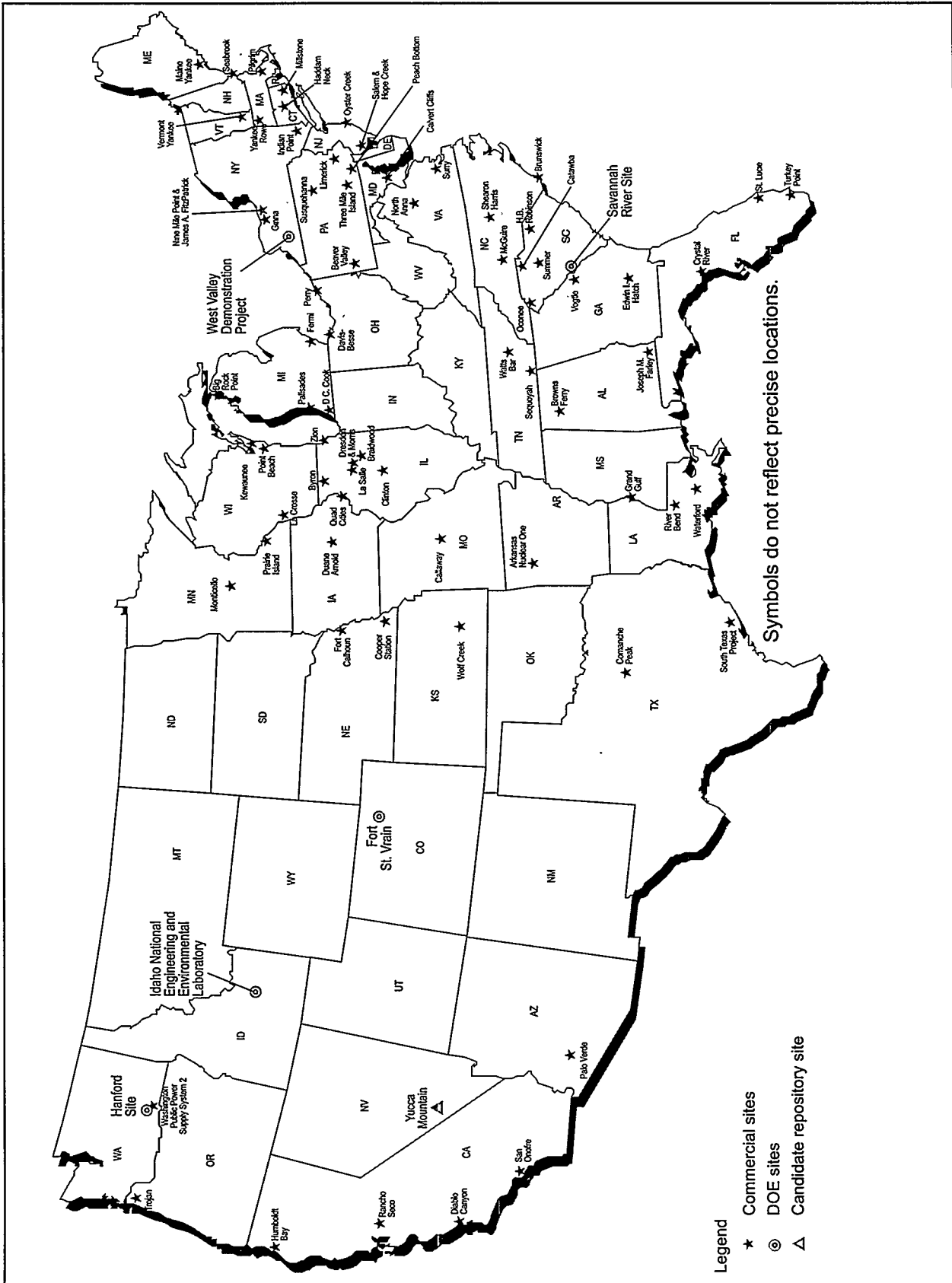
Accordingly, the barriers would serve these principal functions:

- They would keep water away from the waste as long as possible.
- They would limit the amount of water that finally contacts the waste.
- They would slow the release of radionuclides from the waste.
- They would reduce the concentrations of radionuclides in groundwater.

The natural and engineered barriers would work as a system that would exploit a design strategy termed defense-in-depth. This means that some barriers would continue to function even if others failed because no two barriers would be likely to fail for the same reason or at the same time.

The Environmental Protection Agency (EPA) published its proposed site-specific radiation standards for Yucca Mountain, 40 CFR 197, in the *Federal Register* on August 27, 1999. The standards would establish limits for the radiation doses to which a repository system at Yucca Mountain could expose future residents near the site. If the Yucca Mountain site is approved for development as a repository, the Department would have to demonstrate in a licensing proceeding before the Nuclear Regulatory Commission that radiation releases from a repository system at Yucca Mountain would not exceed EPA dose limits.

This page intentionally left blank.



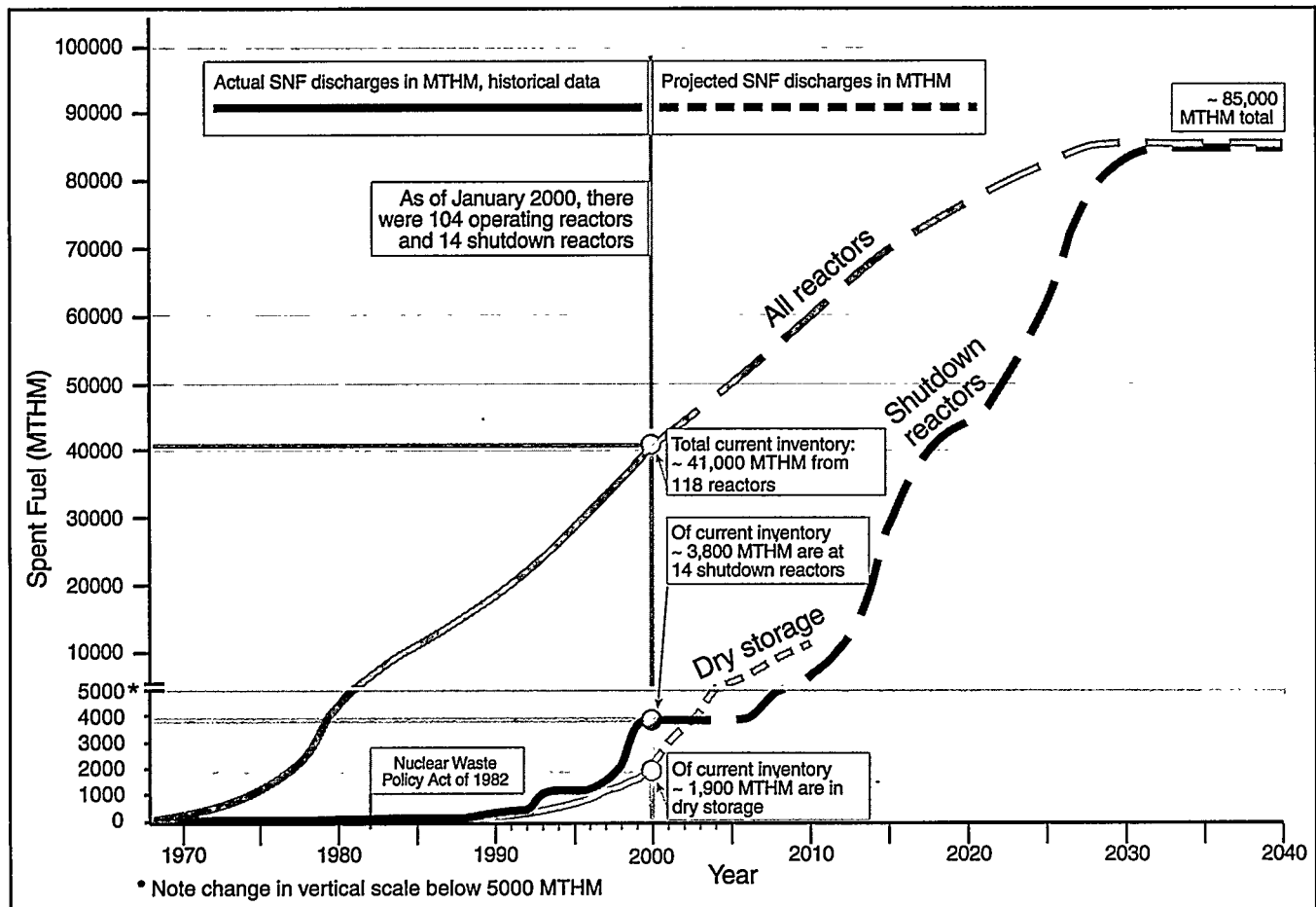
Introduction

Why This Program Matters

What is the extent of “the nuclear waste problem”?

Decisions made many decades ago to pursue a nuclear weapons program and to develop nuclear energy for civilian use committed the Nation to perpetual custody of a large and growing inventory of radioactive materials, as described in Appendix C. Spent nuclear fuel from commercial power plants constitutes the largest portion of this inventory. The

balance consists of nuclear materials managed by the Department of Energy (DOE), which primarily result from defense activities. DOE-managed materials include spent nuclear fuel from weapons production, domestic research reactors, and foreign research reactors; high-level radioactive waste from reprocessing spent nuclear fuel; surplus weapons-usable plutonium waste forms; and naval spent nuclear fuel.



Historical and projected commercial spent fuel inventory

The Nuclear Waste Policy Act of 1982 (the Act) created the Office of Civilian Radioactive Waste Management (OCRWM) to develop a permanent, safe geologic repository for disposal of spent nuclear fuel and high-level radioactive waste. The Act gave the Nuclear Regulatory Commission (NRC), which was already regulating commercial nuclear power reactors, the authority to decide whether to authorize construction and operation of the repository. In its early years, OCRWM was concerned primarily with disposal of commercial spent nuclear fuel. In 1985, President Reagan determined that defense-related high-level radioactive wastes are to be disposed of in the civilian repository. Since then, disposal of DOE-managed nuclear materials has grown in importance.

The Program Profile in Appendix B provides basic information on the Civilian Radioactive Waste Management Program.

What is at stake?

The Administration continues to believe that permanent geologic disposal should remain the basic goal of the Nation's high-level radioactive waste management policy.

- Internationally, permanent geologic disposal is the consensus on management of commercial spent nuclear fuel. The U.S. remains committed to a once-through fuel cycle and to disposing of commercial spent nuclear fuel in geologic repositories. This policy assumes that fuel originating in the U.S. and used in foreign research reactors will be disposed of in a U.S. repository. It undergirds our Nation's advocacy of limiting international trade in weapons-usable nuclear materials and signals our commitment to a policy of non-proliferation of nuclear materials.
- A geologic repository is critical to the accelerated environmental cleanup of numerous DOE sites around the country. That cleanup serves not only an environmental, but a fiscal goal: reduction of the huge mortgage costs that are the legacy of the Cold War.
- The Navy is committed to ensuring uninterrupted operation of its nuclear-powered

fleet and the management of its spent nuclear fuel to facilitate ultimate safe disposal. Naval spent nuclear fuel is currently stored at the Idaho National Engineering and Environmental Laboratory, for which DOE is responsible. Under a consent agreement among the Navy, DOE, and the State of Idaho, DOE shall remove spent nuclear fuel from Idaho by January 1, 2035.

- Operation of the nuclear reactors that supply 20 percent of the Nation's electricity is contingent on NRC licensing, which in turn depends on periodic reviews that NRC conducts to assess prospects for timely disposal of commercial spent nuclear fuel. Without progress toward a repository, continued reactor operations and license renewals could be jeopardized.
- A repository is needed to facilitate the orderly and safe shutdown and decommissioning of older nuclear power plants. If economic conditions accelerate the shutdown of commercial nuclear power reactors, the utilities that own them will have to maintain custody of their spent nuclear fuel until the Federal Government can accept it.

What have we achieved to date?

The "nuclear waste problem" presents a daunting set of challenges: (1) the complexities of managing a large project in a Federal setting subject to multiple regulatory requirements; (2) the challenges of operating on a scientific frontier; (3) the need to integrate an unusually broad array of scientific, technical, and managerial disciplines; (4) the demands of a complex and lengthy NRC licensing proceeding; and (5) the political sensitivities associated with an inherently controversial mission.

Many Congresses, several Administrations, regulatory and oversight bodies, stakeholders, OCRWM staff and contractors, and DOE's National Laboratories have worked steadily toward the goal of geologic disposal. They have achieved significant results:

- Landmark legislation, the Nuclear Waste Policy Act of 1982, that codified the

commitment of the Federal Government to solving the “waste problem,” created a financial mechanism to pay for the solution, and defined an orderly, open process to develop a waste management system.

- A potential repository site at Yucca Mountain, Nevada, and an extensive underground laboratory there that gives scientists direct access to geologic formations within which a repository would be housed.
- An increasingly sophisticated body of scientific, engineering, and performance assessment expertise with which we can (1) design site investigations that yield needed data, (2) use the data to design a repository that is tailored to the site and would comply with NRC licensing requirements, and (3) develop models simulating the performance of the repository under a range of site conditions over thousands of years.
- The regulatory expertise needed to conduct a complex licensing proceeding that could take at least 3 years and entail thousands of supporting documents. A shared understanding of how to approach difficult technical issues has been achieved through years of consultation between OCRWM and NRC, and the regulatory framework that will govern the determination on site

recommendation and a possible licensing proceeding is moving closer to final form.

- Years of experience in safely transporting radioactive waste and the proven technology needed for safe shipments.
- A comprehensive viability assessment detailing what has been learned from years of site characterization.
- A draft environmental impact statement providing the background, data, and analyses to help decision-makers and the public understand the potential environmental impacts that could result from a repository at Yucca Mountain.
- Long-standing and productive working relationships have strengthened our work. Critical comments from oversight bodies, the larger technical and scientific communities, and a host of stakeholders provide the foundation of our efforts to earn public acceptance.

A measure of the U.S. achievement is the fact that other nations continue to look to our Program as a model for their own efforts. The discussion of international cooperation in Chapter 3 underscores the importance of the U.S. contribution to resolution of this problem.

This page intentionally left blank.

Chapter One

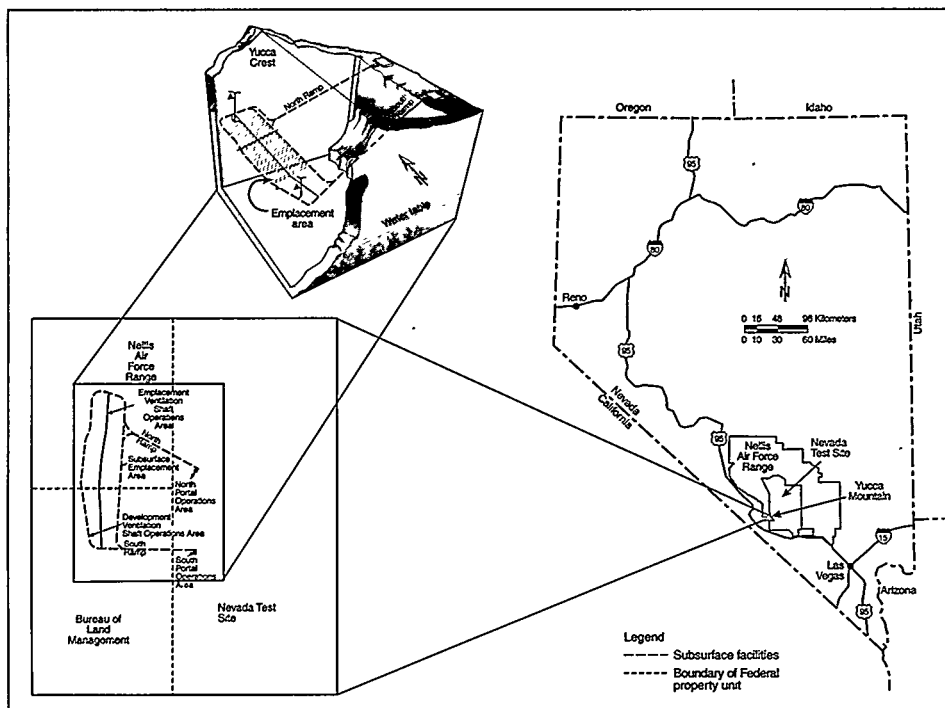
Yucca Mountain Site Characterization Project

Background on the Project

Located 100 miles northwest of Las Vegas, Nevada, on remote and semiarid Federal land, Yucca Mountain has for many years been the subject of studies to support a determination of whether it should be developed as a repository for spent nuclear fuel and high-level radioactive waste. If a repository is developed there, OCRWM will accept waste from the sites where it is stored, transport it to Yucca Mountain, and emplace it in the repository. A plan for closing the repository will be developed, but future generations would decide when to permanently close it.

The site characterization studies of Yucca Mountain have generated a huge volume of information. Ensuring the integrity of the information, evaluating it, and presenting it in forms that other parties can use is a significant task, as is interacting with other parties. By the time site characterization ends, approximately \$4 billion and 18 years of effort will have been invested in studies of Yucca Mountain and design of a repository tailored to its features.

At the conclusion of site characterization, the Secretary of Energy will draw upon the information we have produced and on other sources to determine whether this information is necessary and sufficient to recommend to the President that a repository be developed at the site. If the Secretary does recommend the site for development, and if the President recommends the site to Congress, then the State of Nevada will have an opportunity to disapprove the designation. If Nevada disapproves the designation, Congress must act to designate the site for development. If the site is designated, DOE must submit a license application to NRC for authorization to construct a repository. Subsequent license amendments would authorize operation and eventual closure.



Location of Yucca Mountain candidate repository site

In Fiscal Year 1999, the Project focused on preparing

the documentation needed to support the Secretary's determination on site recommendation. This chapter reports on preparations for this determination, which entailed updating the repository safety strategy that guides site characterization; refining and further documenting performance assessment models, reducing scientific uncertainties, and enhancing repository design; issuing a draft environmental impact statement; and updating the regulatory framework for evaluating site suitability. It also reports on our interactions with external oversight bodies and other parties, continuing efforts to protect workers and the environment, and significant project management functions.

The \$282.4 million allocated to the Project for Fiscal Year 1999 work was distributed as shown below.

Core science:	\$74.8M
Design and engineering:	78.4
Site suitability, licensing, and performance assessment:	53.1
National Environmental Policy Act compliance:	2.0
Operations and construction:	34.2
Project management:	28.2
External oversight and payments-equal-to-taxes:	11.7

The funding profile for the Project has shifted as the work of site characterization has moved toward completion.

Preparing for the Determination on Site Recommendation

The work we did in Fiscal Year 1999 to support the Secretary's determination whether to recommend the site for development of a geologic repository built directly on the *Viability Assessment of a Repository at Yucca Mountain*, which was released on December 18, 1998. It presented the first comprehensive description of a potential repository at

the Yucca Mountain site and of its expected performance in minimizing potential radioactive dose levels over thousands of years. Summing up 15 years of site investigations, it concluded that the work required to determine the suitability of the site for a repository should proceed. It identified key technical areas in which uncertainties about repository system performance should be reduced, and it described the additional work required to reduce them and to eventually submit a license application to NRC. The viability assessment thus narrowed the focus of site characterization studies. In addition, information from semiannual site characterization progress reports to NRC and the Governor and legislature of the State of Nevada, required under the Act, are also being utilized to support the consideration of site recommendation.

Section 114 of the Act requires the Secretary to hold public hearings near the site prior to a determination, and it states that in making a recommendation,

...the Secretary shall make available to the public, and submit to the President, a comprehensive statement of the basis of such recommendation....

Section 114 specifies that the comprehensive statement, which we term a Site Recommendation Report, is to include the following:

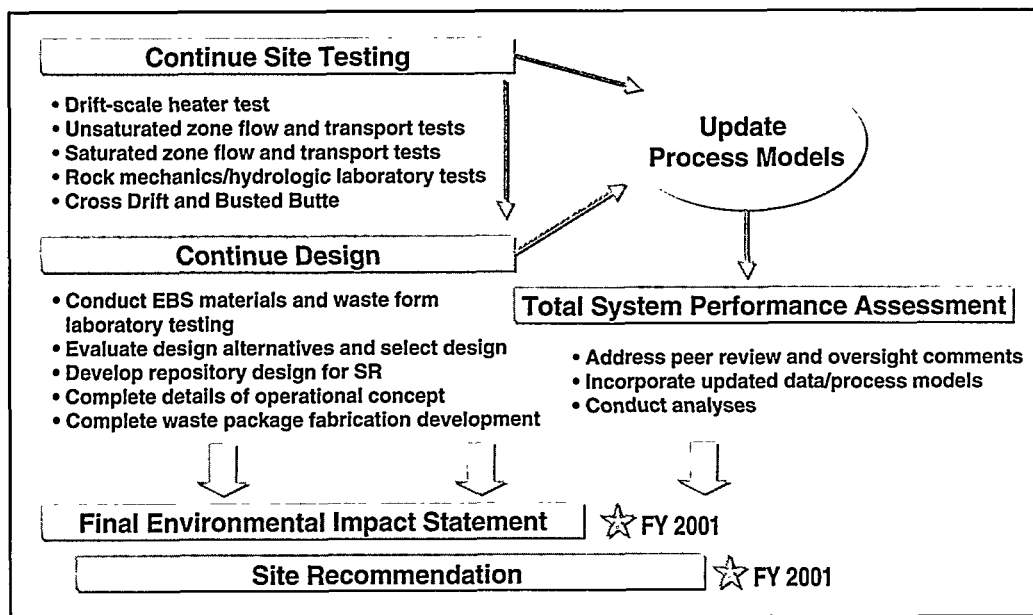
- a description of the proposed repository, including preliminary engineering specifications for the facility;
- a description of the waste form or packaging proposed for use at such repository, and an explanation of the relationship between such waste form or packaging and the geologic medium of such site;
- a discussion of data, obtained in site characterization activities, relating to the safety of such site;
- a final environmental impact statement prepared for the Yucca Mountain site;
- preliminary comments of NRC concerning the extent to which the site characterization analysis and the waste form proposal for such site seem sufficient for inclusion in an

application submitted by the Secretary for licensing of the site as a repository;

- the views and comments of the Governor and legislature of the State of Nevada, together with the response of the Secretary to such views;
- such other information as the Secretary considers appropriate; and
- any impact report submitted by the State of Nevada.

In Fiscal Year 2001, we plan to release a Site Recommendation Consideration Report to inform the public of a potential Secretarial site recommendation and to solicit the views and comments of the public. Public hearings on the potential recommendation will also be held. Designed to provide information on the first three of the Section 114 requirements, above, it

Preparing this report, planning for and conducting the hearings, and managing the collection of other information required by the statute is a major undertaking. To ensure that all information is properly assembled and that all requirements of the Nuclear Waste Policy Act are satisfied, we continued, in Fiscal Year 1999, to closely analyze the Act and applicable regulations, and prepared a detailed work plan to govern preparations for the Secretarial determination. The bulk of this work has entailed the formal integration of what has been learned from the principal components of our site characterization program. Those components consist of scientific studies of the Yucca Mountain site, design of the engineered barriers that would isolate radionuclides and retard their migration to the accessible environment, and a total system performance assessment that synthesizes the results of scientific investigations and engineering into a forecast of repository system performance.



Work leading to site recommendation

will consist of two volumes summarizing the results of site characterization: one will describe a repository system for Yucca Mountain; the second will present a preliminary evaluation of site suitability conducted under the Department's guidelines.

The Repository Safety Strategy

Site characterization studies have been designed for two closely related purposes: (1) to produce information that the Department needs to evaluate site suitability, and (2) to satisfy NRC regulations for

licensing a repository. Central to both is a requirement that the Department demonstrate that a repository at Yucca Mountain would perform safely for thousands of years after it is closed. The postclosure safety case presented in the Site Recommendation Consideration Report will include the following:

- predictions, based on total system performance assessment, of how the repository system would perform after it is closed;
- consideration of how potentially disruptive processes and events could affect repository system performance;
- descriptions of various approaches to demonstrating defense-in-depth, including reliance on multiple barriers to mitigate uncertainties in characterizing the performance of the natural and engineered barriers of the repository system; and
- understanding gained from relevant natural analogues to the Yucca Mountain site.

Our approach to making the postclosure safety case is shaped by a repository safety strategy. It rests on assumptions about four key attributes of a repository system at Yucca Mountain that we formulated by analyzing information about the site and the likely performance of engineered barriers in that setting:

- Limited water would contact the waste packages.
- Waste packages would last a long time.
- Radionuclides would be released from the waste packages slowly.
- Radionuclide concentrations would be reduced during transport through engineered and natural barriers.

These assumptions have remained essentially unchanged since we issued a Site Characterization Plan in 1988, but the details of the repository safety strategy have evolved as our work has progressed. In Fiscal Year 1999, we further updated the strategy to

reflect information presented in the viability assessment. The revised strategy identifies what we now believe to be the factors most important to evaluating repository system performance and what information we need to develop in order to complete the safety case.

Together, the assumptions and the factors important to demonstrating that the assumptions are reasonable constitute a conceptual framework for assessing overall repository system performance. In Fiscal Year 1999, this framework helped scientists and engineers focus data collection, analyses, and modeling on factors important to demonstrating that the performance of natural barriers, the waste package, and other engineered barriers will satisfy regulatory standards for protecting the public. The insights of peer reviewers and oversight bodies also shaped our research, which principally addressed the following:

- volumes and rates of, and mechanisms for, water infiltration and seepage into the repository;
- pathways and mechanisms for transportation of radionuclides through the saturated zone;
- the nature of interactions between engineered barriers and natural processes, including the effects of heat generated by waste;
- how candidate waste package materials would perform over long periods of time, under varying conditions;
- how enhanced repository design concepts could improve safety; and
- how process models could more accurately represent site conditions and waste package performance.

To reduce uncertainties about key factors, we conducted field and laboratory tests, analyzed data, assessed alternative designs, and conducted performance assessments to determine which uncertainties matter most and which are most sensitive to new information that could be obtained from further field and laboratory testing.

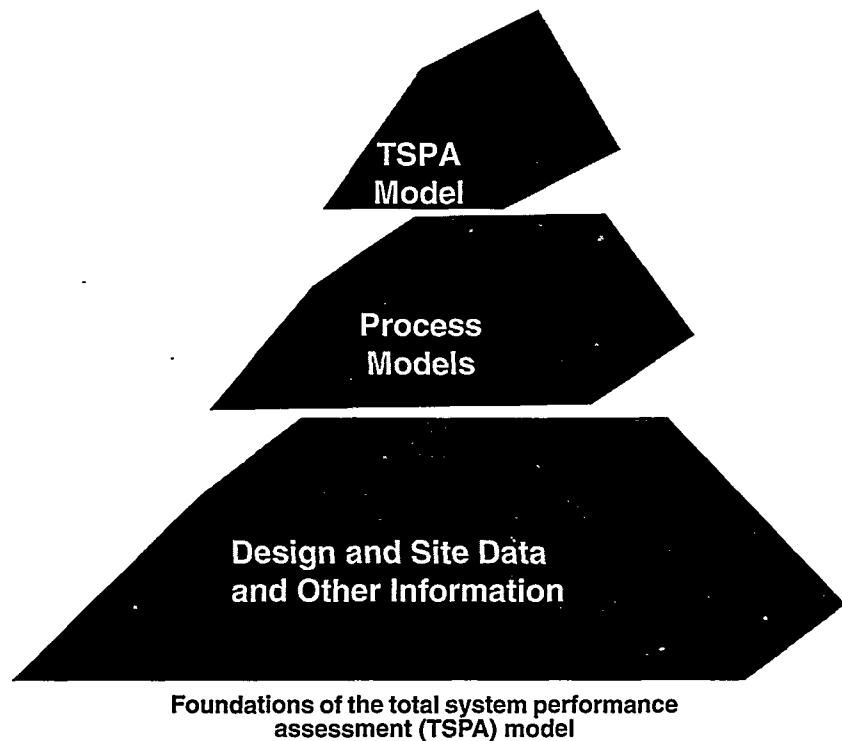
Performance Assessment

The results of performance assessment analyses are a major component of the repository safety case that will be presented in the Site Recommendation Consideration Report, the Site Recommendation and in a license application.

Working within the framework of the repository safety strategy, performance assessment integrates information from site investigations, laboratory studies, expert judgment, and repository design into a set of numerical models that represent the total repository system. The total system model is used to simulate how a repository at the site might perform under a range of conditions over thousands of years after it was closed. We use it to evaluate repository system performance against proposed regulatory criteria, determine the contribution from each engineered barrier to performance, and identify uncertainties in our understanding of performance. We then determine how to reduce the uncertainties by evaluating how sensitive they are to new information from scientific studies or how we might compensate for uncertainties by enhancing design.

The result is a forecast of the radiation dose a person might receive from radioactive waste emplaced within Yucca Mountain. That dose must not exceed regulatory standards if the repository is to be demonstrated to be safe.

In Fiscal Year 1999, we refined the models used in the viability assessment to reflect new information from site investigations and laboratory studies, advances in modeling physical processes at the site, and an enhanced repository design; the scientific and engineering work reflected in these refinements is described below. Model refinement will be completed in Fiscal Year 2000 and an iteration of total system performance assessment will be conducted for the Site Recommendation Consideration Report.



Documenting the foundation for determining site suitability

If a determination on site suitability is to be accepted and understood, our performance assessment models must be defensible and traceable. To ensure that they are, we began, in Fiscal Year 1999, to develop two sets of reports that describe in detail the bases for our total system performance assessment, from compilation and analysis of data to model development. This work was informed by expert elicitations conducted in support of the viability assessment.

Process Model Reports describe the technical basis for each sub-model of the models for each of nine major physical processes that would govern performance of the repository system. The reports present the technical information needed to ensure that models are defensible and that data and references can be traced to their sources. Their subjects are the integrated site model, the flow of water and transport of radionuclides in the unsaturated zone, flow and transport in the saturated zone, the near-field environment around waste packages, waste package degradation, waste form degradation, degradation of

the engineered barrier system and flow and transport through it, the biosphere, and potentially disruptive events.

Supporting Analysis and Model Reports cover analysis of site and laboratory data, incorporation of these data into detailed process-level models, and abstraction of process-level modeling results into sub-models for inclusion into the overall system-level model.

The complexity of performance assessment modeling that will support determinations on site recommendation can be illustrated with the prediction of how quickly waste packages would corrode. To accomplish this we must quantify the amount of water that would contact the waste packages. This requires estimating how much water could enter the site over a specified period of time, examining how water would flow through the porous media of the site to enter waste emplacement drifts and how temperature gradients due to heat generated by spent nuclear fuel would affect the behavior of water, the geochemistry of the near-field environment, and the engineered barriers. All this information must be represented in numerical models, and the sources of the information and analyses that support the models must be documented, along with the software code used to run the models.

Peer Review

A peer review panel had been convened in 1997 to provide an independent evaluation of the total system performance assessment conducted for the viability assessment and to help us make our work transparent to technical peers and regulatory and oversight bodies. This panel included experts in all fields related to repository performance. Panel members evaluated our analytical approach, including physical events and processes considered in analyses, use of appropriate and relevant data, assumptions made, abstraction of process models into total system models, application of accepted analytical methods, and treatment of uncertainty. They also reviewed supporting documentation, including process-level models; attended technical meetings; and reviewed documentation for the total system performance assessment as it was being prepared. Their insights

contributed to development in Fiscal Year 1998 of the total system performance assessment used in the viability assessment.

In February 1999, the panel delivered its final report to us, and we factored its findings, comments, concerns, and recommendations into our work plans for the remainder of Fiscal Year 1999 and for Fiscal Year 2000.

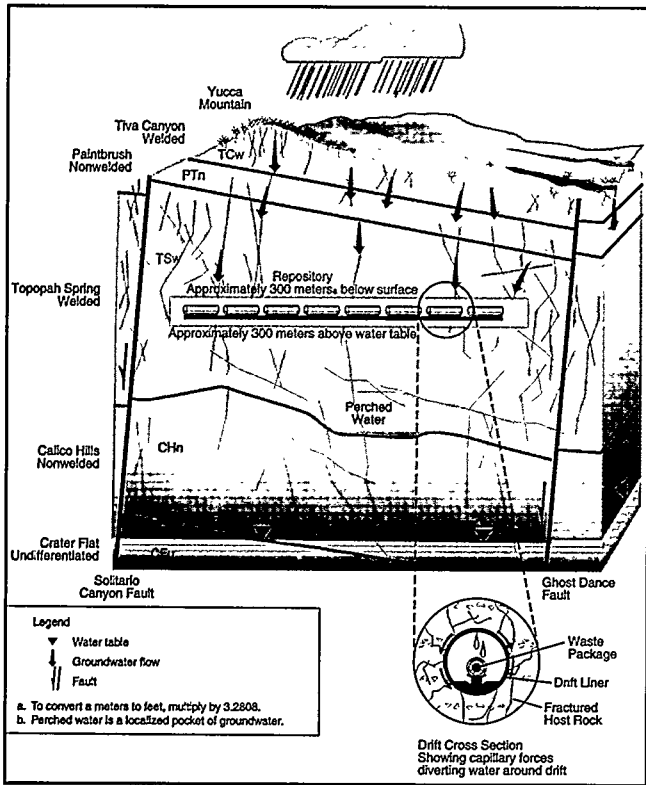
Core Science

Guided by the repository safety strategy, Fiscal Year 1999 site investigations focused on obtaining data we can use to reduce key scientific uncertainties about factors important to repository performance and to refine predictive models of how the engineered and natural barriers of a repository system would perform. By better defining the range of variability in natural processes at the site, testing and monitoring enabled us to make our performance assessment models more accurate. By confirming predictions of conditions we would encounter in site investigations, testing and monitoring helped us validate models. Investigations above and below ground yielded data on geologic, geochemical, geomechanical, and hydrologic features and processes and the coupled mechanical and chemical effects of heat on rock. Some of this work was completed in Fiscal Year 1999; some has continued.

We augmented site investigations with laboratory testing, and we continued to use the results of independent peer reviews to verify the appropriateness of the methods and approaches used in site investigations. We also used data from site investigations to define the physical conditions against which the results of future testing and monitoring would be evaluated under the Performance Confirmation Program as required by NRC regulation.

Test facilities

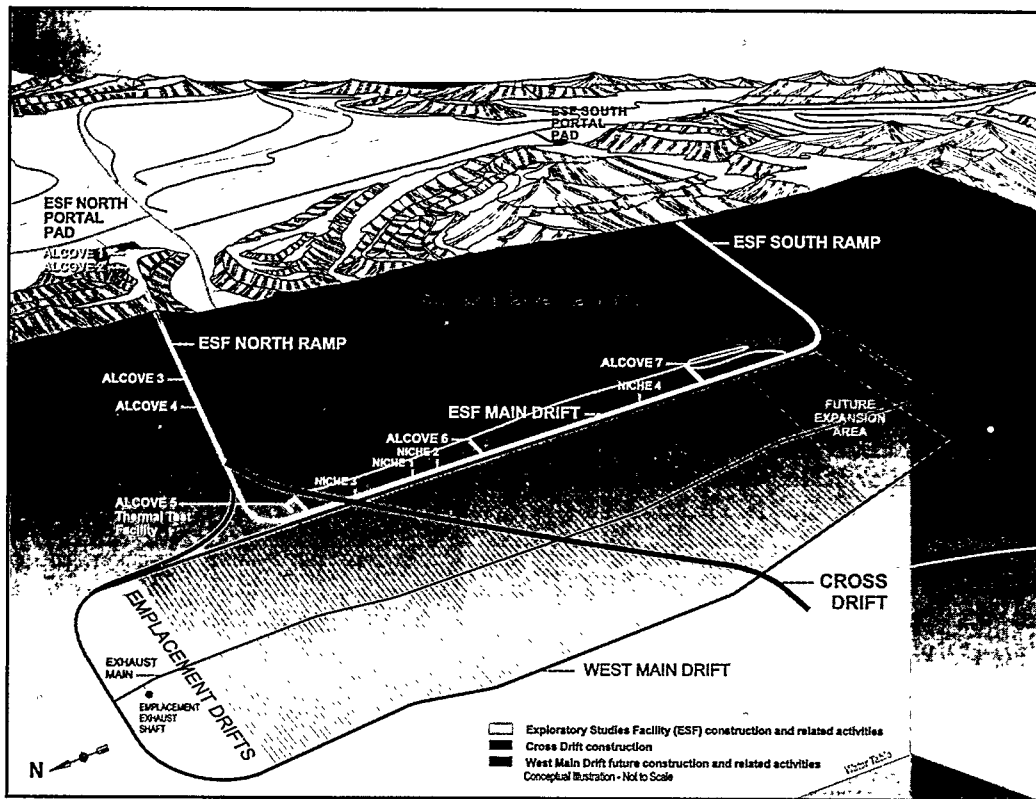
In Fiscal Year 1999, site investigations were carried out within test facilities we have constructed at the Yucca Mountain site. The illustrations on the following page show natural features of the site and test facilities in operation and under construction.



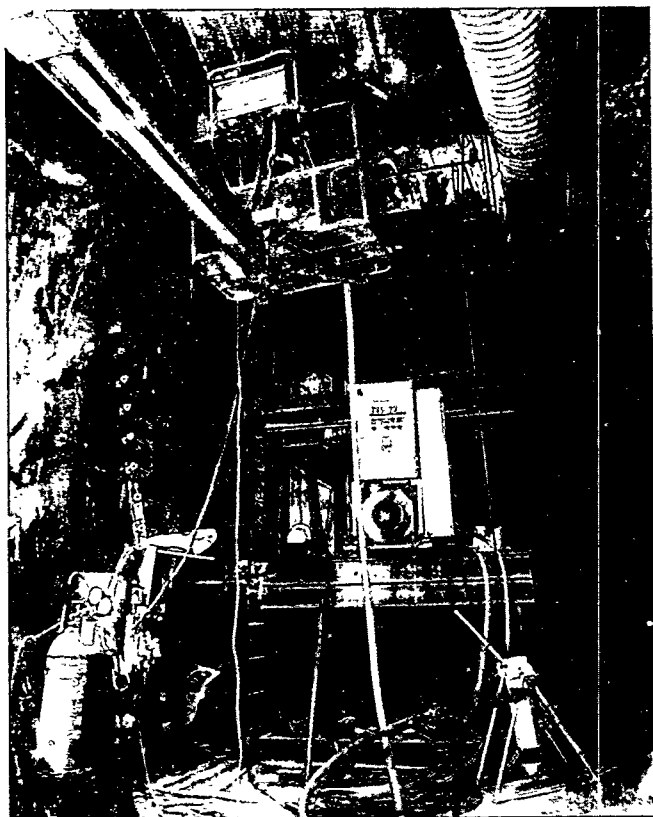
The facilities' hub is an underground Exploratory Studies Facility, the main loop of which is 7.6 meters (25 feet) in diameter and nearly 8 kilometers (5 miles) long. Transecting the main loop is a tunnel, 2.8 kilometers (1.67 miles) long and 5 meters (16.5 feet) in diameter, called the cross-drift, that gives us direct access to the central and western portions of the proposed repository block and to the geologic strata where approximately two-thirds of the waste emplacement tunnels would lie.

A test facility at Busted Butte offers direct access to the Calico Hills formation, rock similar to that beneath the repository. By studying pathways, quantities, and rates at which water travels through this rock, scientists learned more about the potential for radionuclide transport from the repository down 300 meters (1,000 feet) to the water table. We started excavating two one-cubic-meter blocks of rock that will be sent to a laboratory for testing and analysis to determine the radionuclide transport properties in the Calico Hills formation.

Natural features of proposed repository block



Proposed repository subsurface layout and cross drift



Test facility at Busted Butte



Constructing a monitoring station at Crater Flat

Geologic and geochemical data were obtained from more than 350 boreholes drilled from within underground facilities, more than 450 boreholes drilled from the surface, and over 200 pits and trenches. Monitoring wells yielded hydrologic data and Global Positioning System stations measured small movements in the earth's surface.

To ensure the integrity of rock, soil, and water samples, staff at the Project's Sample Management Facility continued to document each sample's chain of custody and to maintain the data in a computerized database. We installed a fiber-optic data network in the Exploratory Studies Facility and the cross-drift—environments in which the presence of many electrical devices creates severe electromagnetic interference. This network ensures the reliability of data transmission, and by instantaneously transmitting data to network servers that back it up, it greatly increases data security and integrity.



Drilling activities near Yucca Mountain

We completed excavation of the cross-drift on October 13, 1998, and we finished installing utilities (ventilation, power, water, compressed air, and lighting) to the end of the tunnel. We installed bulkheads across the tunnel and initiated moisture monitoring under the high infiltration region beneath the crest of Yucca Mountain and in the Solitario Canyon fault zone. The cross-drift bulkhead studies will provide data on moisture and seepage in the Topopah Springs Lower Lithophysal and Lower Nonlithophysal Units and in the Solitario Canyon fault zone.

In Fiscal Year 1999, we started excavating Alcove 8 (the "crossover alcove") within the cross-drift, and we configured the conveyor and ventilation systems to initiate excavation of Niche 5. Construction of both the alcove and niche should be complete in Fiscal Year 2000. Alcove 8 will provide data on flow and seepage between the cross-drift and Niche 3, which is located within the repository host rock in the Exploratory Studies Facility, and it will provide field-scale data on flow, seepage, and matrix diffusion within the unsaturated zone over a scale of tens of meters. Niche 5 will provide data on air permeability and seepage in the Topopah Springs Lower Lithophysal Unit and data on seepage and the variability of hydrologic parameters in the proposed repository host rock.

Drilling of a surface borehole, SD-6, started in Fiscal Year 1998; in Fiscal Year 1999, it was completed to a depth of 856 meters (2,808 feet). It provides data on the stratigraphy and hydrology of the western portion of the proposed repository block. We also completed drilling a surface

borehole to obtain preliminary geotechnical information needed for design of a repository surface facility, the Waste Handling Building.

Understanding the unsaturated zone

The unsaturated zone is the area of rock above the water table. The repository would be located in that zone, about 300 meters (1000 feet) beneath the surface and about 300 meters (1000 feet) above the water table. In Fiscal Year 1999, a peer review panel completed its review of the approach and methodologies we are using to model radionuclide

transport through the unsaturated zone beneath the repository horizon. The panel observed that currently there is no preferred alternative model to ours, but it recommended several ways to technically enhance and validate our model. We are evaluating its recommendations and developing a plan to implement them.

Performance assessments for the viability assessment identified seepage of water into emplacement tunnels and onto waste packages as a possible cause of waste package degradation and eventual release of radionuclides. Determining under what conditions, in what quantities, and at what rates water would seep into drifts and onto waste packages is the subject of continuing study.

The Nuclear Waste Technical Review Board has identified seepage as a critical issue and stated its support for our plans to continue experiments and modeling to investigate it. In September 1999, the peer



Drilling in Alcove 8

review panel we had convened to review the potential for seepage into drifts submitted its report. We are evaluating its recommendations and will develop a plan that will enable us to implement them in Fiscal Year 2000.

In Fiscal Year 1999, major experiments involved measuring seepage at several locations and under two general types of conditions: ambient, in which we measure the amount of natural infiltration of water into test areas, and forced, in which we introduce water into test areas and measure the resulting infiltration. To test deep percolation and seepage through the highly fractured rocks of the Ghost Dance Fault, we constructed Alcove 7 within the Exploratory Studies Facility. The alcove is 200 meters (660 feet) long and approximately 220 meters (726 feet) below the surface. Bulkheads within the alcove isolate faulted and non-faulted sections of rock to limit the drying effects of the ventilation system. Despite this isolation, no seepage has yet been observed in this alcove.

Forced-flow experiments enabled us to investigate how underground openings similar to waste emplacement tunnels alter the groundwater flow field, possibly diverting water into surrounding rock. Using several niches at repository depth in the Topopah Springs tuffs and one alcove closer to the surface of the site, in the Tiva Canyon tuffs, these experiments examined the distribution and amount of seepage that might occur in waste emplacement drifts.

Infiltration tests in the Topopah Springs tuffs involved introducing water above a niche and observing the resulting seepage in the opening. Tests were completed in Niche 2; they are under way in Niche 3. Unlike most of the Exploratory Studies Facility, which is dry due to ventilation, Niche 3 is isolated from ventilation and has high humidity that simulates post-closure repository conditions. Air permeability tests using boreholes were conducted before and after excavation in Niche 4, in a highly fractured region along the main drift of the Exploratory Studies Facility.

Tests in Niche 2 examined seepage into a welded tuff with low fracture density, investigating the flow of air and water through the rock both before and after construction in order to determine the effects of construction on permeability. Data indicated an

increase in air permeability after construction due to changes in rock stress and fracture aperture induced by excavation.

The theory of flow near underground openings predicts that surface tension between water and air near the drift wall can inhibit seepage into the drift. Infiltration tests investigate the influence of these capillary effects in diverting flow away from the excavation. Termed "a capillary barrier," this diversion may play an important role in limiting the contact of water with waste packages. Numerical models used in performance assessment help us design experiments that provide data that can be used to test the concepts and the numerical implementation of the models. The results of testing in Niche 2 suggested the existence of a capillary barrier. When the numerical model is calibrated to the field tests, it can support predictions of drift seepage under a variety of potential repository conditions. The numerical simulations indicated the likelihood that the capillary barrier could prevent seepage up to groundwater flux rates of 200 millimeters per year, far in excess of the tens of millimeters per year currently estimated to pass vertically through the repository horizon.

Alcove 1 is located near the north portal of the Exploratory Studies Facility, closer to the surface of the site than the other test facilities, in the Tiva Canyon welded tuffs. Experiments in that alcove simulated the flow that might result from higher rainfalls in a future climate that is wetter and cooler than the present. The results provided insight into near-surface infiltration processes and the processes and volumes of seepage into underground openings. Scientists divided the roof of the alcove into separate areas of about 0.1-square meter. At the site surface above the alcove, they applied water to a 91-square meter area, while observing seepage in a 44.2-square meter collection area within the alcove. It took 58 days for water to travel from the surface to the collection system, but once flow had been established, changes in the rate at which water was applied at the surface produced corresponding changes in seepage into the alcove within a few days.

Detection of chlorine-36 in the Exploratory Study Facility had raised speculation that it resulted from

nuclear testing conducted in the 1950s in the Pacific Proving Grounds and, to a lesser extent, at the nearby Nevada Test Site. This, in turn, raised questions about groundwater pathways and travel times. Our study of this matter had indicated the presence of fast pathways for groundwater migration from the surface of the site to the repository horizon. In Fiscal Year 1998, the independent peer review we had commissioned to review our study was completed. The panel generally agreed with our approach, methodology, and interpretation of data. It recommended enhanced geologic sampling strategies for isotopic measurements and closer integration with other groundwater-tracer data and flow modeling.

In Fiscal Year 1999, as recommended by the panel, we implemented a sampling and analysis program using boreholes drilled from within the Exploratory Studies Facility and cross-drift. Sampling was completed and analyses are currently under way; results will support the Site Recommendation Consideration Report. On the panel's recommendation, we also started drilling subsurface boreholes from within the Exploratory Studies Facility. Data will be used to determine the distribution of "bomb-pulse" chlorine-36 and to increase our understanding of the potential for preferential pathways for radionuclide transport. This in turn will help us calibrate flow and transport models of the unsaturated zone. At two bomb-pulse locations within the Exploratory Studies Facility, the Sundance Fault and Drillhole Wash Fault zones, we completed chlorine-36 and chlorine mass balance studies.

Understanding the saturated zone

Beneath the unsaturated zone lies the saturated zone, the region in which rock pores and fractures are completely saturated with groundwater. Because radionuclides could migrate through this zone to the accessible environment, we need to understand its characteristics. The Nuclear Waste Technical Review Board has stated its belief that we need to better understand it and supports our plans to further characterize it.

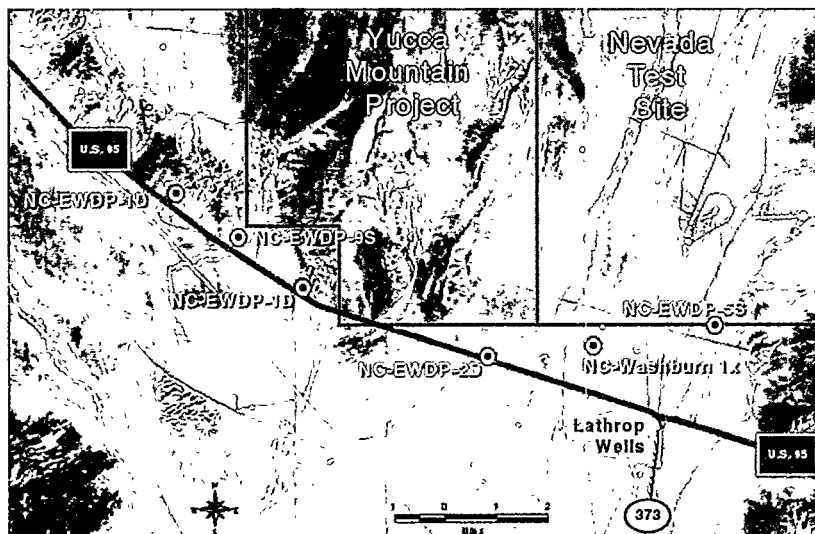
In Fiscal Year 1999, efforts focused on Phase 1 of the Nye County Early Warning Drilling Program. Nye County, the county within which the Yucca Mountain

site is located, is designing a series of boreholes for use as part of an early warning system that could be part of performance confirmation monitoring if a repository is developed at the site. Nye County is conducting its drilling program in cooperation with, and with funding from, OCRWM.



Nye County Early Warning Drilling Program

During the fiscal year, Nye County concluded Phase 1 of its drilling program, completing eight monitoring wells that reach the saturated zone from six drilling sites near Amargosa Valley. Project scientists accompanied Nye County scientists during sample collection and hydrologic testing. Information from rock and groundwater samples collected during and after drilling has been integrated into our conceptual model of the saturated zone. Stratigraphic data from the drilling program and information about the flow and transport properties of the alluvium and valley fill aquifer have been incorporated into our site-scale model. Information on the County's drilling program can be found on the County's Web site: www.nyecounty.com



Locations of completed Nye County drill holes

To obtain data on local and regional water table elevations and fluctuations through time, we continued to take measurements at the network of 22 water monitoring boreholes drilled by our Project. We used the data to assess the seasonal transient effect of precipitation and evaporation, as well as the effects of local and regional water use and potential impacts on repository operations. These ongoing measurements helped us determine the range of variability in the natural environment, and we used the information to calibrate the regional and site-scale groundwater models.



Monitoring water table fluctuations at a borehole

Fiscal Year 1999 brought completion of the C-Wells tracer-testing program, which yielded critical data on the hydraulic properties of the volcanic aquifer, an estimate of flow and transport properties of materials in the aquifer, and laboratory confirmation of the transport properties of those materials from core samples. Test results indicate the range of variability in the flow properties of the hydrogeologic and hydrostratigraphic units within the aquifer and the influence of fracture density on flow rates. These data will be used to test and improve models of radionuclide transport parameters and travel times.

Understanding the effects of heat on repository system performance

A subject of long-term studies is how heat generated by radioactive decay of waste would alter the surrounding environment. Heat-induced changes in rock mineralogy, mechanical properties, rock and water chemistry, and site hydrology would affect the rate at which waste packages degrade and radionuclides are released and the mechanisms and pathways by which radionuclides could be transported. One speculation is that as heat caused water to vaporize, salts would precipitate. Salts could then be redissolved by moisture that condenses and returns, making the moisture a corrosive fluid capable of degrading waste packages and accelerating their eventual failure.

To closely examine these phenomena, DOE's Lawrence Berkeley, Lawrence Livermore, Sandia, and Los Alamos National Laboratories are conducting three tests that use electric heaters to simulate heat generated by waste. Very different in scale, all three tests contribute data on the effects of thermally driven hydrologic, chemical, and mechanical processes in rock. Scientists use these data to develop models of how the engineered and natural barriers of a repository system at Yucca Mountain would respond to heat.

- **The large block test at Fran Ridge** generated data on how heat affects the movement of moisture through rock, the mechanical and chemical responses of rock to heat, the geochemistry of refluxing water, and microbial activity. It involved heating a large

could affect coupled thermo-hydraulic processes that in turn would affect flow and transport in the rocks. This information is needed for models of the near-field environment, the waste package, and the engineered barrier system.



Large block heater test

block cut out of exposed repository host rock. Heaters operated from February 1997 until March 1998; cool-down was completed in September 1998, as scheduled. Post-heating data collection and most of the analyses were completed in Fiscal Year 1999. Results indicate that under the test conditions, groundwater in the block flowed by gravity below the heated region and could transport radionuclides, with fractures acting as the dominant flow conduit. Results also indicate the potential presence of “heat-pipes” – geologic structures that could bring water into contact with waste-packages even in a repository in which the temperature reaches the boiling point. These findings provide vital information on how heat emitted by waste

- **The single heater test**, a large-scale underground test, began in August 1996. It employed one heater approximately 5 meters long to heat a 21-cubic-meter (27-cubic yard) volume of rock over a period of 10 months. Instrumentation included over 300 thermometers that continuously fed data through cables to a computer that recorded approximately 700 channels of information. The results provided initial information on the thermo-mechanical-hydrologic-chemical behavior of the rocks at the potential repository horizon. The test was completed as scheduled in the spring of 1998. During Fiscal Year 1999, the results were analyzed. They are being incorporated into Process Model Reports for the Site Recommendation Consideration Report.

- **The drift scale test** is the largest such test in the world. In a simulation of an actual waste emplacement drift, an underground alcove approximately 48 meters (156 feet) long is being heated for 4 years by electric heaters placed in the walls and floor. The heaters placed in the drift are similar in dimensions and materials to actual waste canisters. The test is designed to heat an estimated 15,000 cubic meters (about 19,600 cubic yards) of rock to a temperature above 100 degrees Centigrade.

Remotely controlled video and infrared cameras monitor this test, and from remote locations scientists can continuously modify system parameters and retrieve data by telephone. Automation permits more accessible, consistent, and reproducible testing, and it allows scientists to spend their time analyzing data instead of physically collecting them. This automated system is supplemented by a limited amount of manual sampling.

The heaters were turned on early in Fiscal Year 1998, ahead of schedule. After 4 years, they will be turned off, and cool-down will be monitored for another 4 years. Data collection continued during Fiscal Year 1999.

Significant results, to date, from the single heater test and the drift scale test include identification of conduction as the dominant heat transfer mechanism and the preliminary indication that rock porewater mobilized by the heat tends to drain by gravity, via fractures in the rock mass, to below the heated region rather than staying perched above it.

Laboratory and field testing

Another important line of inquiry is determining the pathways, mechanisms, and rates at which radionuclides could be transported from the near-field environment that surrounds waste packages if the packages are breached. Studies examine how phenomena such as the solubility limits of specific radionuclides, dispersion and diffusion during

transport, and dilution could minimize resultant dose levels.

Fiscal Year 1999 laboratory testing focused on strengthening our understanding of transport of radionuclides through the unsaturated and saturated zones, by gathering more data on how radionuclides could sorb to rock along transport pathways. The tests involved measurements of sorption coefficients for host rock and the potential for transport of radionuclides by colloids, very fine particles suspended in groundwater. Tests were conducted by scientists at DOE's Sandia, Lawrence Livermore, and Lawrence Berkeley National Laboratories, and the U.S. Geological Survey.

For the unsaturated zone, tests using tracer elements as surrogate radionuclides to measure sorption were conducted in the Busted Butte facility, which provides direct access to rock identical to that below the potential repository host rock. The measurements were made to demonstrate that sorption data collected in laboratory experiments are applicable to site-scale transport modeling. Test results were verified by controlled laboratory measurements on Busted Butte samples using actual radionuclides. They show that sorption of neptunium, a critical radionuclide contributing to radiation doses, is an order of magnitude higher than previously thought.



Preparing for a test using tracer elements to study rock properties

In other tests at Busted Butte, we investigated colloidal migration using polystyrene microsphere, a surrogate colloid. Results show that there was virtually no migration of the colloid through the Calico Hills Formation. Laboratory tests on reversibility of radionuclide sorption by colloids are nearing completion. The colloidal materials tested include iron oxides and clay minerals. The preliminary results indicate that clay mineral-type colloids may show irreversible sorption for plutonium and americium, making them potential transporters of highly insoluble radionuclides.

For the saturated zone, sorption measurements were made in the alluvium samples collected in cooperation with the Nye County drilling program. Data analyses will be completed and the results will be included in the saturated-zone process model used for the Site Recommendation Consideration Report.

To increase confidence in our measurements of transport parameters, we continued to evaluate data about radionuclides in the groundwater of other DOE sites and to use them to verify our transport model. Those sites are the Nevada Test Site, the Hanford site in Washington, and the Idaho National Engineering and Environmental Laboratory. Observations from these analogue sites will be included in the transport models being prepared for the Site Recommendation Consideration Report.

Building a regional groundwater model

We continued work on a major 5-year project to develop a comprehensive regional hydrologic model, sharing databases with the Nevada Test Site; the U.S. Geological Survey; the Bureau of Indian Affairs; Nye, Inyo, Lincoln, and Clark Counties; the National Park Service; the Air Force; and the Nevada State Engineer's Office. The model will incorporate the best features of two independently produced models. The Test Site's model was developed to study existing contamination; it focuses on transport phenomena on a micro scale. Our model is a tool for simulating and evaluating effects of climate change on the regional water table.

Fiscal Year 1999 activities included fieldwork to gather new data and refinement of the regional hydrologic framework model. This effort will yield a more comprehensive model more closely calibrated to observations of actual conditions at the site, both steady-state and transient. The steady-state model will be completed by the end of Fiscal Year 2000; the transient model by the end of Fiscal Year 2002.

Building a three-dimensional model of the site

Data from site investigations were interpreted and extrapolated to build and refine a three-dimensional, integrated model of site hydrogeology—in effect, a picture of what we know about rock layers, faults, rock properties such as porosity and hydraulic conductivity, and mineralogy, including the presence of zeolites (minerals to which some radionuclides can sorb and which, therefore, have the potential to retard radionuclide migration). This integrated site model represents geologic features within an area of 65 square miles and a volume of 185 cubic miles, to a depth of 13,000 feet, as interpreted from data taken from boreholes drilled from the surface of the site to depths of up to 6,000 feet, data from drifts, and other sources such as gravity and magnetic data. The site model was the basis of the site description presented in the viability assessment, and it is the framework for hydrologic studies and repository design investigations.

In Fiscal Year 1999, important validation of our understanding of the site came with confirmation of our predictions of the geologic features that we would encounter in excavating the cross-drift and drilling two boreholes from the surface of the site to a depth of over 2,500 feet. The data input, methodologies, and assumptions used to construct the latest version of the three-dimensional model were documented in a report that was completed in early Fiscal Year 2000. Later revisions of the report will incorporate any new data acquired at the site.

Developing the Performance Confirmation Program

Under NRC regulation, if a repository is developed at Yucca Mountain, DOE must conduct a testing

program to confirm the performance of the natural and engineered barriers that are the basis for the safety case presented in the license application. NRC regulations also require that a repository be kept open for at least 50 years after the start of waste emplacement; our plans would not preclude its being kept open for at least 125 years, and, with a reasonable expectation of appropriate maintenance, for up to 300 years. The repository would be monitored by remote-sensing devices hooked up to computers.

The performance confirmation program we are developing entails monitoring, testing, and analyses. In Fiscal Year 1999, we continued to define the current physical conditions against which repository performance would be compared and to define tests and related activities necessary to monitor performance. Factors to be monitored would include air temperature and relative humidity; the presence and types of radioactive gases; soil and rock temperature, stress, deformation, and displacement; and moisture, vapor, and fluid temperature and conditions in the zone altered by heat generated by radioactive decay of waste.

Design and Engineering

The documentation supporting the Secretary's determination on site recommendation will rest in part on a substantial body of design work. In Fiscal Year 1999, we adopted a set of enhanced design features for a repository that will support the Secretary's determination, and we began to further develop them. Another task in direct support of the Secretary's determination was documentation of major repository subsystems important to safety. Laboratory testing and engineering studies augmented design work.

Design continued to be closely integrated with performance assessment modeling and core science data collection and testing. Integration with performance assessment ensured that models reflected the latest designs and that designers could consider where design enhancements might reduce uncertainties in predictions of repository system performance. Integration with core science ensured

that designs were supported by data on the natural features of the site, including structural, thermal, and hydrologic rock properties, and information on potential climate and seismic conditions.

Enhancing repository design

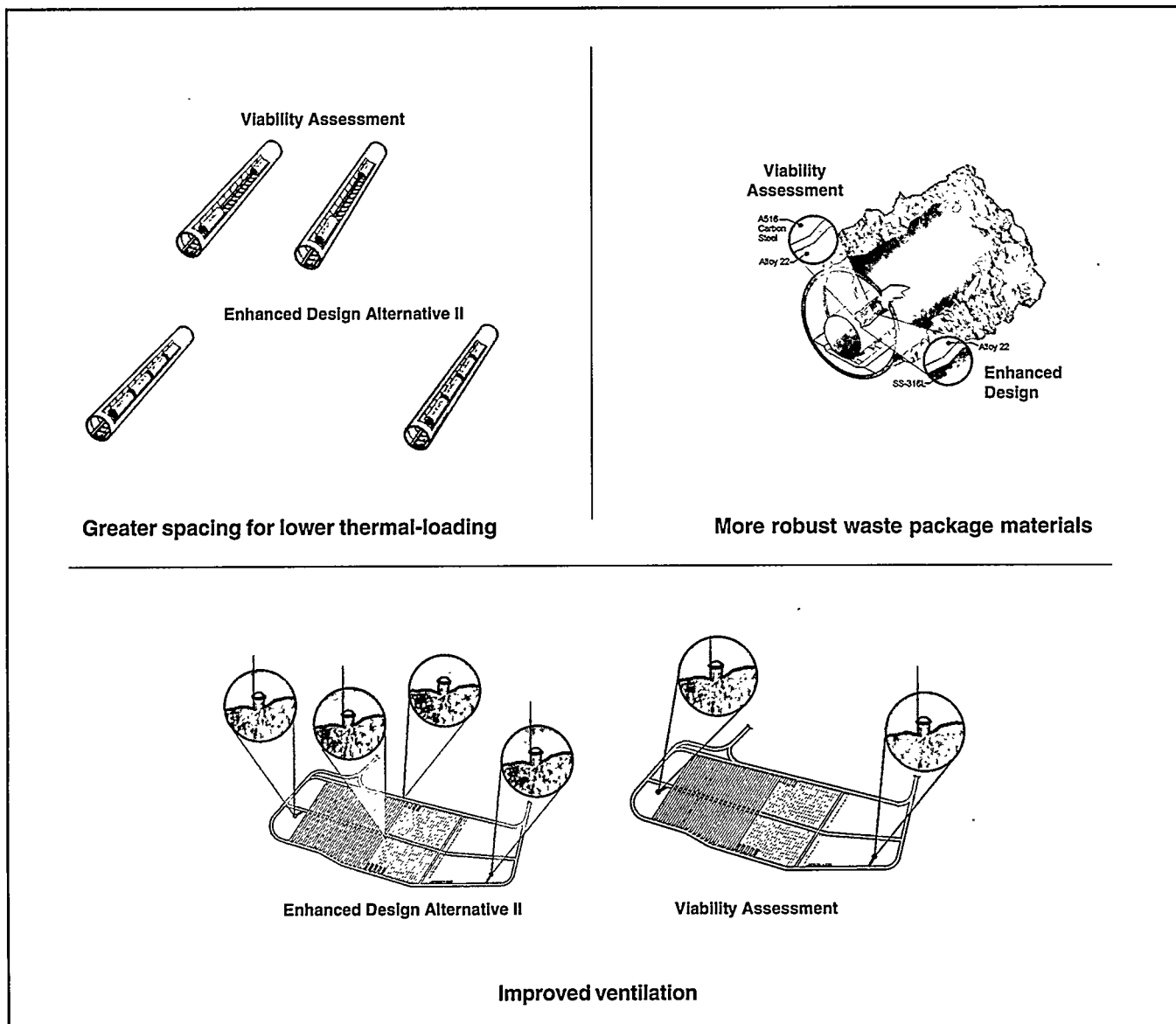
Wastes to be emplaced in a repository contain various types of radionuclides. Our studies indicate that the natural features of the site could contain most of them for long periods of time, but a small fraction appears to be mobile. Under some conditions they could be transported from the repository by water. The engineered barriers we are designing, together with the natural barriers of the site, would limit the amount of water that contacts radionuclides.

Our designs have been evolving over many years. To reduce uncertainties about repository system performance and to respond to Nuclear Waste Technical Review Board concerns about the reference design used in the viability assessment, we began, in July 1998, a study of alternative design concepts. We formulated and evaluated a wide range of design alternatives against a set of criteria: long-term public safety, worker safety, generational equity, cost, and how long-term repository performance could be demonstrated in a licensing proceeding. We sought to maintain flexibility in design, so that as new information—from confirmatory testing, scientific and technological advances, operational and cost considerations, the demands of the licensing process, evolution in national policy, or some other source—arose, further enhancements could be made, even after the repository has been licensed. We also sought to maintain the flexibility that would permit future generations to decide when to close the repository by weighing technical and institutional considerations at that time.

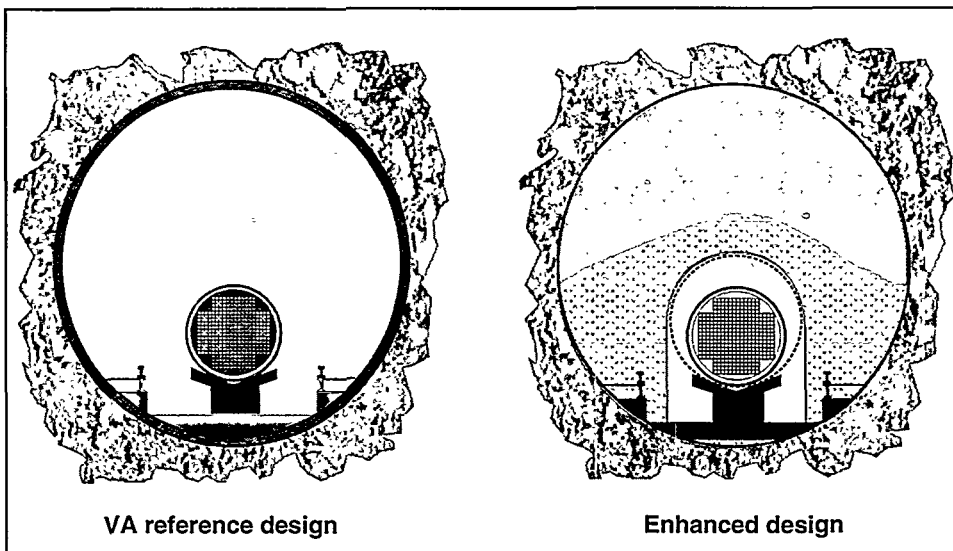
The study was completed in April 1999. We used the results and subsequent analyses, along with policy considerations, to select the next-generation design concept. It will be the basis for the total system performance assessment that will support determinations concerning site recommendation and serve as the starting point for the design concept presented in a license application. Some of the most

important features of the enhanced design concept concern thermal-loading: how hot the repository would be as a consequence of heat generated by spent nuclear fuel and where that heat would be distributed. We recognized that temperature may have a profound effect on the cumulative uncertainty in predictions of long-term repository system performance, and that this uncertainty, in turn, may affect confidence in a determination on site suitability. We, therefore, chose what can be characterized as a lower thermal-loading

design that uses more intensive thermal management techniques than the viability assessment reference design. These techniques include thermal blending of fuel assemblies, closer spacing of the waste packages, wider spacing of the emplacement drifts, and preclosure ventilation. Waste package design was enhanced, and a drip shield that would protect waste packages from water and possible rockfalls was added to the engineered barrier system.



The enhanced design makes several improvements over the VA design



An enhanced design could include drip shields and backfill

is fabricated: a waste package made with Alloy-22, a highly corrosion resistant nickel-chromium-molybdenum alloy, on the outside and a reinforcement cylinder of 316-series stainless steel on the inside would offer greater resistance to corrosion and more confidence in predicting corrosion rates.

The drip shield would be made from 15- to 20-millimeter-thick titanium that would cover the top and full sides of the waste package.

Before settling on the new waste package design and drip shield, we performed rudimentary shielding, thermal, structural, and criticality analyses to justify their selection. More in-depth analyses will be performed to support the Site Recommendation Consideration Report. We also analyzed candidate backfill materials to determine their ability to divert water, their structural properties, and their impacts on heat transfer.

Besides contributing to design decisions, the study advanced our understanding of the relative importance of the many factors involved in repository design. Details on design enhancements are presented in the sidebar below and in the September 10, 1999, letter from OCRWM's Acting Director to the Nuclear Waste Technical Review Board, which is posted on the Board's Web site at: www.nwtrb.gov

Another design change made in Fiscal Year 1999 was adoption of solar power as the source of electricity for the subsurface ventilation system. This change would not enhance repository system performance, but it would be environmentally beneficial.

Designing waste packages and the drip shield

Waste packages will make a major contribution to the repository system's ability to isolate waste and retard the migration of radionuclides. While several waste package designs will ultimately be needed to accommodate waste forms of different dimensions and the necessary criticality safety measures, the primary features—the thickness of the inner and outer barrier walls—are the same for all designs.

Our new waste package design boosts expected performance by changing the materials from which it

We submitted the *Disposal Criticality Analysis Methodology Topical Report* to NRC in Fiscal Year 1999. It explains how we will evaluate waste packages to demonstrate criticality safety during the post-closure period. The NRC accepted the report for technical review, and we held two technical exchanges with NRC staff to further the review. We are expecting a Safety Evaluation Report from NRC that will identify those aspects of the Topical Report that NRC accepts.

We have also completed two additional studies related to criticality. One supplements the Topical Report by presenting the results of additional benchmarking exercises to validate models used to predict the composition of commercial spent nuclear fuel; another presents a process for evaluating criticality safety during the pre-closure period.

Features of the Enhanced Repository Design

Features of the enhanced repository design concept include the following:

- **Thermal management techniques would lower temperatures within the repository block.**
 - **Waste packages would be cooler.** The maximum heat output of each waste package would be lower because adding extra processing space in the Waste Handling Building would allow us to do more “thermal blending.” This involves mixing hotter assemblies with cooler ones to average out temperature differences between waste packages and greatly reduce the variation from the average to the hottest package.
 - **Areal mass loading would be lower.** Within emplacement drifts, waste packages would be placed much closer together end-to-end, generating more heat in any given drift, but drifts would be spaced farther apart (81 meters compared to 28). The combined effect would reduce the number of metric tons uranium (MTU) per acre and thus the amount of heat generated per acre: areal mass loading would fall on average from 85 MTU/acre to around 60 MTU/acre.
 - **Potential for hot spots would be reduced.** Placing hotter waste packages next to cooler ones would allow the heat in the hotter packages to be transferred to the cooler ones. This would “smooth out” temperature differences between them and reduce the potential for local hot spots.
- **Water shedding away from waste packages would be facilitated.** In the previous design, boiling areas could have coalesced, and increased uncertainty where drainage would occur. In the enhanced design, wider spacing between drifts would prevent boiling areas from overlapping, and it would allow a significant portion of the pillar rock temperature to remain below boiling, allowing condensation and drainage between the emplacement drifts and away from waste packages.
- **Waste packages would last longer.** The double-shelled packages would contain two barriers: an outer barrier that would be very corrosion-resistant and an inner barrier of stainless steel that would provide structural protection. The first package breach due to corrosion is predicted to occur well beyond 10,000 years.
- **Drip shields would extend waste package lifetimes.** Highly corrosion-resistant drip shields placed over the waste packages would divert any water that might eventually seep into repository openings. By protecting the waste packages for long periods of time, the drip shields would extend the life of the corrosion-resistant outer shell of the waste package.
- **Preclosure ventilation would be increased significantly.** This could remove some water from within the repository rock mass and help maintain lower peak temperatures both before and after the repository is closed.
- **Ground support would minimize the use of concrete.** More extensive use of steel within emplacement drifts could reduce uncertainties associated with the potential effects of concrete on radionuclide transport.

Laboratory testing to support design

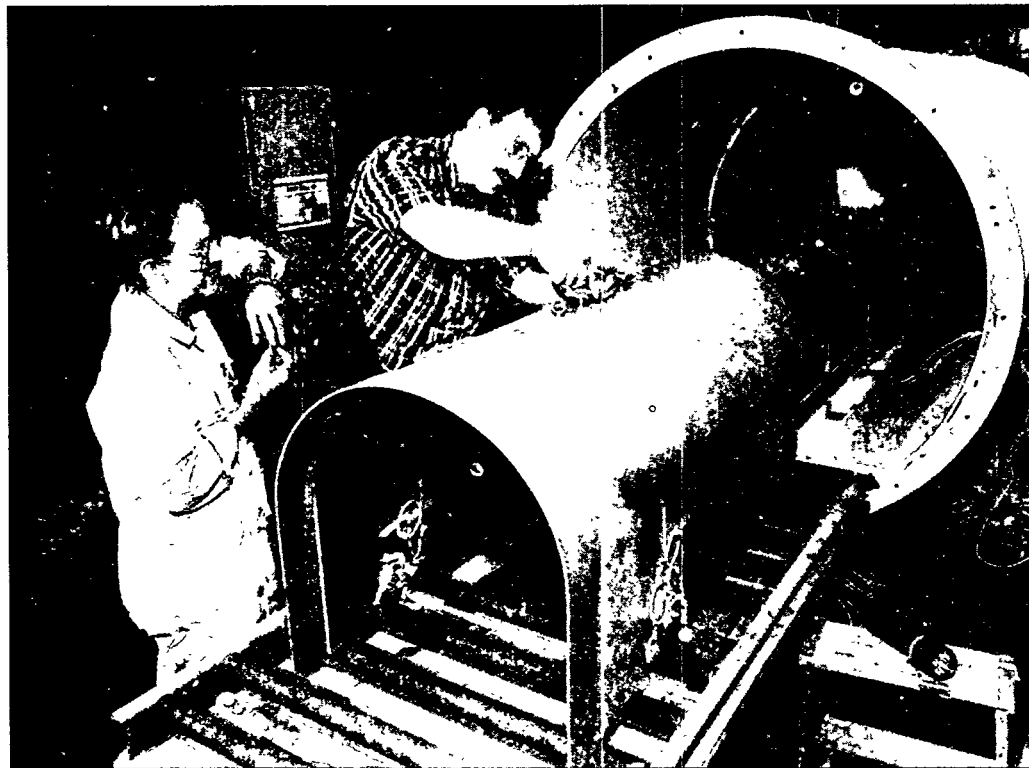
Laboratory testing contributed data that will support determinations on site recommendation. In Fiscal Year 1999, to examine how some key features of the enhanced repository design would affect the release of radionuclides, we established the Atlas engineered barrier system test facility in Las Vegas. A quarter-scale simulation of a waste emplacement tunnel, it is designed to test the drip shield and a Richard's Barrier, which is designed to function as a barrier to liquid flow. Tests determine how effectively each would prevent seepage onto waste packages. Backfill materials to enhance repository performance and mechanical stability were also tested. Test results will be included in the Process Model Report on the engineered barrier system that supports the Site Recommendation Consideration Report.

The Richard's Barrier tests were partly completed on a group of material types, and preliminary results indicate that some of the materials can act as effective barriers to water flow in a repository environment. Further experiments were put on hold in order to conduct high-priority tests on the drip shield and backfill materials.

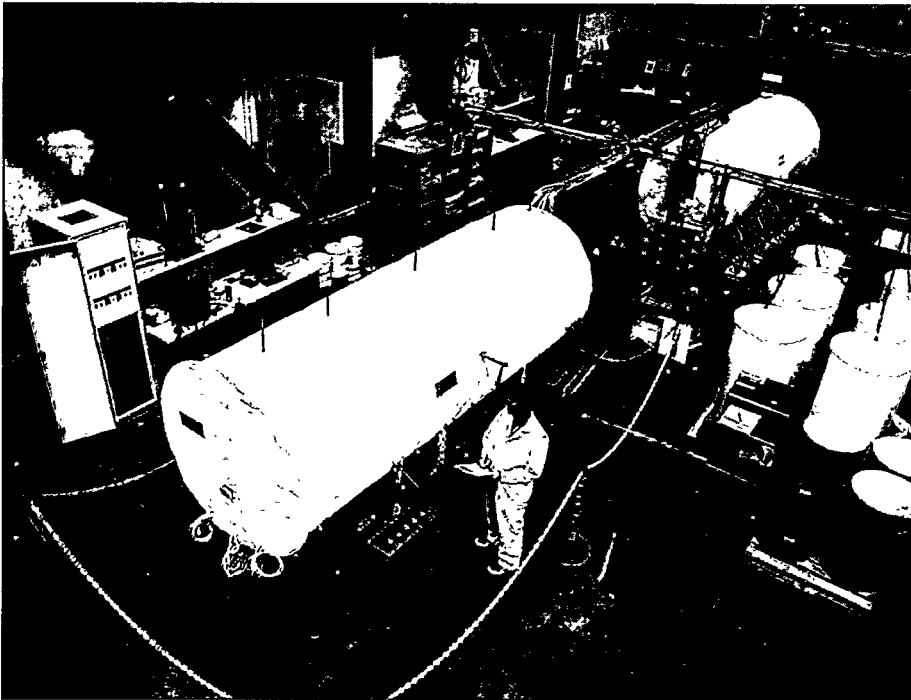
Experimental testing programs investigate the long-term corrosion and degradation mechanisms that would affect waste package materials. The data obtained enable modelers to predict package lifetime under repository conditions. The programs were started in 1996 and will be conducted for at least 5 years, with possible extension up to 10 years.

In Fiscal Year 1999, tests were modified to reflect changes in the waste package design. Corrosion testing on carbon steel ended because carbon steel is

no longer a candidate waste package material. Long-term tests continued on corrosion-resistant materials. Short-term tests continued on galvanic protection, crevice corrosion, stress corrosion cracking, aging and phase stability, and microbiologically influenced corrosion. Results have shown that, for materials selected, general and localized corrosion should not limit the life of the waste package. Stress corrosion cracking and aging and phase stability studies have been identified as warranting further investigation, and those investigations are being conducted.



Preparation of a pilot-scale drip shield



Waste package testing

Waste package material testing and modeling were performed at Lawrence Livermore National Laboratory, the General Electric Corporate Research and Development Center, the Babcock and Wilcox Research Laboratories, and Atomic Energy of Canada, Ltd.

Waste forms themselves (spent nuclear fuel assemblies and high-level waste canisters) are part of the engineered barrier system, as they are designed to contain radionuclides. To determine the degradation behavior of waste form material, long-term tests on commercial spent nuclear fuel and vitrified high-level waste continued. Investigations of the condition of commercial spent nuclear fuel cladding after storage, and its degradation thereafter, are ongoing, and new models are being developed. Studies of colloids and fuel oxidation as well as investigations of in-package chemistry and radionuclide solubility continued.

Long-term tests of waste forms began around 14 years ago and are planned to continue until 2020. In addition to generating data that can be used to characterize mechanisms for waste form degradation, they yield data for establishing parameters for empirical models. Results have reduced uncertainties

in models of waste form degradation, and continued confirmation testing will help reduce uncertainties about the physical processes most important to repository performance.

Waste form testing and modeling are being performed at DOE's Pacific Northwest, Lawrence Livermore, Argonne, Idaho National Engineering and Environmental, Sandia, and Los Alamos National Laboratories.

Engineering studies

Because OCRWM would accept plutonium waste forms in a repository, we must understand how they would affect repository operations and performance. In Fiscal Year 1999, we completed the *Plutonium Can-in-Canister Waste Form Preclosure Radiological Safety Report*. Based on the reference design described in the viability assessment, it examines design basis events (hypothetical scenarios developed to account for all plausible events within a system) that could occur above and below ground at the repository before it is permanently closed, and it analyzes them to calculate off-site doses to the public that could result. The analysis is used to establish specifications for acceptance of these waste forms, and it helps us determine how to design the repository to reduce any potential impacts.

During the fiscal year, to focus and prioritize engineering work on those elements of the repository that are most important to safety, we revised the safety classification analysis of systems, structures, and components to reflect a risk-based approach.

Developing canister specifications for DOE spent nuclear fuel

OCRWM would accept for disposal spent nuclear fuel managed by the Department; this fuel consists of over

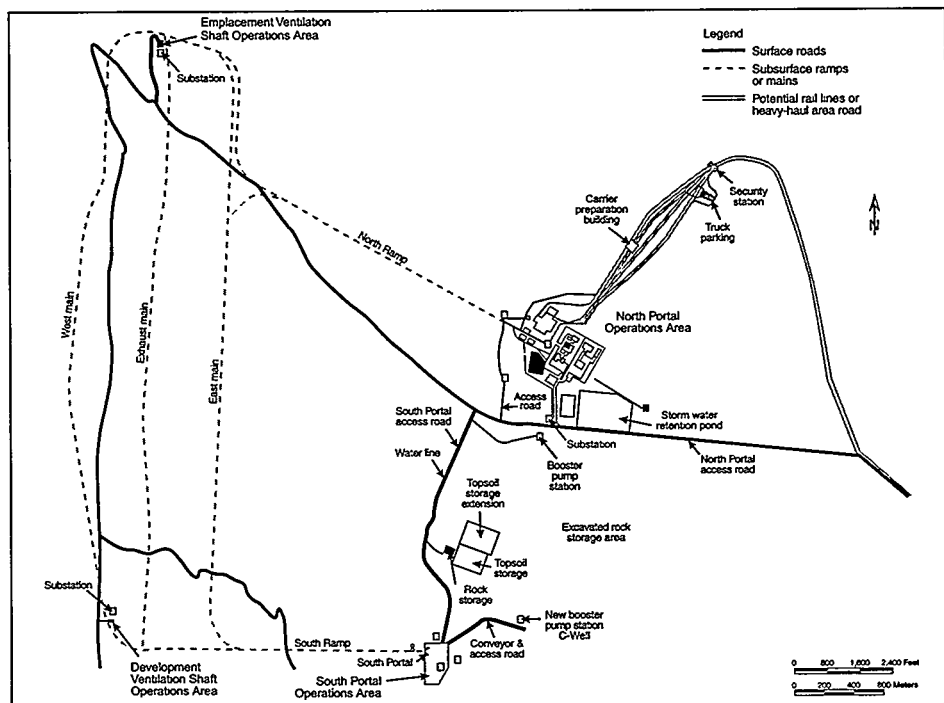
250 types, the characteristics of which vary widely. To support a determination of whether to recommend the site, as well as a potential license application and eventual waste acceptance, we continued to work closely with the Office of Environmental Management's National Spent Nuclear Fuel Program to develop specifications for a suite of standardized canisters that will accommodate all types of DOE spent nuclear fuel. That office, not OCRWM, funds this work.

In Fiscal Year 1999, our joint efforts focused on analysis of proposed canister designs loaded with representative fuel types. The analyses chiefly examined criticality, design basis events, and total system performance assessment of the canisters, both alone and within the context of the total repository system. We established external dimensions for the canisters and are now demonstrating viable designs for configuring representative DOE fuel types within canisters. We will perform more analyses in Fiscal Year 2000 to cover more representative fuel types and to determine more accurately the performance of canisters loaded with spent nuclear fuel.

Designing repository surface facilities

Occupying about 100 acres, repository surface facilities would initially support the excavation, construction, loading, and ventilation of repository tunnels. Eventually, they would receive spent nuclear fuel and high-level radioactive waste and prepare it for disposal. Shipping casks containing waste would be received from rail or truck carriers at the Carrier Preparation Building. Waste would be removed and loaded into waste packages in the Waste Handling

Building, where waste packages would be welded shut. Low-level waste generated during waste handling operations would be prepared for disposal. Vehicles used to transport sealed waste packages to a holding area and then to emplacement drifts would be serviced at the Transporter Maintenance Building. Major surface facilities would also include a Waste Treatment Building, site utilities, and other support facilities, such as warehouses, maintenance shops, and administrative facilities.



Repository surface and subsurface facilities plan

During Fiscal Year 1999, work on design of surface facilities supported the major study of enhanced design alternatives, through evaluation of various design features and alternatives. We also evaluated a configuration for the Waste Handling Building for the following purposes:

- Determining how much surface storage capacity would be needed to allow for selection and thermal blending of commercial spent nuclear fuel assemblies.

- Allowing for a larger storage area so that enough spent nuclear fuel assemblies would be on hand at any one time to permit the blending of hot and cool fuel needed to maintain waste package heat specifications.
- Evaluating two concepts for handling bare commercial spent nuclear fuel: pools of water versus dry hot cells. The configuration of the Waste Handling Building will depend on whether wet handling or dry handling operations are selected.
- Evaluating concepts for constructing the Waste Handling Building. A single building for all operations could be constructed at one time, or individual operating modules could be constructed in phases to spread costs out over time.

Documenting design to support the determination on site recommendation

The repository design consists of design packages for each of the major repository subsystems, such as the materials handling system, the carrier/cask transport system, and the disposal container handling system. An important part of the documentation that will support the Site Recommendation Consideration Report will be the system description documents that we are developing for major repository subsystems related to safety. The documents are part of the technical baseline, and they specify requirements and criteria for a specific repository subsystem and describe the resulting design.

To support eventual receipt of a license to construct a repository, system description documents would be developed for all major repository systems. The entire suite of documents would constitute life-cycle records of repository development and would be retained as permanent records.

Draft Environmental Impact Statement

The Nuclear Waste Policy Act requires that an environmental impact statement (EIS) be included in

the “comprehensive statement” that would accompany a site recommendation by the Secretary. The EIS must be developed in accordance with the National Environmental Policy Act (NEPA) of 1969.

On July 31, 1999, we completed the *Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada*. It provides background, data, and analyses that can help decision-makers and the public understand the potential environmental impacts that could result from the actions the Department may propose: constructing, operating and monitoring, and eventually closing a repository at Yucca Mountain. It also examines the impacts of transporting waste from around the country to the repository.

The draft EIS also analyzes the consequences of continued storage of spent nuclear fuel and high-level radioactive waste at current sites under a No Action Alternative that provides a basis for comparison to the proposed action. The document states that the Department’s preferred alternative is to proceed with the proposed action, as its analyses did not identify any potential environmental impacts that would be a basis for not proceeding with the proposed action. The draft was released in the form of hard copy and a CD-ROM. It is posted on our Web site at: www.rw.doe.gov

In the course of developing the draft EIS, we consulted interested organizations to discuss their concerns and to obtain information pertinent to the EIS. These include interactions with agencies that would have oversight or approval authority over some aspect of the repository, including the Nuclear Regulatory Commission, Environmental Protection Agency, Bureau of Land Management and the U.S. Air Force.

The public comment period extended from August 13, 1999, through February 28, 2000. We held public hearings as part of this process, scheduling ten in Nevada and eleven in cities around the United States.

The National Environmental Policy Act Process

The National Environmental Policy Act (NEPA) of 1969 specifies steps that Federal agencies must follow when developing an EIS. The process encourages early public involvement in defining the scope and content of the statement, and it requires Federal agencies to provide opportunities for public comments on the draft EIS.

The Nuclear Waste Policy Act specifies how NEPA requirements must be applied to a proposed repository at Yucca Mountain, and it states that the Secretary need not consider the need for a repository, alternatives to geologic disposal, or any sites other than Yucca Mountain. Nonetheless, we evaluated a No-Action Alternative in order to provide a basis for comparison with the proposed action: development of a repository.

During the fiscal year, we held periodic meetings to interact with and brief stakeholders on issues related to the draft EIS. Among the groups we met with are the Consolidated Group of Tribes and Organizations and affected units of local governments. Because the latter are particularly interested in transportation issues, we briefed their representatives on the details of how we analyzed transportation issues in the draft EIS and conducted a training course on the transportation models used in the draft EIS.

Public comments and responses will be documented in a Comment Response Document that will be part of the final EIS, scheduled for release in Fiscal Year 2001.

The Regulatory Framework for Repository Development

The Nuclear Waste Policy Act of 1982 assigned to the NRC responsibility for licensing geologic repositories, and it required that a regulatory framework govern certain statutory determinations about repository development. It directed DOE to issue general guidelines for selecting repository sites for site characterization, EPA to set generic radiological protection standards for repositories, and NRC to establish rules it would apply in licensing repositories.

The 1987 Nuclear Waste Policy Amendments Act limited characterization of candidate repository sites to

Yucca Mountain. The Energy Policy Act of 1992 directed EPA to develop site-specific radiation standards for a repository at Yucca Mountain, and it directed NRC to revise its repository licensing regulations to be consistent with the EPA standards. Between February and November 1999, EPA, NRC, and DOE released proposed regulations that reflect site-specific criteria to regulate a repository at Yucca Mountain.

The proposed regulations reflect a shift away from a generic

evaluation of site suitability to a site-specific evaluation that relies on an overall systems approach to repository performance. The specific standards established by EPA and implemented by NRC in its licensing regulations will be central to evaluating the technical suitability of Yucca Mountain as a repository site.

Department of Energy siting guidelines

When the Department issued repository siting guidelines at 10 CFR 960 in 1984, multiple sites were under consideration for a repository. The 1987 Nuclear Waste Policy Amendments Act identified Yucca Mountain as the sole site to be studied. In December 1996, DOE published a Notice of Proposed Rulemaking, proposing to modify its guidelines by adding a site-specific subpart for evaluating the suitability of the Yucca Mountain site. The proposed approach would not contain requirements relative to how individual subsystems of the repository would perform. Rather, it would require an assessment of how the total repository system would perform and a comparison of that predicted performance with the regulatory limits on permissible radiation doses for members of the public living near Yucca Mountain.

After evaluating the comments we received, and in light of EPA's proposed radiation dose standard and NRC's proposed licensing regulations, both described below, we revised our 1996 proposal and published it

for public comment, in the *Federal Register* as 10 CFR 963 on November 30, 1999. We held four public hearings over a two-day period as part of this process, both in Nevada in the vicinity of the site. The comment period closed on February 28, 2000.

Environmental Protection Agency radiation protection standards

EPA's site-specific radiation standards for a repository at Yucca Mountain would establish limits on annual radiation doses to individual members of the public from repository releases before and after the repository was permanently closed. The Energy Policy Act of 1992 requires that the standards be based on and consistent with findings and recommendations of the National Academy of Sciences. The Academy issued its report in 1995. On August 27, 1999, EPA published in the *Federal Register* a proposed rule, 40 CFR 197, for site-specific health and safety standards.

In keeping with interagency cooperation, several Federal agencies provided technical information to EPA before EPA issued its proposed rule. The White House Office of Science and Technology Policy and the Office of Management and Budget coordinated interactions among EPA, DOE, NRC, the Navy, and the Department of the Interior.

EPA's rule is divided into two subparts:

- Subpart A sets standards for the period of repository operations and monitoring before the facility is closed. It proposes that DOE must ensure that no member of the public receive more than an annual dose of 15 millirem (mrem/year) from management and storage of radioactive materials inside the repository and outside the repository but within the Yucca Mountain site.
- Subpart B proposes three separate standards after the repository is permanently closed: (1) the individual protection standard limits doses to 15 mrem/yr. from all pathways of radionuclide travel to an individual at 20 km from the repository, assuming no human intrusion into the repository occurs; (2) the

groundwater protection standard sets a separate limit of 4 mrem/year for contamination of groundwater, and EPA presented four options for a compliance distance for public comment; (3) the human intrusion standard sets a 15 mrem/year limit to an individual at 20 km from an assumed intrusion into the repository from above. DOE must demonstrate, using the performance assessment techniques described below, that there is a reasonable expectation that the standards will not be exceeded for 10,000 years following disposal.

In response to EPA's request for public comments on its proposed rule, we submitted comments on November 26, 1999. EPA plans to finalize the rule in Fiscal Year 2000. The proposed radiation standards for Yucca Mountain are posted on EPA's Web site at: www.epa.gov/radiation/yucca/rule.htm

Nuclear Regulatory Commission licensing regulation

On February 22, 1999, NRC proposed to establish a new licensing regulation at 10 CFR Part 63 that would apply only to a repository at Yucca Mountain. The proposed rule removes the previous performance requirements for each subsystem of a repository and the technical criteria for siting and engineering, leaving overall performance objectives for preclosure and postclosure phases of the repository as the measures of acceptable repository performance. It requires that DOE demonstrate compliance with overall performance objectives through an integrated safety analysis of preclosure operations and a performance assessment for long-term postclosure performance.

NRC held five public meetings in Nevada between March and June 1999 to discuss and get feedback on the proposed regulation. We presented preliminary comments on the proposed rule during the first two public meetings. The Department's final comments endorsed the Commission's strategy of using risk-informed, performance-based overall performance objectives and removing both subsystem performance objectives and siting and engineering criteria.

The public comment period on the proposed rule extended through June 30, 1999. Commission staff are reviewing more than 1,000 comments. They plan to present the proposed final rule to the Commission for approval in calendar year 2000.

After EPA issues final standards for Yucca Mountain, NRC is expected to amend its rule to be consistent with them. NRC's proposed regulation for Yucca Mountain is posted at: http://ruleforum.llnl.gov/cgi-bin/rulemake?source=YM_PRULE

Protecting Workers, the Public, and the Environment

Fostering a nuclear safety culture

Field work can be inherently dangerous. Safety is our top priority, and we have an outstanding safety record in the field. Our Standards/Requirements Identification Document identifies safety requirements and contains detailed instructions that describe the work to be performed, potential hazardous conditions, and steps and tools that can mitigate hazards. Instructions cover construction, maintenance, operations, and testing. In Fiscal Year 1999, we completed the development of over 500 detailed work instructions.

We also worked to foster the safety culture that the NRC demands of potential licensees for nuclear facilities. This includes strict compliance with safety requirements, attention to detail, personal accountability, continuous self-assessment and improvement, avoidance of complacency, and regular and critical reviews of work. We built accountability into operating procedures and maintained it through annual employee appraisals; a policy calling for application of progressively severe disciplinary measures, if necessary; and a "Time Out For Safety" policy that empowers employees to take immediate action whenever they have a safety concern.

Other management tools included additional training on environment, safety, and health requirements; analysis to determine root causes of incidents that compromise safety; and clear definitions of roles and responsibilities for all actions. Performance indicators and self-assessments supported a process of continuous improvement. The incidence of reporting

and evaluating "near-miss" events rose, while harm to employees remained well below the Department average.

One instance of our commitment to safety was a safety stand-down imposed in June 1999 as a result of a near-miss involving surface drilling into a high-voltage electrical cable. The incident produced no injuries, but was significant enough in potential harm that management decided to terminate all activities in that work area until the root causes of the incident were fully understood and preventive practices were put in place.

Our progress in complying with the Secretary's requirement that all DOE sites have an integrated safety management system in place and verified by September 30, 2000, is reported in Chapter 3.

Environmental protection

OCRWM developed an environmental program before site characterization began in order to ensure compliance with all required Federal and State environmental requirements and DOE orders. We perform our work at the Yucca Mountain site in a manner that minimizes adverse environmental impacts. In support of construction and testing both above and below ground, in Fiscal Year 1999 our environmental staff continued to meet responsibilities that ranged from training new employees on their environmental obligations to reclaiming approximately 4.33 hectares (11.0 acres) of disturbed areas where site characterization activities had been completed.

Obtaining and maintaining required environmental permits is important to site characterization activities. Without them, work cannot proceed. Among the many activities subject to permits are air quality, underground injection of water for drilling, drinking water, waste water discharge, water appropriation, and land management. In Fiscal Year 1999, we maintained compliance with over forty environmental permits, plans, and procedures, and our environmental program continued to evolve to address new regulatory requirements. As required to maintain these permits, we continued to submit quarterly and annual compliance reports to the Nevada Division of

Environmental Protection and other regulatory agencies. We also maintained land access and land withdrawal agreements and rights-of-way reservations with the Bureau of Land Management, U.S. Air Force, National Park Service, and U.S. Forest Service. These agreements facilitate seismic studies at Yucca Mountain and remote sites in Southern Nevada and California. To ensure that the conditions and requirements of all environmental permits, plans, and procedures were being fulfilled and applicable regulations were met, we conducted frequent, unannounced surveillance field checks. In Fiscal Year 1999, 540 such surveillances were conducted.



Archaeological survey near Yucca Mountain

In concert with the permitting process, we conduct surveys to inventory and protect ecological and cultural resources in areas proposed for surface-disturbing activities. Before work begins, specially trained personnel thoroughly examine these areas to identify important plant and animal species, such as the desert tortoise, and items of archaeological significance, primarily Native American artifacts, in the Yucca Mountain vicinity. In Fiscal Year 1999, we conducted six archaeological and six biological surveys before the start of work.

As stewards of the environment, and to adhere to the terms and conditions of our permits, we monitor air quality, meteorology, water quality, terrestrial ecosystems, and archaeological and Native American cultural resources to determine potential impacts from site characterization activities. To date, there have been no significant adverse environmental impacts. In Fiscal Year 1999, environmental data collection continued to support

repository design, biosphere modeling, total system performance assessment, and development of the draft EIS. The data will also support the determination on site recommendation.



Waste management survey

In compliance with the Programmatic Agreement between DOE and the Advisory Council on Historic Preservation, consultation and interactions with 17 Native American Tribes and organizations continued. At our invitation, Tribal representatives examined and evaluated nearly 400 artifacts for their significance under the Native American Graves Protection and Repatriation Act. A document presenting Native American perspectives on our Project and on the EIS was developed and used in preparation of the draft EIS.

Other efforts include terrestrial ecosystem studies and site reclamation. Information on these and other environmental program activities can be found in the *Site Environmental Report*, which is published annually and is available upon request from the Yucca Mountain Site Characterization Office.

Project Management

Reorganization of the Yucca Mountain Site Characterization Office, effective September 6, 1999, refocused functions related to Project management, planning, information systems management, and safeguards and security, in order to ensure adequate support for near-term goals, including support for determinations on site recommendation.

Project technical baseline changes

The repository system we are designing continues to evolve as our understanding of the natural setting grows and as we continue to enhance design concepts for engineered barriers. In Fiscal Year 1999, we produced or revised several technical baseline documents that define our understanding of the natural and engineered components of a repository system and ensure their thorough integration. Systems studies were completed to support decision-making on technical changes. We also modified the cost and schedule baseline and the work breakdown structure to reflect technical changes. We developed or upgraded Web-based information management tools to support efforts to integrate technical, cost, and schedule planning.

To implement the enhanced repository design concept, we revised the *Monitored Geologic Repository Concept of Operations* and the *Reference Design Description for a Geologic Repository* to include features associated with thermal management and emplacement operations, including installation of drip shields and use of backfill.

A baseline change was initiated for the *Monitored Geologic Repository Requirements Document* to incorporate Program-level changes to the *Civilian Radioactive Waste Management System Requirements Document*. The revision implemented requirements associated with adoption of the enhanced repository design concept: that the repository rock and drift wall temperatures be reduced, and that solar power be used for the subsurface ventilation system.

Project cost and schedule baseline changes

We revised the *Yucca Mountain Site Characterization Project Cost and Schedule Baseline* to reflect our new product-based work breakdown structure, to incorporate our new approach to documenting science and total system performance information for the site recommendation, and to reflect cost and schedule changes resulting from Fiscal Year 1999 planning.

The *Yucca Mountain Site Characterization Project Work Breakdown Structure* describes the "cost bins" for technical work. We revised the document to align it with Project work products: the site recommendation, the environmental impact statement, a license application, and a monitored geologic repository. Previous work breakdown structures were organized around functional areas (site testing, design, and performance assessment) and did not allow clear definition of the requirements and costs for the major products required by statutes and regulations. Clearly linking the cost baseline, its associated schedule, and the technical requirements for major products specified in the technical baseline will facilitate product-oriented planning over the next 5-year planning cycle.

External Oversight

As noted above, NRC plays a statutory role in the Civilian Radioactive Waste Management Program: it is responsible for licensing the repository and for issuing rules to govern licensing. NRC regulations also govern storage and transportation of radioactive materials.

The Nuclear Waste Technical Review Board also plays a statutory role: it was created by Congress to oversee our technical work. Composed of distinguished experts appointed by the President, it acts both as a full Board and through five panels organized around site characterization; the repository; the waste management system; the environment, regulations, and quality assurance; and performance assessment.

Meetings we held in Fiscal Year 1999 with NRC and the Board are listed in Appendix E. Publications the Board issued in Fiscal Year 1999 are listed in Appendix F.

Interactions with the Nuclear Regulatory Commission

Under the Nuclear Waste Policy Act, if the Secretary recommends to the President that the Yucca Mountain site be developed as a repository, the recommendation must include preliminary comments from the NRC to the Secretary on whether our site characterization analysis and proposed waste form appear sufficient to serve as the foundation for a license application. If Yucca Mountain is formally designated as the site of the Nation's first geologic repository, the Department must submit a license application to NRC.

The work of preparing for a determination on site recommendation also serves to develop the basis of a license application, but the application would be far more comprehensive, and the licensing proceeding would be among the most complex NRC has ever undertaken, requiring up to 3 years and entailing thousands of documents. None of DOE's licensed facilities approaches a geologic repository in complexity or the time frame for which safe performance must be demonstrated. Consequently, work to develop the basis for a license application

began some years ago, and our interactions with NRC have been important to developing a mutual understanding of both the Commission's expectations and our plans for presenting documentation of our findings and analyses. In Fiscal Year 1999, we revised our Technical Guidance Document for development of the license application.

NRC's strategic planning calls for early identification and resolution of issues at the staff level before a license application is submitted. To provide feedback on key issues, NRC has developed nine *Issue Resolution Status Reports* that define criteria for resolving each issue and that report on its status, including areas of agreement and NRC staff comments and questions. Fiscal Year 1999 meetings encompassed the results of the final peer review report on the total system performance assessment for the viability assessment, models of the natural system, total system performance assessment methodologies and results, models of the engineered system, and potential disruptive events that could affect repository performance.

On February 8, 1999, OCRWM's Acting Director briefed the Commissioners on the Program's status and the recently released viability assessment. In addition, three management meetings kept NRC informed of our overall progress and ensured that issues needing management attention were addressed. As we move closer to potential licensing, quality assurance issues become more central and, therefore, are discussed at management meetings. We are working to resolve concerns about quality assurance, and in Fiscal Year 1999, NRC continued to closely monitor our progress. More information on our quality assurance program is presented in Chapter 3.

For some years, NRC and the Department have been planning for an electronic licensing support network that would meet NRC requirements for electronic access to the unprecedented volume of documents required for a repository licensing proceeding. In December 1998, NRC published a final rule, 10 CFR 2 Subpart J, providing for electronic filing of documents and use of an Internet-based network that would enable all parties to repository licensing to share and access information through the Internet.

More information about NRC is available through its Web site at: www.nrc.gov

Interactions with the Nuclear Waste Technical Review Board

Pursuant to the Nuclear Waste Policy Act, as amended, the Nuclear Waste Technical Review Board must report its findings, conclusions, and recommendations to Congress and the Secretary of Energy at least twice a year. In April 1999, the Board released its *Report to the U.S. Congress and the Secretary of Energy*, summarizing its calendar year 1998 activities.

The Board stressed the importance of continuing to study the potential for water seepage into repository drifts, retardation of radionuclides in the unsaturated zone, long-term corrosion rates of waste package materials, and groundwater flow and radionuclide transport properties in the unsaturated zone. In our response to the Board, we reported our plans to continue seepage testing in the Exploratory Studies Facility main tunnel and in the cross-drift above it. We are continuing to study retardation of radionuclides in the unsaturated zone through tests at Busted Butte. We agreed that determining long-term corrosion rates of waste package materials is a high priority; we have been conducting such tests, for several years and have added data from other long-term tests to our databases. We agree that an important priority is understanding groundwater flow and the potential for radionuclide transport within the saturated zone under the repository to the geographic point at which compliance with radiation dose limits must be demonstrated. We are continuing to develop a three-dimensional flow and transport model with current data in an effort to reduce uncertainties.

The Board also expressed concerns about whether performance assessment models should assume that cladding on spent nuclear fuel would be a barrier to radionuclide migration. Our expert elicitation panel diverged on the issue of spent fuel cladding as a barrier to radionuclide migration, but it generally agreed there is not much information available on this topic. As a first step in resolving the issue, we undertook a detailed literature review involving

internationally known and respected experts on this subject. The review provided insight into the likely mechanisms that would be active under expected conditions, particularly late in the long life of the enhanced waste package. Several kinds of cladding integrity tests are under way at Argonne National Laboratory. Testing on crevice corrosion in cladding has been initiated.

The Board made several suggestions regarding our plans for developing a national transportation program. We will consider these suggestions when work in that area resumes.

In a separate report in April 1999 on the viability assessment, the Nuclear Waste Technical Review Board also stressed the merits of a cooler repository in reducing uncertainties about performance. As described previously, we evaluated alternative repository designs and selected a set of enhancements that conform to a number of the Board's recommendations. We reported on design work at the Board's January, June, and September 1999 meetings.

In Fiscal Year 1999, the full Board held three meetings. The first addressed the viability assessment, repository design, scientific investigations in the saturated zone, and Nye County's drilling program. The second focused on repository design and our study of enhanced design alternatives. The third focused on revision of the repository safety strategy, testing and analysis to support a site recommendation, model validation, and ways to enhance confidence in model results. EPA provided a summary of its proposed site-specific radiation protection standards for the Yucca Mountain site. In addition, the repository panel held a meeting on the design selection process for a license application.

More information about the Board, and the text of correspondence between the Board and OCRWM's Acting Director, is available on the Board's Web site at: www.nwtrb.gov

Relations with Affected Parties

Formal relationships

Under the terms of the Nuclear Waste Policy Act, the State of Nevada, Nye County, and nine contiguous counties, including Inyo County in California, are entitled to exercise oversight of site characterization activities and to receive financial assistance for this purpose. In Fiscal Year 1999, Congress continued to provide financial support for oversight efforts by the 10 affected counties and the State of Nevada: it provided \$5.54 million to the counties and \$250,000 to the State.

County's oversight program can be found through its Web site, at: www.nyecounty.com

During the fiscal year, we continued interactions with the ten affected counties and the State. Project staff hosted two meetings in Las Vegas with county representatives. We also provided Project updates to the County Commissions, Boards of Supervisors, and State and local government committees, and we conducted 29 site tours for community, county, and State officials.

Recipient	FY 1992	FY 1993	FY 1994	FY 1995	FY 1996	FY 1997	FY 1998	FY 1999	FY 2000 Plan
Churchill	70,000	111,386	200,000	200,000	0	0	178,000	197,224	193,379
Clark	1,508,550	2,227,722	2,430,000	2,430,000	0	0	1,300,000	1,440,400	1,412,320
Esmeralda	125,000	185,644	210,000	210,000	0	0	178,000	197,224	193,379
Eureka	70,000	148,515	200,000	200,000	0	0	178,000	197,224	193,379
Lincoln	327,900	475,248	544,000	544,000	0	0	582,500	645,410	632,828
Inyo	135,000	289,604	386,000	386,000	0	0	374,500	414,946	406,858
Lander	70,000	111,386	200,000	200,000	0	0	178,000	197,224	193,379
Mineral	70,000	111,386	200,000	200,000	0	0	178,000	197,224	193,379
Nye	1,508,550	2,227,723	2,430,000	2,430,000	0	0	1,675,000	1,855,900	1,819,720
White Pine	70,000	11,386	200,000	200,000	0	0	178,000	197,224	193,379
Total AULG	4,000,000	6,000,000	7,000,000	7,000,000	0	0	5,000,000	5,540,000	5,432,000

Oversight financial assistance payments to the ten affected counties

The Nuclear Waste Policy Act also gives the State and Nye County the right to designate on-site representatives to oversee our work and to receive funding for associated "reasonable expenses." The State has never designated such a representative, but Nye County has, and its representatives continued to oversee our work in Fiscal Year 1999. As reported previously, Nye County implemented its Fiscal Year 1999 initiative to drill boreholes near Amargosa Valley. Sampling and data collection are yielding needed information about water flow and fault structure in the saturated zone. OCRWM provided Nye County \$3.6 million in Fiscal Year 1999 for this program. Information about the



Meeting with local government representatives

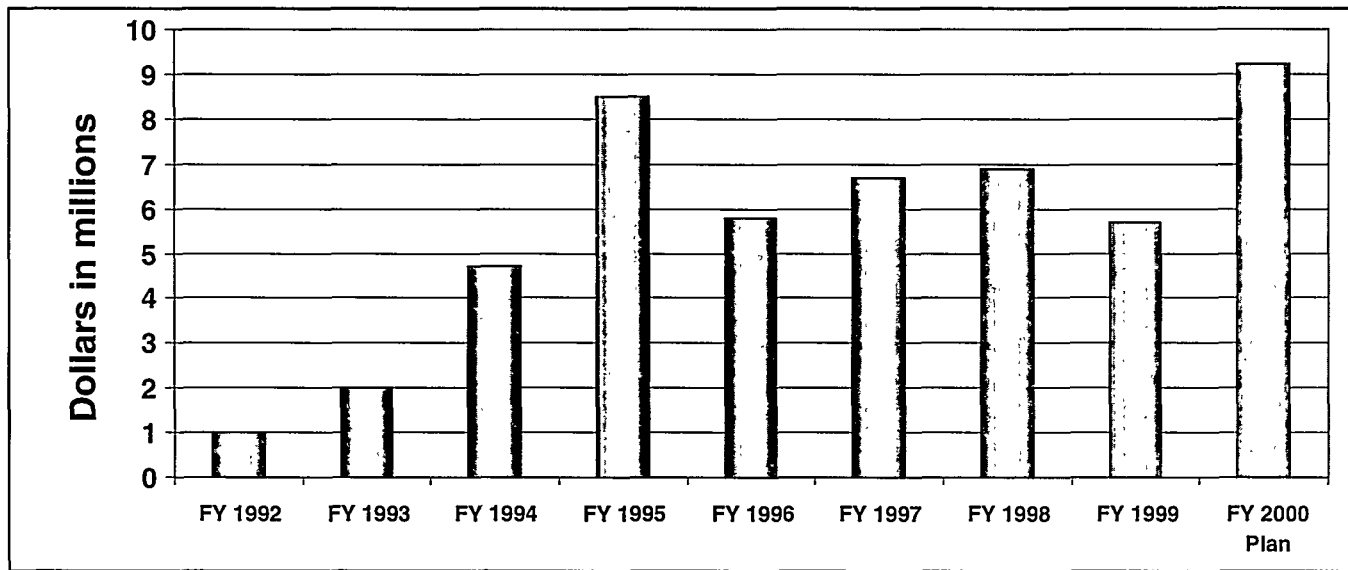
We continued funding our Payments-Equal-to-Taxes (PETT) agreement with the State of Nevada and Nye, Clark, Esmeralda, Lincoln, and Inyo Counties. Under Section 116(c)(3) of the Nuclear Waste Policy Act, these payments are intended to compensate for taxes that affected entities would have collected on site characterization and the development and operation of a repository if they were authorized to tax Federal Government activities. A total of \$5.7 million was provided in Fiscal Year 1999, of which \$5 million went to Nye County.

In Fiscal Year 1998, the Yucca Mountain Site Characterization Project and the University and Community College System of Nevada entered into a cooperative agreement for conducting scientific studies that could augment our own studies by expanding scientific data on the Yucca Mountain site or filling data gaps. Under this agreement up to \$40

packages. Studies will also contribute geochemical data for development of the single regional groundwater model described above.

Yucca Mountain Site Characterization Project Outreach

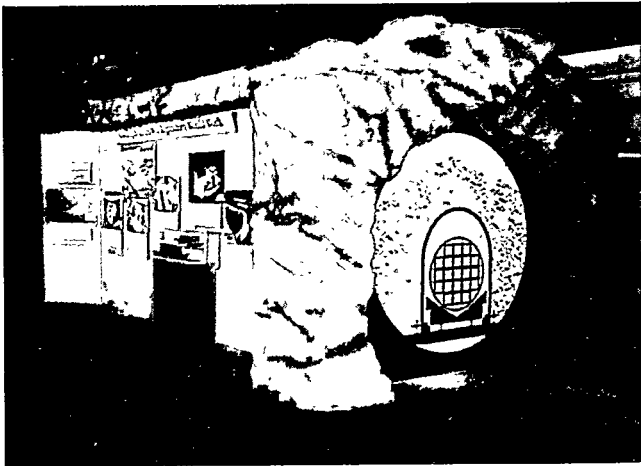
To provide timely and accurate information about the Yucca Mountain Site Characterization Project, we maintained an active communication program in Las Vegas, Nevada. We reached stakeholders, interested groups, and members of the public through a variety of means: newsletters and fact sheets; a toll-free information number; science centers; and correspondence. Our Web site remained one of our most important tools for this purpose. Through a speakers' bureau, tour program, exhibits at key events, and meetings, we promoted two-way communication with technical audiences and the general public.



Historical profile of Payments-Equal-to-Taxes

million may be applied to such studies for Fiscal Years 1998 through 2002; through Fiscal Year 1999, \$6.2 million had been provided. Subjects of the studies include geophysical strain accumulation in the Yucca Mountain area, fluid inclusion in rock fracture fillings, seismicity, water infiltration through the site, and the potential for seepage into repository drifts and waste

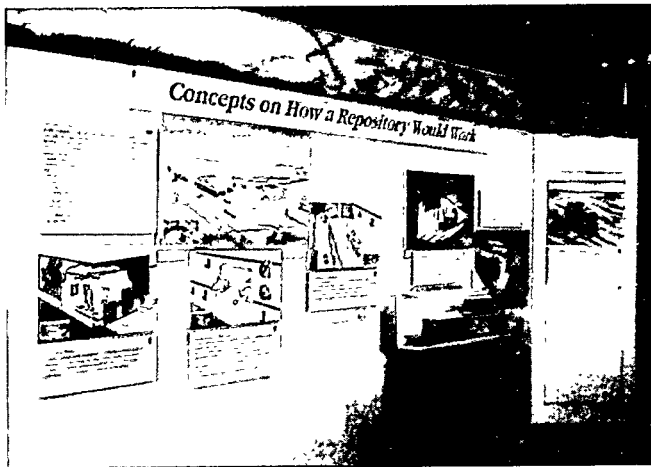
In Fiscal Year 1999, we conducted more than 250 tours of the Yucca Mountain site, briefing more than 4,300 visitors. Our exhibit was seen by nearly 10,000 people at 20 meetings held throughout the United States. Through our speakers' bureau, we made 85 presentations to civic, educational, business, and professional groups, reaching more than 4,800 people.



Yucca Mountain exhibit



Visitors in Alcove 2



Yucca Mountain exhibit



Yucca Mountain tour group

We answered more than 13,500 phone calls and letters, providing written responses and Project literature. We also filled 2,200 requests for documents, shipping more than 31,900. Our three Nevada Science Centers hosted 9,880 visitors. Our Web site was heavily visited by individuals and by business, educational, and government entities around the world.

In educational settings, we reached over 8,500 Nevada students in kindergarten through twelfth grade and

more than 300 Nevada teachers and parents. These activities included workshops on energy, geology, and environmental studies; classroom presentations; field trips; science discovery days; scout merit badge workshops; and participation in the JASON Project, a nationwide, interactive science program.

This page intentionally left blank.

Chapter Two

Waste Acceptance, Storage, and Transportation Project

The commercial spent nuclear fuel and DOE-managed nuclear materials that would be disposed of in a repository are now stored at 129 commercial and DOE sites in 39 States. Planning for the legal transfer of these materials to OCRWM and their physical transport to a repository is a significant task. Last year, most of the transportation-related components of this work were put on hold pending designation of a Federal site to which waste could be shipped.

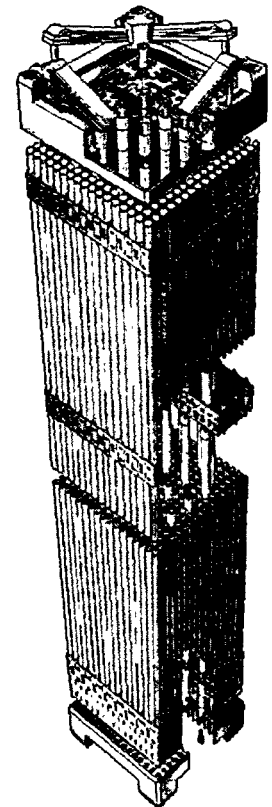
Acceptance of Commercial Spent Nuclear Fuel

The Nuclear Waste Policy Act of 1982 authorized the Secretary to enter into contracts with the owners and generators of commercial spent nuclear fuel. Our interactions with them on matters concerning receipt, shipment, and disposal of their spent nuclear fuel are

governed by the *Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste*, 10 CFR Part 961, promulgated as a Federal rule in 1983. Under the standard contract, the Department was to start accepting spent nuclear fuel from utilities in 1998. With no Federal facility available to receive the material, utilities are pursuing litigation to seek relief from hardships they allege as a consequence of the Department's inability to accept waste. The Department is working actively with the utilities to negotiate a settlement. Note 12 to OCRWM's Financial Statements (Appendix A) contains a discussion of the litigation and its current status.



Commercial nuclear power plant



Commercial nuclear fuel assembly

On March 12, 1999, in testimony before the House Subcommittee on Energy and Power, the Secretary proposed to take title to utilities' spent nuclear fuel at reactor sites pending the opening of a repository. By taking title, the Department could assume financial responsibility for a utility's continued management of the spent nuclear fuel.

Among other issues, the Department is examining how this option would be funded, how and when it would be implemented, who would own and regulate the spent fuel storage sites. Answers to these questions would depend on the specific needs of individual utilities. In return for taking title and financial responsibility for the spent nuclear fuel, the Department would expect the utilities to terminate their claims.

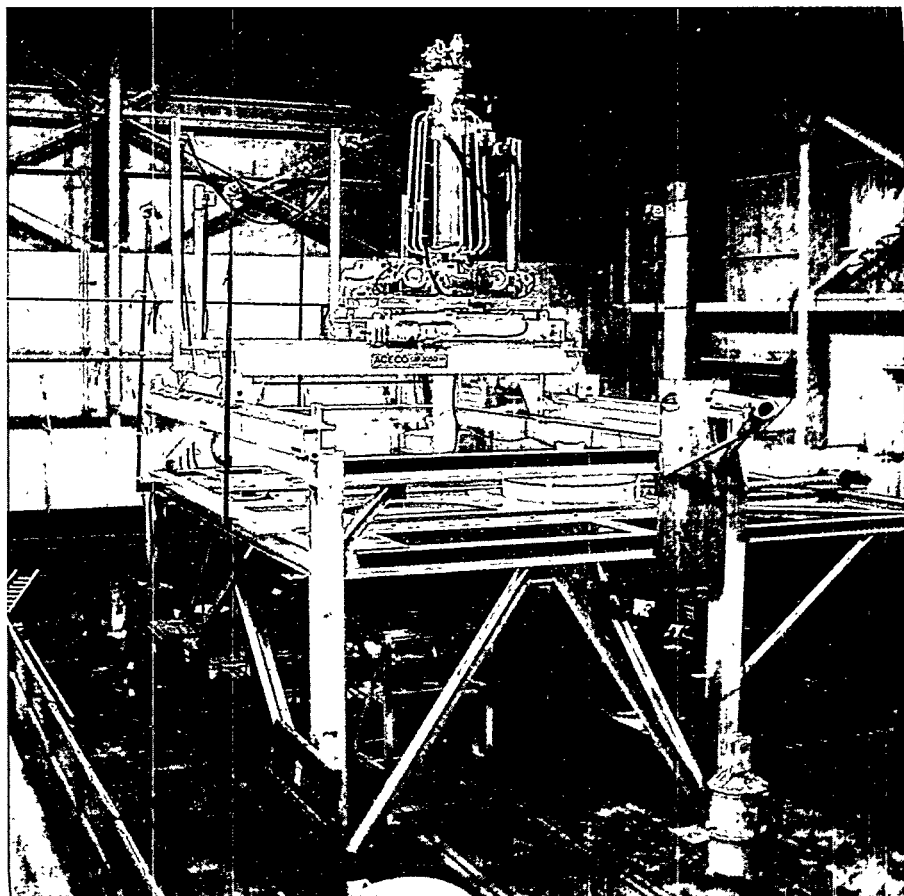
Dry transfer system for spent nuclear fuel

Development of the spent nuclear fuel dry transfer system continued in Fiscal Year 1999. The system has the potential to assist utilities and the Department in future spent fuel management activities. Congress appropriated funds in Fiscal Years 1992 and 1993 for DOE to develop the system in cooperation with the Electric Power Research Institute. The system design was completed in December 1995, and the Topical Safety Analysis Report was finalized in August 1996. A prototype demonstration project was initiated in August 1996 and completed in October 1999. During 1999, OCRWM also responded to technical questions from the Nuclear Regulatory Commission to support the Commission's review of the Topical Safety Analysis Report.

As depicted in the figure, the dry transfer system will enable the transfer of individual spent fuel

assemblies between a conventional top-loading cask and a multi-purpose canister in a shielded overpack, or accommodate spent fuel transfers between two conventional casks.

OCRWM initiated a \$4.5 million project in August 1996 to demonstrate a prototype dry transfer system with mockup spent fuel. The prototype, based on a design developed by the Electric Power Research Institute, was demonstrated at the Idaho National Engineering and Environmental Laboratory (INEEL). Completed in October 1999, it validated the performance of systems and components, determined design adequacy, confirmed system and operational capability to recover from off-normal conditions, and provided loading cycle time and overall system throughput rates. It also provided information on



Dry transfer system at INEEL

equipment fabrication costs through actual purchases under a rigorous quality assurance program.

In September 1996, we submitted a Topical Safety Analysis Report to the NRC. During Fiscal Year 1999, we responded to two requests for additional information on the report. The report is currently under review by the NRC, with completion anticipated in the Spring of 2000.

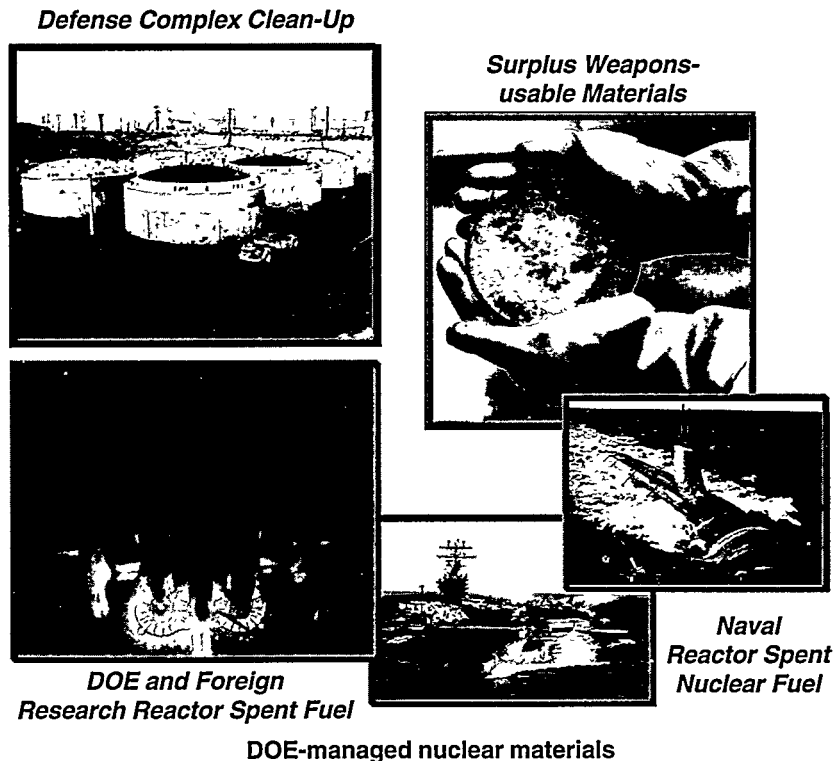
Acceptance of DOE-Managed Materials

Integrating DOE-managed nuclear materials into our Program

Three offices within the Department manage materials destined for geologic disposal. The Office of Environmental Management (EM) manages high-level radioactive waste, DOE spent nuclear fuel, and surplus nuclear materials. The Office of Fissile Materials Disposition plans for the disposition of surplus weapons-usable plutonium. Naval spent nuclear fuel is managed by the Naval Nuclear Propulsion Program, which represents both the DOE Office of Nuclear Energy, Science, and Technology and the Department of the Navy.

In Fiscal Year 1999, we issued Revision 1 of our memorandum of agreement with EM. It modified how changes would be recorded and revised the quality assurance subagreement between EM and OCRWM. We continued discussions on defining the terms and conditions under which we would accept EM's nuclear materials, and we are now developing an integrated schedule for acceptance.

We continued to implement our memorandum of agreement with the Director, Naval Nuclear Propulsion Program, Department of the Navy, to achieve safe and timely disposal of naval spent nuclear fuel. Our schedule calls for receipt of naval spent nuclear fuel early in repository operations. The parties to the agreement seek to identify data needs, interfaces and acceptance criteria, and to develop compliance procedures needed to support waste acceptance. The focus of this work in Fiscal Year 1999 was identifying data needs, defining requirements for transportation and storage systems, and specifying transportation, loading, and waste acceptance operations.



Baseline Management

Two of the six documents that constitute the Project's technical baseline were updated in Fiscal Year 1999: the *Waste Acceptance System Requirements Document* (WASRD) Revision 3, and the *Integrated Interface Control Document, Volume I*. Also updated were the *Project Cost and Schedule Baseline* and *Work Breakdown Structure and Dictionary*. Project control and baseline management of waste acceptance, storage, and transportation elements were coordinated with Program efforts, as described in Chapter 3.

- The WASRD defines acceptance criteria for D to be the single document governing criteria for waste acceptance. The revision contains waste-acceptance criteria for DOE spent nuclear fuel, high-level radioactive waste, naval spent nuclear fuel, and immobilized plutonium.
- To define the programmatic interfaces between the Waste Acceptance, Storage, and Transportation Project and the Yucca Mountain Site Characterization Project, we developed a draft *Integrated Interface Control Document, Volume II*. It contains a set of preliminary agreements with respect to issues associated with waste characteristics.
- We updated the *Waste Acceptance, Storage, and Transportation Project Cost and Schedule Baseline* to reflect the lack of authorization for work on interim storage, to incorporate revisions to the Program's work breakdown structure dictionary, and to implement other policy decisions described in the *Program Plan, Revision 2*. The most significant changes reflect the deferral of the procurement of waste acceptance and transportation services and of implementation of Section 180(c) of the Nuclear Waste Policy Act.
- To reflect policy changes described in the *Program Plan, Revision 2*, and consolidation under the Waste Acceptance, Storage, and Transportation Project of functions related to acceptance of DOE-managed nuclear materials, we updated the *Waste Acceptance, Storage, and Transportation Project Work Breakdown Structure and Dictionary*. In addition, we closed out all cost elements for work related to interim storage.

Chapter Three

Program Management Center

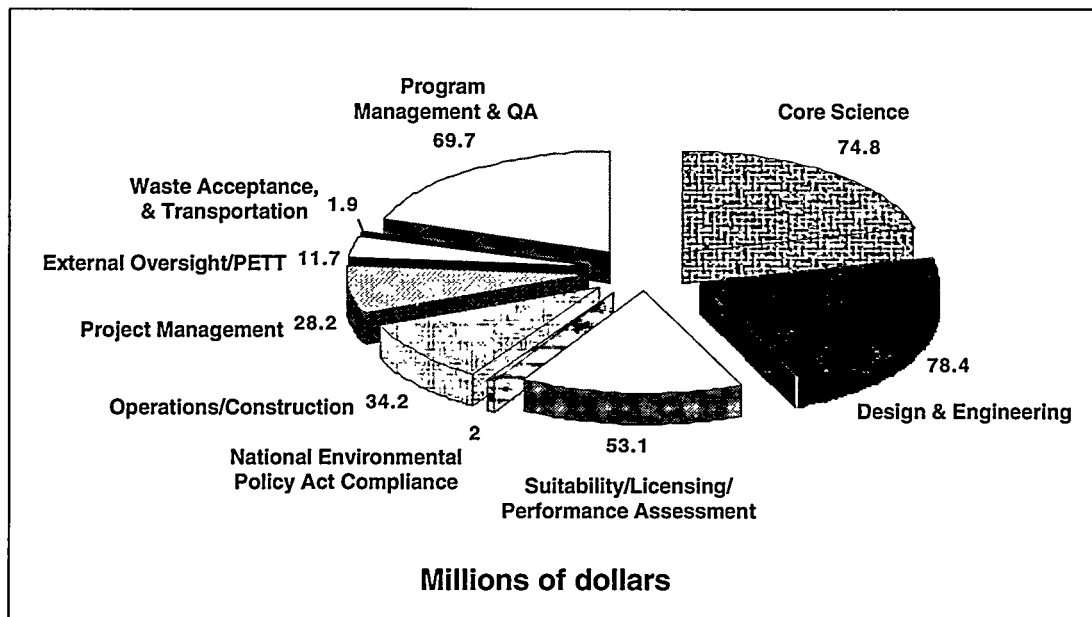
The Program Management Center consists of the Office of Quality Assurance, the Office of Program Management and Administration, and the Systems Engineering and International Division of the Office of Acceptance, Transportation and Integration. The former is located in Las Vegas, the latter two organizations in Washington, D.C.

Appropriation and Budget

Our Fiscal Year 1999 appropriation of \$358 million was \$12 million more than the Fiscal Year 1998 appropriation of \$346 million, but \$22 million less than the President's budget request.

We allocated \$282.4 million, or roughly 79 percent of our appropriation, to the Yucca Mountain Site Characterization Project. The remaining funds were used to support the Waste Acceptance, Storage and Transportation Project, which received \$1.9 million, or less than 1 percent; and the Program Management Center, which received \$69.7 million, or roughly 20 percent, approximately half of which supported the Yucca Mountain Site Characterization Project. In addition, \$4.0 million was provided by Congress to be

used for a civilian research and development program to conduct a study of accelerator transmutation of waste (ATW) technology.



OCRWM Program FY 1999 budget allocation (excludes ATW)

The conference report accompanying the Fiscal Year 1999 Energy and Water Development Appropriations Act directed a 10-percent reduction from the Administration's budget request for support service contractors at the Yucca Mountain Site Characterization Project and at OCRWM headquarters. The report also provided for the following distributions from funding for the Yucca Mountain Site Characterization Project:

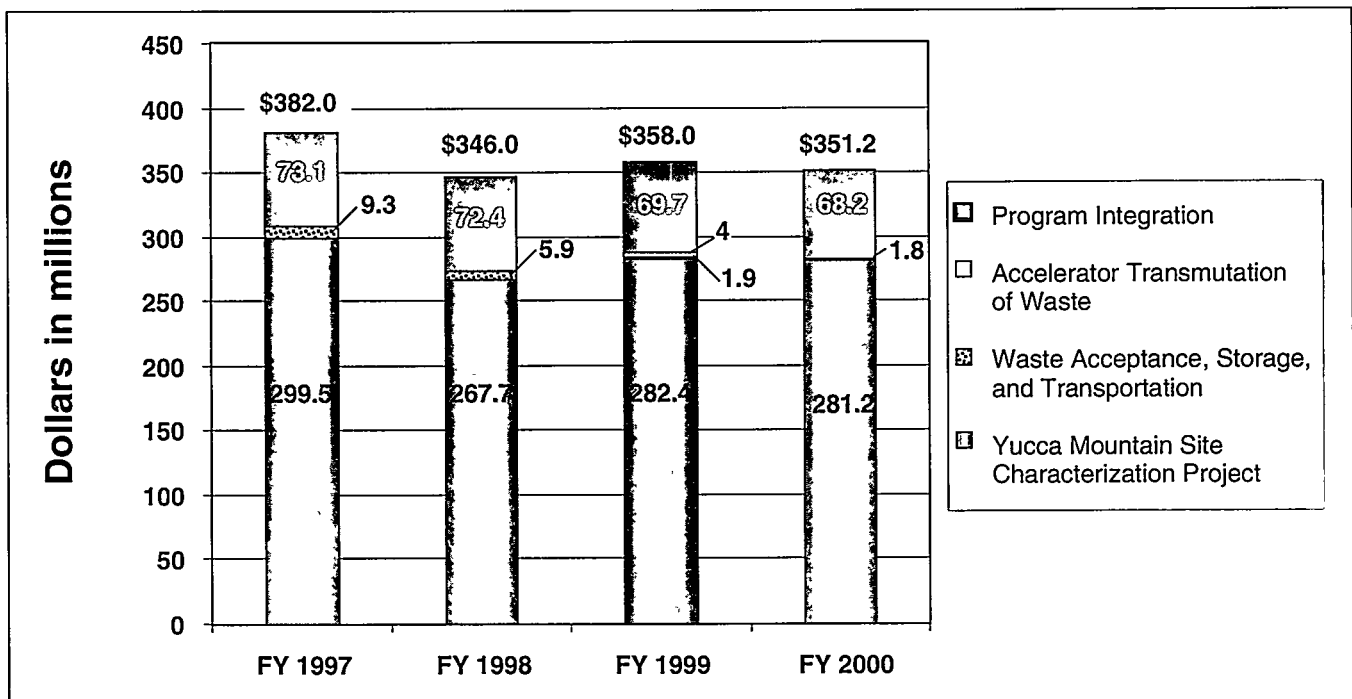
- \$250,000 to be reimbursed to the State of Nevada "for actual expenditures on

appropriate scientific oversight responsibilities...”

- \$5,540,000 for affected units of local government, to be allocated in the same proportion as was provided in the previous fiscal year.
- \$400,000 for the University of Nevada-Las Vegas to manage data from scientific studies of Yucca Mountain.

activities that have the greatest impact on confidence in the information on which the determination will rest. They worked to ensure that appropriate QA requirements were in place, fully understood, and implemented. In-line reviews of draft documents and quality assurance audits helped ensure compliance.

One of the benefits of increased interaction between QA and technical personnel was that real-time feedback on the QA program was received. As a result, we were able to target several areas of the



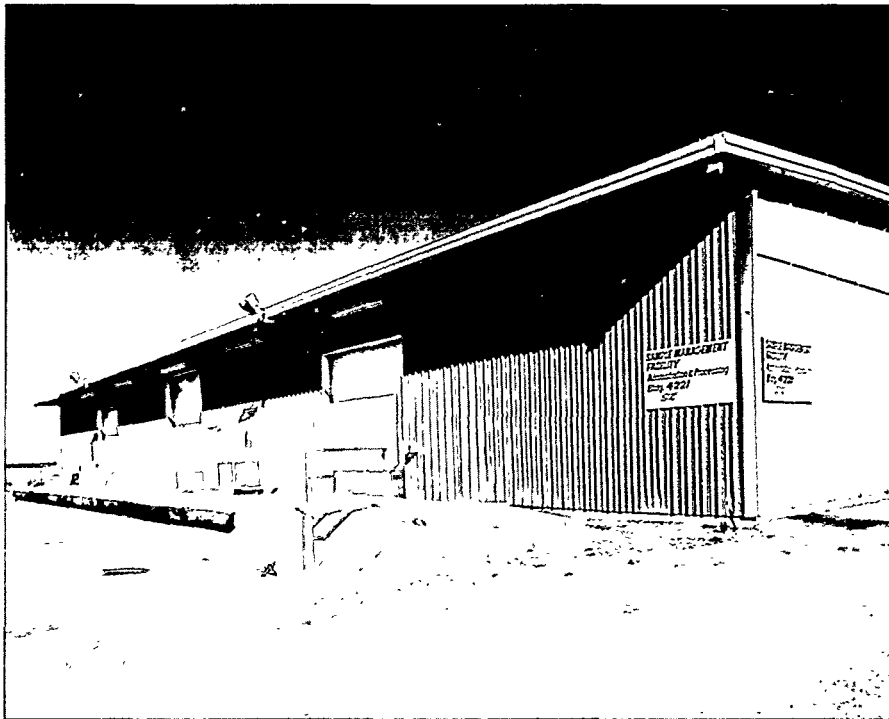
OCRWM funding profile for FY 1997-2000

Quality Assurance

Fiscal Year 1999 quality assurance (QA) activities focused on tasks related to a determination on site recommendation and, in particular, on activities and products in support of total system performance assessment. QA personnel worked closely with technical personnel conducting scientific, engineering, and performance assessment work to identify those

program for enhancement. These enhancements included the clarification of requirements for model validation and data qualification as well as the streamlining of requirements for software control.

These enhancements have been incorporated into the *OCRWM Quality Assurance Requirements and Description* and were implemented in early in Fiscal Year 2000.



QA Sample Management Facility at Yucca Mountain

Through audits and other means, QA personnel continued to examine the full range of quality-affecting activities performed by OCRWM, its contractors, and the organizations within the Department's Office of Environmental Management that interface with OCRWM. Audits and monitoring were used to evaluate how well QA requirements were being met and whether documentation was sufficient to demonstrate compliance. Deficiencies were evaluated and, if warranted, root causes were investigated. For each deficiency, a corrective action plan was developed, reviewed, and implemented. Deficiencies were promptly identified, and their correction was tracked. Audit and surveillance schedules and reports were posted on the OCRWM Web site.

QA staff continued to interact with staff from the Naval Nuclear Propulsion Program and the Office of Environmental Management, and they began a review of the QA program documentation of the Department's Office of Fissile Materials Disposition. These DOE organizations are responsible for waste forms that may be disposed of in the repository, and

QA staff work closely with them to ensure that they apply appropriate QA requirements to activities that could impact OCRWM's acceptance and disposal of their materials.

Program Management and Integration

Program planning

Revision 2 of the *Civilian Radioactive Waste Management Program Plan*, issued in July 1998, described the Program's strategic objectives and the strategies, success measures, schedules, and costs for completing them. We began to update major milestones and work plans in a draft revision of the *Program Plan* to reflect and build upon recent events,

including DOE's issuance of the viability assessment, the draft EIS, and proposed revisions to the Department's repository siting guidelines; EPA's release of proposed new, site-specific radiation standards, and NRC's publication of proposed new, site-specific repository licensing regulations. The fact that Congress appropriated significantly less funding for fiscal years 1999 and 2000 than required to carry out work as scheduled played a major role in updating our planning. An internal review draft of *Program Plan, Revision 3*, was completed in Fiscal Year 1999 and also provided a source of input to the Department's new strategic plan. In spite of the reduced Fiscal Year 1999 appropriation, OCRWM met all its success measures in the Secretary's Fiscal Year 1999 Performance Agreement with the President. (These measures are presented on the inside cover of this report.)

We supported the Department's implementation of the Government Performance and Results Act (GPRA), and we integrated OCRWM plans and strategies with those of the Department. We developed performance

measures for inclusion in the Secretary's Fiscal Year 2000 Performance Agreement with the President; these measures also satisfy the GPRA requirement for the Department's annual performance plan. We also developed preliminary performance measures for OCRWM for Fiscal Year 2001.

In keeping with GPRA's emphasis on strategic planning, internal review, and stakeholder input, we held two OCRWM planning workshops at which Program managers, senior contractor personnel, and representatives of DOE headquarters, the National Laboratories, the U.S. Geological Survey, and other parties engaged in intensive discussion of key issues and proposed approaches, solutions and decisions.

Program-level systems studies

Systems studies serve to ensure that the effects of a major decision about one component of the national waste management system are technically integrated with all other components. In Fiscal Year 1999, we conducted one major study and released the results of two others as companion documents to the viability assessment. All are available on the OCRWM Web site at: www.rw.doe.gov

- A study that resulted in a *Modular Design/Construction and Operations Options Report* was undertaken to evaluate ways of minimizing peaks in Program expenditures during repository construction, which would be the period of highest annual costs. The report describes analyses of alternative approaches to developing a waste management system during the period between 2000 and 2020. The analyses were performed for scenarios that assume that waste receipt begins at the repository in 2010, as envisioned in Revision 2 of the *Program Plan*, and for alternate scenarios that assume that waste receipt begins as early as 2007.
- Issued as a companion to the viability assessment, the December 1998 *Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program* was the latest in a series of total

system life cycle cost (TSLCC) estimates. This estimate aids in financial planning, gives policy makers information they need to determine the course of the Program, and provides input to the fee adequacy analysis described below. The analysis is based on current plans, strategies, and policies for a national waste management system.

The 1998 TSLCC analysis reflected significant changes in the Program since the previous TSLCC was conducted in 1995. Based on design concepts used in the viability assessment, it provides a comprehensive cost estimate for disposal of all wastes projected through the year 2035. It includes all future repository costs identified in the viability assessment, as well as historical costs, the costs of transportation, and construction of a rail spur in Nevada, and certain institutional, Program integration, and management cost categories not included in the viability assessment.

The 1998 TSLCC projects a total future cost to complete the Civilian Radioactive Waste Management Program, through repository closure in 2116, of \$36.6 billion in constant 1998 dollars. Although elimination of extensive use of multi-purpose canisters lowered cost projections in the 1998 TSLCC, this decrease was offset by an increase in the costs of disposal containers and surface facilities. Other cost increases resulted from planned disposal of larger quantities of DOE wastes and a longer monitoring period after waste emplacement ends. In addition, the transportation cost algorithm was updated based on new tariff information, and institutional costs were reexamined. As the Program matures, estimates of its costs will evolve to reflect changes in repository design and other cost drivers.

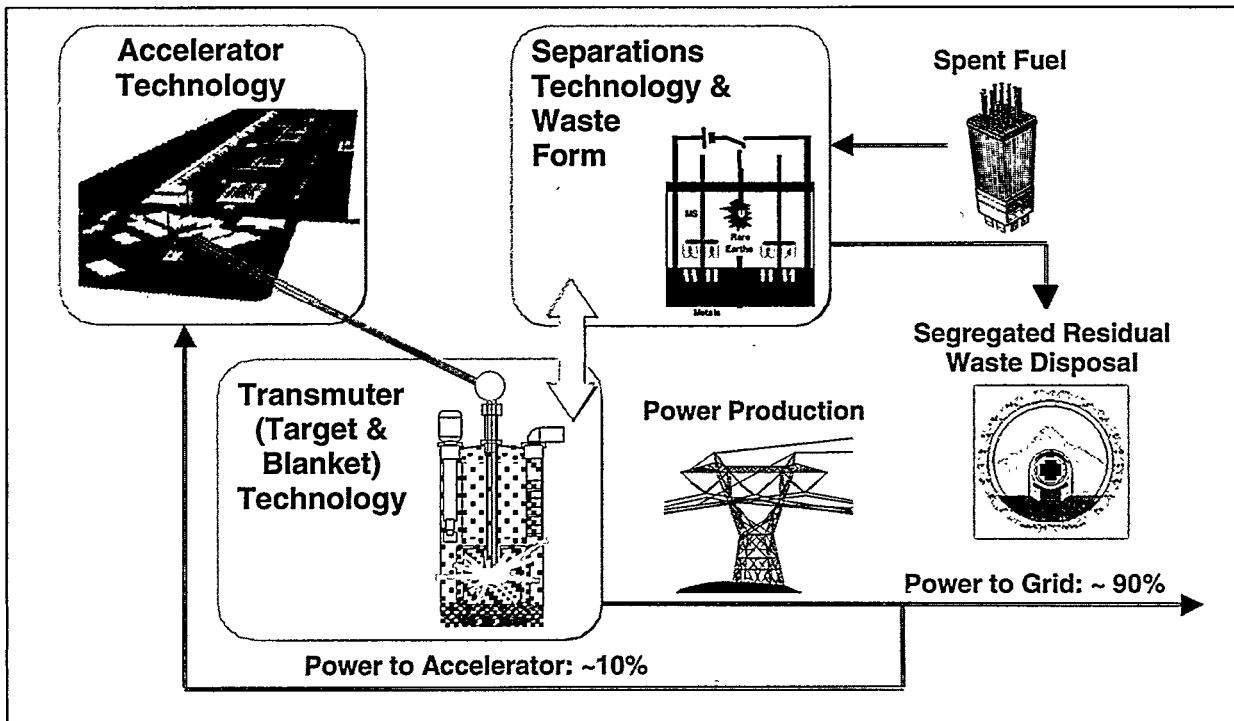
- *Nuclear Waste Fund Fee Adequacy: An Assessment* was based on the 1998 TSLCC and fee income projections from the Department's Energy Information

Administration. It was also issued as a companion document to the viability assessment. Because the owners and generators of commercial spent nuclear fuel must pay the full cost of disposing of it, the Nuclear Waste Policy Act requires an annual assessment of whether the fee the utilities pay into the Nuclear Waste Fund is adequate to cover those costs. The 1998 assessment considered a reasonable range of uncertainties in projecting what the Fund's balance would be at the end of the Program's life, and it concluded that the fee provided an adequate margin of safety for uncertainties and changes in Program scope, cost, revenues, and economic assumptions. The fee has remained unchanged since it was established by the original Act at 1.0 mil per kilowatt-hour of electricity generated and sold.

mandated by the Fiscal Year 1998 Energy and Water Development Appropriations Act. This technology, which several nations are exploring, would alter the waste stream produced by the nuclear fuel cycle, reducing the volume and long-lived radioactive content of spent nuclear fuel.

The evaluation was carried out by a steering committee consisting of Federal employees and national laboratory staff, supported by four technical working groups, individual consultants, and world experts. Their findings, presented in an October 1999 report to Congress, responded to specific congressional requests; however, the findings do not constitute a policy decision. The steering committee recommended a 6-year, science-based, research and development effort to determine the technical feasibility of the technology, but emphasized that efforts to develop a geologic repository should continue because a repository will be needed even if the technology proves successful.

In addition, *A Roadmap for Developing Accelerator Transmutation of Waste (ATW) Technology* was prepared by OCRWM in Fiscal Year 1999, as



Components of an ATW system

Integrated safety management

The Secretary of Energy requires all DOE sites and contractors to systematically integrate safety into management and work practices at all levels so that missions are accomplished while protecting the public, the worker, and the environment.

An integrated safety management system must be in place and verified by September 30, 2000. In February 1999, we issued Revision 1 of the Civilian Radioactive Waste Management Program *Safety Management Functions, Responsibilities, and Authorities Manual*, which describes how we will meet and implement the requirement for this system. In the spring of 1999, we asked the Department's Office of Environment, Safety, and Health to assess our work planning and control processes and our efforts to develop an integrated safety management system. Our goal was to identify weaknesses and obstacles to timely implementation. Although the reviewers acknowledged our good safety record, they noted weaknesses in work planning and control and in our overall approach to developing the system. We, therefore, restructured our strategy and made it more comprehensive.

In Fiscal year 1999, as part of our efforts to improve our integrated safety management strategy, we developed and began implementing a working draft *Safety Requirements Document* that defines high-level safety requirements and standards, permit conditions, and safety-related expectations. It identifies organizational roles and responsibilities, describes key processes and products, and explains how to tailor compliance with requirements to our mission and work. One key process will be confirmation that system expectations have been satisfied. We examined all DOE directives and compiled those that apply to OCRWM in a safety requirements database. As the directives change, we will modify the database accordingly. The first phase of requirements documentation was completed on September 30, 1999; the second phase is in progress.

Program-level baseline control

Baselines that define and document the features of the waste management system, including technical work, its cost, and the schedule for completing it, are the foundation of our Program. The technical, cost, and schedule components of the baseline must be integrally linked. A work breakdown structure provides one link between technical work scope and costs. Another is provided through cost-loaded and logic-linked Program and project summary schedules that are the products of annual and multi-year planning.

Because baselines are so important, changes to them must be closely controlled. Our Strategic System Management Policy outlines a process that ensures that baselines are defined and controlled at the appropriate level of authority. As the Program evolves, baselines are modified, but only after change control boards at each appropriate level approve each change. These boards follow formal procedures to evaluate proposed changes against impact thresholds specified for each level of authority.

The following changes were made in Fiscal Year 1999 to the three documents that constitute the Program's technical baseline: the *Civilian Radioactive Waste Management System Requirements Document* (CRD), the *Total System Description*, and the *Integrated Interface Control Document Volume 1*. They specify requirements that must be met by all components of the national waste management system, or they provide a reference description of the engineered and natural systems that meet those requirements.

- In Fiscal Year 1999, we made important revisions to the CRD, which defines the basic technical requirements for a national waste management system.
- We added mixed oxide spent nuclear fuel and immobilized plutonium waste forms to the technical baseline, and we established waste acceptance requirements applicable to surplus weapons-grade plutonium waste forms.

- We defined the total projected spent nuclear fuel and high-level radioactive waste inventory through 2035. This clarification was needed because inventories used in cost estimates, technical, design, environmental information, and other documents were inconsistent. The clarification supports planning and a repository design capable of accommodating the full inventory of spent nuclear fuel and high-level radioactive waste expected to be generated.
- We established the concept of allowing future generations to decide when to permanently close a repository. The repository design would not preclude its remaining open for up to 300 years.
- We established tentative receipt rates for naval spent nuclear fuel in dual-purpose canisters and canisters containing immobilized plutonium waste forms to ensure that the Program can begin to receive that waste in the years 2010-2014. This was necessary to allow the Department to meet the consent agreement among the Navy, DOE, and the State of Idaho under which spent nuclear fuel must be ready for shipment from Idaho by 2035.
- We transferred acceptance criteria for commercial spent nuclear fuel and all criteria for waste acceptance, storage, transportation, and disposal of DOE spent nuclear fuel, high-level radioactive waste, and naval spent nuclear fuel from the CRD and consolidated them in the *Waste Acceptance System Requirements Document*.
- The *Total System Description* provides a top-level description of design assumptions for the waste management system's basic physical facilities and concept of operations. It enables senior managers to evaluate the impacts of significant design and operational decisions that affect major subsystems. It also serves as a frame of reference for communication with Program participants, regulatory and oversight entities, and stakeholders. Because the

Program continues to evolve, the *Total System Description*, which presents a snapshot in time, must be revised to reflect the latest operations concepts and designs. Revision 1 was issued early in Fiscal Year 1999 to reflect the repository design used in the viability assessment. Another revision was initiated late in Fiscal Year 1999 and will be issued in Fiscal Year 2000 to reflect the enhanced repository design that will support a determination on site recommendation. Revision 1 of the *Total System Description* is posted on the OCRWM Web site.

- We completed and incorporated into the technical baseline the *Integrated Interface Control Document, Volume I*. It specifies the physical and operational interface agreements among all components of the national waste management system, including the waste acceptance, transportation, and repository systems, and the DOE offices whose wastes OCRWM will accept. These interfaces are important to the design of a repository because they define how waste handling facilities and equipment must be designed to accommodate shipping casks and waste forms.

The Program Cost and Schedule Baseline, the other component of the program-level baseline, also underwent changes in Fiscal Year 1999. We updated the Program Cost and Schedule Baseline to reflect the lack of explicit legislative authorization of work on interim storage, our organizational realignment, and the resulting changes to milestone responsibilities, revisions to project work breakdown structure dictionaries, and other policy decisions described in Revision 2 of the *Program Plan* and subsequent Program documents. The most significant changes were deferral of procurement of waste acceptance and transportation services and of implementation of Section 180(c) of the Nuclear Waste Policy Act. Further modification will be made to the baseline in Fiscal Year 2000 to reflect changes to the WBS and product definitions for the Yucca Mountain Site Characterization Project.

A fundamental tool for controlling and collecting cost data is the Program Work Breakdown Structure (WBS). The WBS defines the work scope at the Program, project, and contractor levels. It provides the basis for the Program's budget structure and for the allocation of budgets and the collection of cost data.

The Program Work Breakdown Structure Dictionary was revised to establish a separate Quality Assurance element, on a par with other Program elements. This activity was previously captured under the Program Management and Integration WBS. We also updated the Program Management and Integration Work Breakdown Structure Dictionary to reflect the consolidation of systems integration activities under a separate WBS element and the transition of DOE nuclear materials activities to the Waste Acceptance, Storage, and Transportation WBS element.

Information management

OCRWM is headquartered in Washington, DC, but most Federal and contractor personnel work at the Yucca Mountain Site Characterization Office in Las Vegas, NV, and at the Yucca Mountain site. In Fiscal Year 1999, we consolidated information management functions under an Office of Information Management within the Yucca Mountain Site Characterization Office. A small team of Federal information management staff, supported by contractors, remains at OCRWM Headquarters to provide ongoing support to OCRWM Federal staff in Washington, DC.

Since Fiscal Year 1997, we have been working to upgrade systems and networks with Y2K-compliant hardware and software. OCRWM met all of the Department's Y2K milestones for both mission-critical and non-mission-critical systems ahead of the Secretary's stretch goals. We also completed and tested our Y2K Business Continuity Plan. It was designed to mitigate risks in the event of Y2K-related system failures or loss of external or internal support and to ensure timely resumption and continuation of core business processes and activities by providing for minimum levels of service or operations. The subsequent transition to 2000 proceeded smoothly and without significant problems.

On December 30, 1998, the NRC finalized its revision of 10 CFR 2, Subpart J, which establishes the requirements for an Internet-based Licensing Support Network that would provide an electronic means of supporting document discovery motions and would permit electronic docketing of the license application itself. The final rule revises the requirement for a large centralized database but retains the requirement to provide scanned images with associated bibliographic indexes and searchable full text of each document related to licensing. We will procure a full-text database management system to develop the retrieval techniques necessary to support licensing.

We have continued to reprocess legacy records and to process current records into the format required. At the end of Fiscal Year 1999, our system held a total of 917,200 legacy and current records. Of this total, 482,600 were reprocessed legacy records; 237,500 legacy records remained to be reprocessed; and 197,100 were current records.

We also assessed our information technology (IT) management practices and presented the findings in an *IT Investment Management Baseline and Recommendations Report*. As a result of this assessment, we established an Investment Review Board to develop IT initiative investment review thresholds, procedures, and criteria, and approve major IT investments.

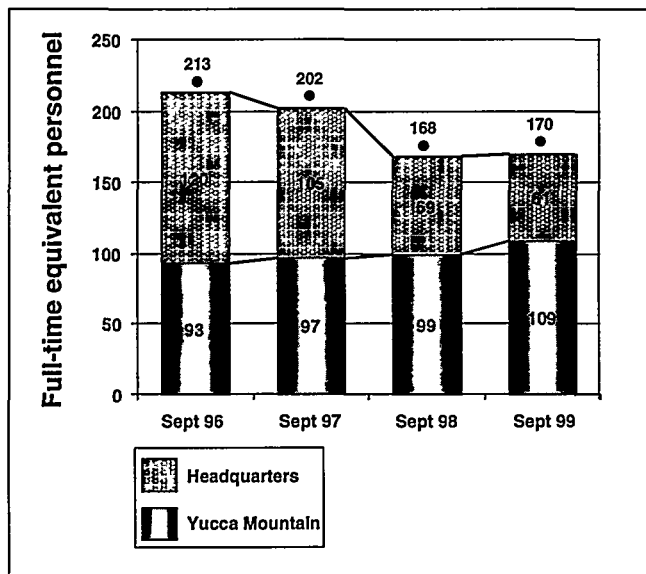
Staffing

In November 1998, the Secretary announced completion of the Strategic Alignment Initiative that had mandated a series of workforce reductions. Since then, we have participated in the Department's Workforce for the 21st Century initiative, termed *Workforce 21*. OCRWM's Workforce 21 Plan outlines our strategy to further streamline and restructure the workforce and to hire and retain personnel with the skills and technical expertise in key areas needed to carry out our mission.

Federal staffing levels remained relatively stable from the end of Fiscal Year 1998 through Fiscal Year 1999. By the end of Fiscal Year 1999, 109 Federal employees were working in Las Vegas; 61 were at

headquarters in Washington, DC, including staff assigned to the Waste Acceptance, Storage and Transportation Project. The figure shows how Federal employment levels have changed at these two locations.

Contractor staffing declined slightly from the end of Fiscal Year 1998; at the end of Fiscal Year 1999, approximately 1,950 contractors were supporting the Program. The graphic below shows this contractor staffing profile for Fiscal Years 1996-1999.



Federal staffing levels for Fiscal Years 1996 to 1999

OCRWM supported scholarships for ten juniors and seniors attending Historically Black Colleges and Universities in Fiscal Year 1999. Scholars serve summer internships at the Yucca Mountain Site Characterization Project or with other Program participants, providing an opportunity to learn how the skills and knowledge gained through their undergraduate scientific and technical studies can contribute to our work.

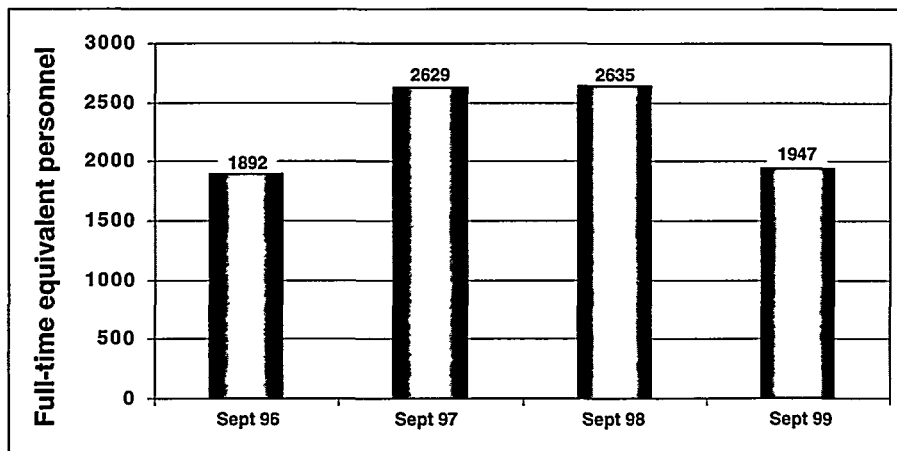
Through its Radioactive Waste Management Graduate Fellowship Program, OCRWM provided fellowships to eight graduate students pursuing advanced degrees in disciplines directly related to high-level radioactive waste management at the Nation's top colleges and universities. Fellows complete a practicum assignment that involves research relevant to ongoing site characterization studies, at the Yucca Mountain Site Characterization Project or with other Program participants.

Program Business Plan

In Fiscal Year 1999, we published an *OCRWM Program Business Plan* to document our overall business and contracting strategy for managing the Program's acquisition requirements. For the short term, it focuses on the recompetition of OCRWM's management and operating contract. In the long term, if repository development is approved, the plan will guide acquisition of contractors to accept and transport spent nuclear fuel and high-level radioactive waste to

Scholarship and fellowship programs

OCRWM's scholarship and fellowship programs implement Executive Order 12677, which directs support to Historically Black Colleges and Universities, and the Secretary of Energy's Science and Math Education Initiative. The programs provide a potential pool of skilled scientists and engineers to help meet OCRWM's future staffing needs.



Contractor staffing levels for Fiscal Years 1996 to 1999

a repository and to construct and operate the repository.

Based on assumptions, task descriptions, schedules, and cost estimates for the Program from Fiscal Year 2002 through Fiscal Year 2010, as described in the viability assessment, the plan provides an acquisition roadmap for both OCRWM and potential bidders. Its successful implementation is predicated on our receiving necessary funding and approvals, and on other external factors.

The plan has been designated a model for other DOE programs to follow in developing site management plans required by the Department. It is posted on our Web site.

External Interactions

Outreach

Each statutory milestone on the path to an operating repository presents opportunities for public participation. To participate meaningfully and constructively, stakeholders want and need information about our work. In turn, we want and need their views as we formulate our plans and assess our performance. Although external interactions have been curtailed in recent years because of funding cuts, we continue to provide information to other parties and to actively solicit their views.

In Fiscal Year 1999, OCRWM's Acting Director and staff at headquarters and at the Yucca Mountain Site Characterization Office met with representatives of over 20 Federal agencies, environmental groups, technical and professional organizations, policy groups, and international organizations:

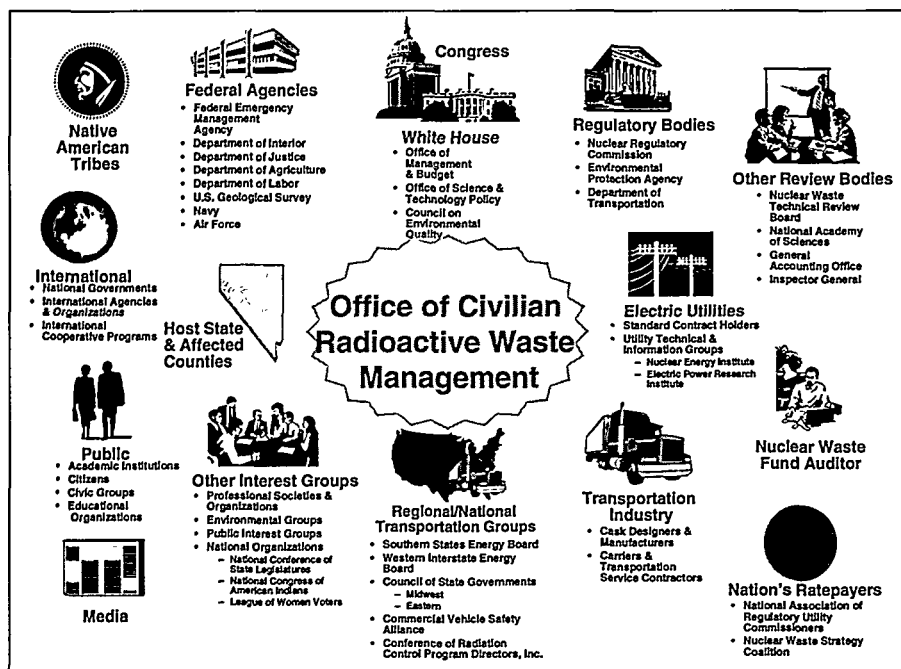
- Groups representing State, Tribal, and regional interests, such as the Nevada Legislative Committee on High Level Radioactive Waste, Nevada Test Site Citizens Advisory Board, Nevada Commission on Nuclear Projects, Nevada Alliance for Defense, Savannah River Citizen's Advisory Board, Midwestern High-Level Radioactive Waste Committee, National Congress of American Indians, National Conference of State Legislatures,

Environmental Council of the States, Council of State Governments, Association of American State Geologists, and National Association of Regulatory Utility Commissioners.

- Academic, technical and professional organizations, such as the Institute of Nuclear Materials Management, American Nuclear Society, University of Arizona Waste Management Conference, Center for Strategic and International Studies, International Association on the Environmental Disposal of Radioactive Waste Materials, Air and Waste Management Association, American Society of Mechanical Engineers, and the Massachusetts Institute of Technology.
- Organizations representing business interests, such as the Nuclear Energy Institute, the U.S. Chamber of Commerce, and Atomic Energy of Canada, Limited.
- Nonprofit foundations such as the Aspen Institute.

These meetings served the purpose of building understanding of our work and helping us learn the views of other parties.

We rely heavily on our Web site as the most efficient and cost-effective means of making Program documents, announcements, and other materials available to the general public. The OCRWM Home Page presents current Program and budget plans, major documents, congressional testimony, *Federal Register* notices, speeches, fact sheets, news releases, and photographs of the Yucca Mountain site. In Fiscal Year 1999, we redesigned our Home Page to make it more user-friendly, reorganizing some information and adding a search capability. An interactive mailbox facilitates responses to individual questions and elicits comments on the Web site. The site is linked to the Web sites of other agencies and organizations with which OCRWM regularly interacts, including the NRC, EPA, NWTRB, and the State of Nevada. Web site visitors came from more than 30 countries and represented a variety of government, commercial,



OCRWM stakeholder groups and oversight bodies

conference in October 1998, and OCRWM was assigned lead responsibility. Working with the Office of Environmental Management and the Office of Nonproliferation and National Security, we coordinated planning in cooperation with the IAEA and the Organization for Economic and Cooperative Development/ Nuclear Energy Agency (OECD/NEA). Hosted by the City of Denver, Colorado, the conference was held on October 31-November 2, 1999, and included more than 250 participants from approximately 25 countries. Participants were invited to tour the Yucca Mountain site and the Department's Waste Isolation Pilot Plant (WIPP) on November 3, 1999. We coordinated the

academic, and private organizations. The Web site address is: www.rw.doe.gov

The OCRWM Enterprise, a semiannual newsletter, is posted on our Web site. We continued to publish it and distribute it through the mail, to meet the needs of interested parties without access to the Internet. The OCRWM Calendar is both posted on the Web site and published in *The OCRWM Enterprise*; it announces opportunities for public involvement, Programwide meetings, and Yucca Mountain tours open to the public. The Calendar also identifies public meetings that are video-conferenced.

International cooperation

International cooperation to advance geologic disposal received increased attention in Fiscal Year 1999. In 1998, Secretary Richardson had announced at the first International Atomic Energy Agency (IAEA) General Conference that the Department would convene an international conference in 1999 to highlight the global progress made on the management of nuclear materials and radioactive waste in geologic repositories. The Department began to prepare for the

timing of the conference with the National Academy of Sciences' technical workshop on geologic disposal in Irvine, California, on November 4-5, 1999.

We held several meetings during Fiscal Year 1999 with officials of the Russian Federation's Ministry for Atomic Energy (Minatom) in an effort to formalize an agreement for cooperative activities on geologic disposal of radioactive materials. In June 1999, senior Minatom officials met with us at DOE headquarters and the Yucca Mountain Site Characterization Office, and they visited the Yucca Mountain site. The joint working group that we established on spent nuclear fuel will assess broader issues associated with the shipment, storage, direct disposal, and management of radioactive waste and spent nuclear materials. We are coordinating efforts to develop a preliminary list of general issues to be addressed by the working group, which is expected to issue a report on its findings in February 2001. We also participated in a joint working group meeting on the study of radionuclide migration.

During Fiscal Year 1999, OCRWM continued to participate in the OECD/NEA, and the IAEA. In addition to representing the United States on the OECD/NEA Radioactive Waste Management

Committee, OCRWM participated in the following technical projects: Thermochemical Data Base, GEOTRAP, and DECOVALEX. GEOTRAP is an international project aimed at exchanging information and in-depth discussions on approaches to acquiring field data, as well as testing and modeling the transport of radionuclides in actual geologic formations. DECOVALEX fosters international cooperation on modeling and validation of coupled thermo-hydromechanical models. The third phase of this project will model data from the drift-scale heater test at Yucca Mountain, and several other participating nations will use that data in their thermo-hydromechanical models.

OCRWM continued to serve as the official U.S. representative to the IAEA's Spent Nuclear Fuel Working Group. We developed information on OCRWM and technical materials in support of the

IAEA Convention on the Safety of Spent Nuclear Fuel and the Safety of Radioactive Waste Management.

OCRWM is one of 11 members of the newly-formed International Association for the Environmentally Safe Disposal of Radioactive Materials. OCRWM representatives attended the annual meeting of this multilateral forum in Avila, Spain, in May 1999, to discuss policy issues related to the management and disposal of nuclear materials. We held one bilateral meeting and three technical coordination workshops with ENRESA, the Spanish National Waste Management Company. One workshop focused on performance assessment, another on waste package development, and the third on site characterization. Further discussions with the United Kingdom and Finland identified the mutual benefits associated with development of a cooperative agreement on waste management and geologic disposal.

Chapter Four

Financial Management

We continued to carry out our primary financial management functions: accounting for the Program's assets, liabilities, and cash flows; quantifying the Program's long-range financial needs; and managing the investment of civilian revenues so that they are available to meet Program requirements.

Program Funding

The Nuclear Waste Policy Act requires that the costs of disposing of spent nuclear fuel and high-level radioactive waste be borne by the parties responsible for the generation of these wastes. The Act left it up to the President to determine whether civilian and defense-related waste should be emplaced in the same repository. On April 30, 1985, President Reagan issued a decision that they should be, with each party paying its proportional share of the full cost. To implement that decision, public rulemaking was used to develop a methodology for allocating defense and civilian costs. The result was published in the *Federal Register* in August 1987. The Program's accounting system is consistent with this methodology.

Program revenues: civilian utility fees for civilian waste

The Nuclear Waste Policy Act provides for two types of fee to be levied on the owners and generators of civilian spent nuclear fuel: an ongoing fee of 1.0 mil (one tenth of one cent) per kilowatt-hour on nuclear electricity generated and sold after April 7, 1983, and a one-time fee for all nuclear electricity generated and sold prior to that date. The fees are defined in the *Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste*, which was promulgated in 1983 and executed between the

Department and the owners and generators of the waste. Nuclear power producers make quarterly payments of the ongoing fee. For the one-time fee, the contract allowed owners to choose to pay immediately or defer payment and incur interest. Contract holders chose to pay approximately \$1,400 million and to defer approximately \$900 million.

Fees for spent nuclear fuel disposal are deposited in the Nuclear Waste Fund, a separate account in the U.S. Treasury that is managed and administered by the Department of Energy. Amounts not appropriated by the Congress for current Program expenses are invested in U.S. Treasury securities. OCRWM manages these investments strategically to ensure that the long-term costs of waste disposal can be met.

The Program earns civilian revenue when nuclear power plants generate and sell power, when the Program earns interest or realizes capital gains on U.S. Treasury investments, and when interest is charged on the utilities' unpaid fee balances. During Fiscal Year 1999, the Program earned \$1,419 million in civilian revenue. Fiscal Year 1999 civilian revenue consisted of \$673 million in ongoing 1 mil/kWh fees, \$108 million in interest on and adjustments to one-time fees, and \$638 million in investment earnings. The cumulative civilian revenue, as of September 30, 1999 (shown in Table 4-1), was \$16,730 million, of which \$14,081 million had been paid and \$2,649 million remained unpaid. Civilian revenue includes \$4,383 million in earnings on U.S. Treasury investments, of which \$4,302 million has been paid and \$81 million was due with the next semiannual interest payment. On September 30, 1999, the market value of Nuclear Waste Fund investments was approximately \$8,481 million, compared with \$8,611 million at the end of Fiscal Year 1998.

The market value of the Nuclear Waste Fund declined during the past year because, by law, it must be entirely invested in Treasury securities. The market value of the securities falls when interest rates rise, as they did last year. Standard accounting practices require that we report the market value of the Fund because we occasionally sell securities before maturity to adjust investments to Program spending plans. However, most of the securities will be held to maturity and should earn the return expected when they were purchased.

In Fiscal Year 1999, we continued to work to implement the terms of the memoranda of agreement that we had executed with the Office of Environmental Management and the Naval Nuclear Propulsion Program in Fiscal Year 1998. The memoranda establish a process for determining waste acceptance and fee payment schedules.

Table 4-1 also shows Program revenue from defense sources. Defense revenue is earned when the Program incurs costs related to defense waste

	CIVILIAN					DEFENSE			Grand Total
	1 Mil/ kWh Fee	One-Time Fee	Interest on fees	Return on Investment	Civilian Total	Fees	Interest on fees	Defense Total	
FY 1999 ¹	673	0	108	638	1,419	320	182	502	1,921
Cumulative through FY 1999 ²	8,458	2,337	1,552	4,383	16,730	1,772	833	2,605 ³	19,335
Paid by Waste Owners ⁴	8,293	1,457	29	4,302	14,081	1,119		1,119	15,200
Receivable ⁵	165	880	1,523	81	2,649	1,486 ³		1,486	4,135

1 From Note 14 to the Financial Statements (Appendix A).
 2 Cumulative totals are calculated by adding the FY 1999 value to cumulative amounts in the FY 1998 Financial Statements.
 3 From Note 2 to the Financial Statements. Defense payments include the \$12.5 million paid by the Department into the Nuclear Waste Fund, Defense Nuclear Waste Disposal appropriations, and credits to the government for use of the Nevada Test Site facilities. Because payments are credited against the balance due and not separated into interest and principal, only one number is shown on the Paid and Receivable lines.
 4 Paid amounts are calculated by subtracting the Receivable amount from the cumulative total.
 5 From the Balance Sheet in the Financial Statements.

Table 4-1
Cumulative Program revenue as of September 30, 1999
 (in millions of dollars)

Program revenues: defense dollars for defense waste

The Department of Energy's Office of Environmental Management and the Office of Nuclear Energy, Science and Technology's Naval Nuclear Propulsion Program are the custodians of the Department's inventory of high-level radioactive waste and spent nuclear fuel.

disposal and when interest is charged on unpaid defense balances. During Fiscal Year 1999, the Program earned \$502 million in defense revenue, which included \$320 million in fee revenue and \$182 million in interest on deferred fees. Fiscal Year 1999 defense revenues reflect the re-estimation of prior-year costs in the 1999 update to the 1998 Total System Life Cycle Cost (TSLCC) estimate. The Program's

cumulative accrued revenue as of September 30, 1999, consisted of \$1,772 million in fees and \$833 million in interest, for a total of \$2,605 million. Of the total, \$1,119 million had been paid and \$1,486 million (including interest) remained unpaid.

Program expenditures

Congress makes two separate appropriations for the Program, one from the Nuclear Waste Fund, the other through a Defense Nuclear Waste Disposal appropriation. These appropriations are recorded in separate internal accounts; however, they are consolidated in the OCRWM financial statements.

Appropriations for the Program are subject to the Federal budget process. They are considered part of the discretionary portion of the budget and thus compete for resources with other discretionary

spending programs. As a consequence, although the Nuclear Waste Fund is composed of dedicated utility money, appropriations from it are included in the total spending limits imposed on general Federal programs. Historically, this has resulted in constraints on Program funding.

As shown in Table 4-2, cumulative Program expenditures were \$6,381 million, of which \$4,609 million was allocated to civilian and \$1,772 million to defense waste disposal activities. Through Fiscal Year 1999, Congress had appropriated a total of \$6,265 million for the Program and related activities under the Nuclear Waste Policy Act, as amended.

The OCRWM Financial Statements for Fiscal Year 1999 and the report of OCRWM's independent auditor are at *Appendix A*.

	CIVILIAN	DEFENSE	TOTAL
FY 1999 ¹	261	109	370
Cumulative through FY 1999 ²	4,609	1,772	6,381
Paid by Program ³	4,581	1,760	6,341
Payable	28	12	40
Appropriations ⁴	5,172	1,093	6,265
1	Total Program expenditures are from Note 14 to the Financial Statements, which says that kWh and defense fees are recognized as revenue to the extent of expenses incurred and recognizes earned revenue of \$370 million. The total is divided into civilian and defense portions based on the TSLCC defense share of 29%.		
2	Cumulative total expenditures are calculated by adding this year's total to last year's total. Cumulative defense expenditures also include an adjustment of \$211 million for prior costs due to the increase in the percent of total costs attributed to defense. Cumulative civilian expenditures are the difference between total expenditures and defense expenditures.		
3	The Paid amount is the difference between total expenditures and payables. (Payables are shown in the Balance Sheet of the financial Statements and are amounts owed by the Program that have not yet been paid.)		
4	Appropriation totals are based on historic appropriation legislation and are not discussed in the Financial Statements. Total appropriations are not equal to total expenditures because: 1) civilian expenditures include \$135 million in interest on utility overpayment, most of which was funded through fee credits, i.e., not through appropriations; 2) capital expenditures are amortized in the Financial Statement; and 3) some appropriated funds were carried over into FY 2000 from FY 1999. Civilian appropriations include \$254 million appropriated from the Nuclear Waste Fund to the Nuclear Regulatory Commission the Nuclear Waste Technical Review Board, and the now defunct Office of the Nuclear Waste Negotiator. Defense appropriations do not include \$85 million appropriated in FY 1996, which is reserved pending statutory authority to develop an interim storage facility, and \$12.5 million paid into the Nuclear Waste Fund in FY 1991 and FY 1992.		

Table 4-2
Cumulative Program Expenditures as of September 30, 1999
 (in millions of dollars)

Managing Investments

The objectives of OCRWM's investment strategy are to: (1) ensure that investment income is available when needed, (2) support the adequacy of the fee paid into the Nuclear Waste Fund by waste owners and generators, and (3) hedge against uncertainty and unplanned funding requirements. To achieve these objectives, the Nuclear Waste Fund is managed as two portfolios: a contingency portfolio and a match portfolio.

The purpose of the contingency portfolio is to hedge against reasonable contingencies, such as unexpected near-term expenditures. The purpose of the match portfolio is to provide reliable funding for expected program expenditures. It serves to bring into balance the Program's assets and liabilities and to maintain that balance. The contingency portfolio is highly liquid and consists of Treasury securities whose average maturity does not exceed 3 years. The match portfolio consists of a mix of Treasury bills, notes, bonds, and zero-coupon bonds. The durations and present values of these investments are matched or will be matched, year-for-year, to the durations and present values of the Program's projected liabilities. Matching investments to planned spending reduces the sensitivity of the fee adequacy balance to changing interest rates.

Each month, near-term cash flow expectations and current asset and liability values are reassessed and used as the basis for investment selection. The portfolio is rebalanced, as required, upon completion of each new total system life cycle cost analysis or when changes in Program assumptions warrant. During Fiscal Year 1999, the average of the contingency portfolio's month-end balances was \$1.7 billion and the

average of its month-end maturities was 2.9 years. Match portfolio investments matched the Program's cumulative spending profile to within 12.5% in all but one year through 2020. An additional \$320 million had been invested in later years.

Over the last year, the Nuclear Waste Fund investments earned a market value return of -6.34 percent and a book value return of 8.14 percent. Market value moves in the opposite direction to interest rates. Because interest rates rose, the market value fell. Market value returns can change significantly from year to year - we earned 17.1 percent in Fiscal Year 1998. Book value returns reflect the actual income received from investments and realized capital gains. They are much more stable than market returns. Over many years, average book and market value returns will be approximately equal. Since the first investments were made in 1985, the average market value return has been 7.88 percent and the average book value returns has been 8.18 percent.

Civilian Radioactive Waste Research and Development Account

We also administer the Civilian Radioactive Waste Research and Development account, which, like the Defense Nuclear Waste Disposal appropriation, is supported by general taxpayer revenues. It pays for generic research, development, and demonstration activities authorized by Title II of the Nuclear Waste Policy Act. There was no appropriation to this account for Fiscal Year 1999; only funds carried over from prior years were spent.

Appendix A

Financial Statements

This page intentionally left blank.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Table of Contents

	Page
Overview	1-5
Independent Auditors' Report on Financial Statements	6-7
Balance Sheets	8
Statements of Net Cost	9
Statements of Changes in Net Position	10
Statements of Budgetary Resources	11
Statements of Financing	12
Notes to Financial Statements	13-30
Independent Auditors' Report on Internal Control Over Financial Reporting	31-32
Independent Auditors' Report on Compliance with Laws and Regulations	33

OVERVIEW

Reporting Entity

The Nuclear Waste Policy Act (NWPA) of 1982 (Public Law 97-425) established the Office of Civilian Radioactive Waste Management (OCRWM) within the Department of Energy (DOE). OCRWM's mission is to manage and dispose of the nation's spent nuclear fuel and high-level radioactive waste. The Office provides leadership in developing and implementing strategies to accomplish this mission that ensure public and worker health and safety, protect the environment, merit public confidence, and are economically viable.

The Nuclear Waste Policy Amendments Act of 1987 (Title V, Public Law 100-203) directed the Secretary of Energy to characterize only the Yucca Mountain site in Nevada to determine if it is suitable for a repository for spent nuclear fuel (SNF) and high-level radioactive waste (HLW).

As of September 30, 1999, OCRWM employed 2,138 people. This included 170 OCRWM Federal staff, 14 Federal full-time equivalents (FTEs) at other Headquarters offices, 6 Federal FTEs at the DOE Nevada Operations Office, 110 U.S. Geological Survey employees, and 1,838 contractor employees, including employees of national laboratories.

OCRWM carries out its mission through two business centers -- the Yucca Mountain Site Characterization Project and the Waste Acceptance, Storage and Transportation Project -- and a Program Management Center.

The Yucca Mountain Site Characterization Project, located in Las Vegas, Nevada, oversees the scientific and technical investigation of Yucca Mountain, including:

- Addressing the major unresolved technical questions about the site;
- Operating the exploratory studies facility;
- Developing repository and waste package design elements that are critical to determining the feasibility of the engineered barrier system;
- Preparing a final environmental impact statement to accompany the Secretarial site recommendation, should the site be found suitable;
- Preparing a site recommendation report for the Secretary's submittal to the President should the site be found suitable; and
- Preparing and submitting a license application for repository construction to the Nuclear Regulatory Commission, should the President recommend and the Congress approve the Yucca Mountain site.

The Waste Acceptance, Storage and Transportation Project, located in Washington, D.C., focuses on the development of processes for the legal and physical transfer of commercial SNF to the Federal Government, establishment of an acceptance process for DOE-owned SNF, including naval SNF; HLW and immobilized surplus plutonium, creation of a national transportation capability for waste acceptance, and the resolution of institutional issues with Program stakeholders.

OCRWM's Program Management Center provides program integration and management support to the

Director, OCRWM, and to the two business centers. The Program Management Center is comprised of the Office of Quality Assurance in Las Vegas, Nevada, the Office of Program Management and Administration, and the Systems Engineering and International Division of the Office of Acceptance, Transportation and Integration, in Washington, D.C. The Center is responsible for quality assurance, program planning and administration, program management, technical and regulatory integration, international waste management activities, institutional activities, and management of the Nuclear Waste Fund (NWF) and OCRWM's investment portfolio.

Fiscal Year (FY) 1999 Technical Performance

OCRWM's three technical performance measures in the Secretary's Fiscal Year 1999 Performance Agreement with the President were all completed during the fiscal year. The FY 1999 measures were:

- **Complete peer review of the total system performance assessment to provide formal, independent evaluation and critique.**

RESULTS: The peer review of the total system performance assessment was completed on May 26, 1999, and the Final Peer Review Report containing comment responses was completed on August 12, 1999. The review panel's recommendations have been factored into FY 2000 and out-year planning.

- **Complete repository and waste package design inputs for use in total system performance assessment.**

RESULTS: Repository and waste package design inputs were completed on August 27, 1999, and will be used in the development of the total system performance assessment for the Yucca Mountain site recommendation.

- **Complete a draft environmental impact statement.**

RESULTS: The draft environmental impact statement was completed in July 1999.

Fiscal Year 2000 Technical Performance Measures

The following Secretarial commitments have been identified as technical performance measures for OCRWM in FY 2000:

- Complete public hearings on the Draft Environmental Impact Statement which was published in July 1999.
- Select the reference design for site recommendation and license application.
- Select the reference natural systems models for site recommendation and license application.

Fiscal Year 1999 Financial Performance

OCRWM is required by the NWPA to recover the full cost of the Program. The Program's total cost was estimated in *Analysis of the Total Systems Life Cycle Cost of the Civilian Radioactive Waste Management Program*, dated December 1998, and updated in December 1999.

Program funding comes from the NWF and the Defense Nuclear Waste Disposal appropriation (DNWDA). The NWF consists of fees paid by the owners and generators of SNF from commercial reactors, in accordance with provisions of their contracts with DOE for disposal services. NWF assets in excess of those appropriated to pay program costs are invested in U.S. Treasury securities. The DNWDA was established by the Congress in lieu of direct payment of defense fees by DOE into the NWF, to pay for the disposal costs of HLW resulting from atomic energy defense activities and other DOE-managed nuclear materials. As of September 30, 1999, cumulative revenue from fees, including the DNWDA, totaled approximately \$12.583 billion, and cumulative interest earnings and other revenue totaled approximately \$6.769 billion. Cumulative expenditures from appropriations, including direct appropriations to the Nuclear Regulatory Commission, the now defunct Office of the Nuclear Waste Negotiator, and the Nuclear Waste Technical Review Board, totaled approximately \$6.383 billion.

As of September 30, 1999, the U.S. Treasury securities held by OCRWM had a market value of \$8.481 billion, compared to \$8.611 billion at the end of FY 1998, reflecting a decline because of rising interest rates. Investment income for FY 1999 was \$638.4 million, including \$519.7 million in interest earnings and \$118.7 million in net gains on the sale of securities.

OCRWM's primary financial goal is to ensure that future spending needs can be met. Therefore, OCRWM relies on the asset-liability matching approach to investing used by pension funds and insurance companies. By matching investments to anticipated funding requirements, OCRWM reduces the risk that changes in interest rates will adversely affect the fee adequacy balance, ensures that identified spending projections will be met, and makes investments at the most favorable rates currently available.

In its FY 1998 financial statements, OCRWM established the following two financial performance measures, both of which were achieved in FY 1999. The FY 1999 measures were:

- To maintain an adequate liquid reserve of approximately \$2 billion in short-term Treasury securities with an average maturity of 3 years, to meet unexpected spending needs.

RESULTS: During the year, the average month-end balance in the contingency fund was \$1.7 billion, and the average of its month-end maturities was 2.9 years.

- To reallocate existing investments and invest any additional surpluses to match the revised Program spending profile through at least the year 2019.

RESULTS: The cumulative spending profile was matched in all but one year through the year 2020, and additional funds were invested in later years.

Fiscal Year 2000 Financial Performance Measures

The following have been identified as financial performance measures for OCRWM in FY 2000:

- To maintain an adequate liquid reserve of approximately \$2 billion in short-term Treasury securities, with an average duration not to exceed 3 years, to meet unexpected spending needs.
- To invest any surpluses to match anticipated Program spending through at least the year 2021.

Year 2000 (Y2K) Compliance

The high priority OCRWM accorded Y2K preparedness paid off in a smooth transition to the January 1, 2000, date rollover. OCRWM experienced only two minor Y2K software problems, which did not impact core operations. Since FY 1997, OCRWM had worked to upgrade systems and networks with Y2K-compliant hardware and software. Significant efforts and resources were invested in the assessment, renovation, validation as Y2K-compliant, and implementation of both mission-critical and non-mission-critical systems.

OCRWM's four mission-critical systems were validated as Y2K-compliant and implemented ahead of the Secretary's stretch goal of January 31, 1999. OCRWM also validated as Y2K-compliant and implemented 1,013 non-mission-critical software applications, 10 telephone systems, 31 networks, 168 servers, 3,173 workstations, 23 building systems, 10 pieces of laboratory equipment, 4 health and safety systems, and 1,400 embedded systems. Again, OCRWM exceeded the Secretary's stretch goal of March 31, 1999, for non-mission-critical systems.

OCRWM completed and tested a Y2K Business Continuity Plan, which provided contingency plans and a strategy for mitigating risks in the event of Y2K-related system failures or loss of external or internal services. The plan provided for timely resumption and continuation of core business processes and activities by establishing minimum levels of service or operations. The required end-to-end testing documents and contingency plans for mission-critical systems were completed by August 30, 1999. The contingency planning process entailed the identification of the most likely worst-case scenarios and plans for their mitigation. In accordance with DOE direction, OCRWM's contingency plan addressed several possible failure scenarios including a four-hour interruption, a four-day unavailability of service, and a worst-case scenario of a four-week service interruption. The most likely scenario, a four-hour interruption, would have been only a minor inconvenience for OCRWM personnel in ensuring business continuity. As a precautionary measure, however, OCRWM created duplicate hard copies of its mission-critical databases for use with manual processes.

The following table estimates OCRWM's Y2K costs; it includes the costs of hardware and software procurements and upgrades, as well as burdened labor costs to investigate, test, renovate, and validate Y2K compliance for all systems and software.

OCRWM Y2K Cost Estimates (dollars in thousands)

Budget Organization	1996	1997	1998	1999	2000	Total
RSIS	\$ -	\$ 2,448	\$ 72	\$ 285	\$ 150	\$ 2,955
RW	-	283	160	75	25	543
TESS (TRW)	-	3,802	372	562	262	4,998
YMSCO	-	857	25	25	25	932
Totals	\$ -	\$ 7,390	\$ 629	\$ 947	\$ 462	\$ 9,428

Limitations of the Financial Statements

The accompanying financial statements were prepared to report the financial position, net cost, changes in net position, budgetary resources, and financing of the NWF and the DNWDA, pursuant to the NWPA, as amended. While the statements have been prepared from the books and records of the NWF and the DNWDA, in accordance with the formats prescribed by the Office of Management and Budget, the statements are different from the financial reports used to monitor and control budgetary resources, which are prepared from the same books and records.

The statements should be read with the realization that they relate to the NWF and the DNWDA; that unfunded liabilities reported in the financial statements cannot be liquidated without the enactment of an appropriation; and that the payment of all liabilities, other than those resulting from contractual obligations, can be abrogated by DOE.



2001 M Street, N.W.
Washington, D.C. 20036

Independent Auditors' Report on Financial Statements

United States Department of Energy
Office of Civilian Radioactive Waste Management:

We have audited the accompanying balance sheets of the Office of Civilian Radioactive Waste Management (OCRWM) as of September 30, 1999 and 1998, and the related statements of net cost, changes in net position, budgetary resources, and financing for the years then ended. These financial statements are the responsibility of OCRWM's management. Our responsibility is to express an opinion on these financial statements based on our audit.

We conducted our audit in accordance with generally accepted auditing standards; the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States; and Office of Management and Budget Bulletin No. 98-08, *Audit Requirements for Federal Financial Statements*, as amended. Those standards require that we plan and perform the audit to obtain reasonable assurance about whether the financial statements are free of material misstatement. An audit includes examining, on a test basis, evidence supporting the amounts and disclosures in the financial statements. An audit also includes assessing the accounting principles used and significant estimates made by management, as well as evaluating the overall financial statement presentation. We believe that our audit provides a reasonable basis for our opinion.

As discussed in note 12 to the financial statements, OCRWM is involved as a defendant in several matters of litigation relating to its inability to accept waste by the January 31, 1998 date specified in the Nuclear Waste Policy Act of 1982, as amended. The Court of Appeals for the District of Columbia Circuit has ruled that the Standard Contract (1) imposes an unconditional obligation on DOE to initiate waste acceptance by January 31, 1998 and (2) offers a potentially adequate remedy for the failure of DOE to meet this obligation. It is too early to evaluate the ultimate impact on OCRWM of claims based on the decisions in these cases and resolution of such claims will involve highly fact-specific and individualized decisions about the costs incurred by each contract holder as a result of the delay of DOE in meeting its obligation under the Standard Contract. However, DOE has estimated possible damages to be between \$500 million and \$1 billion. OCRWM has recorded an estimated liability of \$500 million relating to these matters in the financial statements for the years ended September 30, 1999 and 1998.

In our opinion, the financial statements referred to above present fairly, in all material respects, the financial position of the Office of Civilian Radioactive Waste Management as of September 30, 1999 and 1998, and its statements of net costs, changes in net position, budgetary resources, and reconciliation of net costs to budgetary obligations for the years then ended in conformity with generally accepted accounting principles.



As discussed in note 2 to the financial statements, OCRWM implemented Statements of Federal Financial Accounting Standards No 4, *Managerial Cost Accounting Concepts and Standards for the Federal Government* and No. 7, *Accounting for Revenue and Other Financing Sources and Concepts for Reconciling Budgetary and Financial Accounting*, effective October 1, 1997.

In accordance with *Government Auditing Standards*, we have also issued reports dated January 14, 2000 on our consideration of OCRWM's internal control over financial reporting and on our tests of its compliance with certain provisions of laws and regulations. Those reports are an integral part of an audit performed in accordance with *Government Auditing Standards* and should be read in conjunction with this report in considering the results of our audit.

Our audit was made for the purpose of forming an opinion on OCRWM's financial statements, taken as a whole. The information presented in the Overview is not a required part of the basic financial statements but is supplementary information required by Office of Management and Budget Bulletin No. 97-01, *Form and Content of Agency Financial Statements*, as amended. We have considered whether this information is materially inconsistent with the principal financial statements. Such information has not been subjected to the auditing procedures applied in the audit of the financial statements and, accordingly, we do not express an opinion on it. The performance information included in the Overview is addressed in our auditors' report on internal control over financial reporting in accordance with OMB Bulletin No. 98-08, as amended.

KPMG LLP

January 14, 2000

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Balance Sheets

As of September 30, 1999 and 1998

(Dollars in thousands)

	1999	1998
Assets		
Intragovernmental:		
Fund balance with Treasury (note 3)	\$ 88,101	\$ 90,765
Investments (note 4)	8,481,205	8,610,666
Accounts receivable:		
Receivable from Department of Energy (notes 2 and 11)	1,486,056	1,175,211
kWh fees (note 5)	11,298	9,848
Accrued investment interest (note 4)	81,388	83,857
Other assets	445	278
Total intragovernmental assets	10,148,493	9,970,625
Accounts receivable (note 5):		
kWh fees	153,258	144,321
One-time spent fuel fees	880,489	880,489
Interest from one-time spent fuel fees	1,523,355	1,415,345
General property, plant, and equipment, net (note 6)	22,367	28,112
Other assets	808	993
Total Assets	\$ 12,728,770	\$ 12,439,885
Liabilities		
Liabilities covered by budgetary resources:		
Intragovernmental:		
Accounts payable	\$ 5,249	\$ 4,253
Deferred revenue (note 14)	1,142,059	925,141
Total intragovernmental liabilities	1,147,308	929,394
Accounts payable	34,896	47,437
Deferred revenue (note 14)	11,802,824	10,242,761
Contract holdback	322	390
Other governmental liabilities	3,462	3,390
Total liabilities covered by budgetary resources	12,988,812	11,223,372
Liabilities not covered by budgetary resources:		
Intragovernmental:		
Pension and other actuarial liabilities	3,564	3,740
Other unfunded governmental liabilities	1,454	3,451
Estimated liability for waste acceptance obligation (note 12)	500,000	500,000
Total liabilities not covered by budgetary resources	505,018	507,191
Total Liabilities	13,493,830	11,730,563
Commitments and contingencies (notes 12 and 13)		
Net position:		
Unexpended appropriations (note 7)	87,663	89,256
Cumulative results of operations	(500,000)	(273,915)
Total net position before unrealized gain	(412,337)	(184,659)
Unrealized gain (loss) on investments available for sale	(352,723)	893,981
Total Net Position	(765,060)	709,322
Total Liabilities and Net Position	\$ 12,728,770	\$ 12,439,885

The accompanying notes are an integral part of these statements.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Statements of Net Cost

For the years ended September 30, 1999 and 1998

(Dollars in thousands)

	<u>1999</u>	<u>1998</u>
Costs:		
First repository costs (Notes 9 and 10):		
Intragovernmental	\$ 35,015	\$ 39,384
With the public	<u>335,651</u>	<u>389,760</u>
Total first repository costs	370,666	429,144
Less: earned revenue (note 14)	<u>(369,594)</u>	<u>(428,042)</u>
Net first repository costs	1,072	1,102
 Cost not assigned to first repository:		
Estimated liability for waste acceptance obligation (note 12)	<u>—</u>	<u>500,000</u>
Net cost of operations	<u>\$ 1,072</u>	<u>\$ 501,102</u>

The accompanying notes are an integral part of these statements.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Statements of Changes in Net Position

For the years ended September 30, 1999 and 1998

(Dollars in thousands)

	1999	1998
Net cost of operations	\$ (1,072)	\$ (501,102)
Financing Sources (other than exchange revenues):		
Imputed financing	1,072	1,102
Net results of operations	—	(500,000)
Prior period adjustment (note 15)	(226,085)	149,822
Net change in cumulative results of operations	(226,085)	(350,178)
Decrease in unobligated balances	(1,593)	(55,823)
Change in unrealized gain on investments	(1,246,704)	774,018
Change in net Position	(1,474,382)	368,017
Net position - beginning of the period	709,322	341,305
Net position - end of period	\$ (765,060)	\$ 709,322

The accompanying notes are an integral part of these statements.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Statements of Budgetary Resources

For the years ended September 30, 1999 and 1998

(Dollars in thousands)

	<u>1999</u>	<u>1998</u>
Budgetary resources:		
Budgetary authority	\$ 353,465	\$ 346,000
Unobligated balance:		
Brought forward October 1	99,534	107,075
Adjustments:		
Temporarily restricted from FY 96 authority (note 3)	<u>(85,000)</u>	<u>(85,000)</u>
Total budgetary resources	<u>\$ 367,999</u>	<u>\$ 368,075</u>
Status of budgetary resources		
Obligations incurred	\$ 360,439	\$ 353,545
Unobligated balances available:		
Apportioned, balance currently available	11,560	14,530
Unobligated balances not yet available:		
Other unobligated balances not yet available	<u>(4,000)</u>	<u>—</u>
Total status of budgetary resources	<u>\$ 367,999</u>	<u>\$ 368,075</u>
Outlays		
Obligations incurred	\$ 360,439	\$ 353,545
Obligated balance net, beginning of period	97,985	138,396
Obligated balance transferred, net	—	(18)
Less: obligated balance net, end of period	<u>(100,476)</u>	<u>(97,985)</u>
Total outlays	<u>\$ 357,949</u>	<u>\$ 393,938</u>

The accompanying notes are an integral part of these statements.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Statements of Financing

For the years ended September 30, 1999 and 1998

(Dollars in thousands)

	1999	1998
Resources used to finance activities		
Budgetary resources obligated for orders and delivery of goods and services to be received or benefits to be provided to others	\$ 360,439	\$ 353,545
Less earned revenue	(369,594)	(428,042)
Less offsetting collections, recoveries of prior year authority	—	(19)
Appropriations transferred-out	19,600	21,600
Total resources used to finance activities	10,445	(52,916)
Relationship of total resources to the net cost of operations		
<i>Deduct resources used to fund items not part of the net cost of operations:</i>		
Increase or (decrease) in budgetary resources obligated to order goods and services not yet received or benefits not yet provided	(14,650)	44,949
Resources that fund expenses recognized in prior periods	(1,541)	3,363
Resources that finance the acquisition of assets or liquidation of liabilities	(2,133)	(5,918)
Total resources used to fund items not part of the net cost of operations	(18,324)	42,394
Resources Used to Finance the Net Cost of Operations	(7,879)	(10,522)
Costs that do not generate resources		
<i>Components of net cost of operations that do not require or generate resources during the reporting period:</i>		
Expenses or exchange revenue related to the disposition of assets or liabilities, or allocation of their costs over time:		
Expenses related to use of assets	8,369	10,371
Losses or (gains) from revaluation of assets and liabilities	(490)	189
Decrease or (increase) in exchange revenue receivable from the public	—	(38)
Subtotal	7,879	10,522
Estimated liability for waste acceptance obligation (note 12)	—	500,000
Other net cost components that do not require or generate resources during the reporting period	1,072	1,102
Total components of net cost of operations that do not generate resources during the reporting period	8,951	511,624
Net cost of operations	\$ 1,072	\$ 501,102

The accompanying notes are an integral part of these statements.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

(1) Legislative Background

The Nuclear Waste Policy Act (NWPA) was signed into law on January 7, 1983. The NWPA establishes a framework for the financing, siting, licensing, operating and decommissioning of one or more mined geologic repositories for the Nation's spent nuclear fuel and high-level radioactive waste which is to be carried out by the Department of Energy's (DOE) Office of Civilian Radioactive Waste Management (OCRWM). In addition, the NWPA contains other provisions including:

Assigning responsibility for the full payment of disposal costs to the owners and generators of high-level radioactive waste and spent nuclear fuel and creating a special Nuclear Waste Fund (NWF) within the Treasury of the United States.

Providing for contracts between DOE and the owners and generators of spent nuclear fuel and high-level radioactive waste pursuant to which DOE is to take title to the spent nuclear fuel or high-level radioactive waste as expeditiously as possible, following commencement of repository operations and, in return for payment of fees established by the NWPA, to begin disposal of the spent nuclear fuel or high-level radioactive waste not later than January 31, 1998.

Requiring evaluation of the use of civilian disposal capacity for the disposal of high-level radioactive waste resulting from atomic energy defense activities (defense waste). In April 1985, President Reagan notified DOE of his determination that a separate defense waste repository was not necessary and directed DOE to proceed with arrangements for disposal of such waste. Fees, equivalent to those paid by commercial owners, must be paid for this service by the Federal Government.

On December 22, 1987, the President signed into law the Budget Reconciliation Act; Subtitle A of Title V of which contained amendments to the NWPA of 1982. The legislation directed DOE to characterize only the Yucca Mountain site in Nevada as a candidate site for the first repository.

The legislation also provided for the termination of site-specific activities at all candidate sites other than the Yucca Mountain site, within 90 days of enactment, and for phasing out, not later than 6 months after enactment, all research programs in existence designed to evaluate the suitability of crystalline rock as a potential repository host medium. In the event that the Yucca Mountain site proves unsuitable for use as a repository, the legislation requires DOE to terminate site-specific activities and report to Congress.

Further, the legislation authorized DOE to pay interest on overpayments of kilowatt hour (kWh) fees consistent with the December 5, 1985 ruling of the United States Court of Appeals. Interest on these overpayments of kWh fees was fully paid or credited as of September 30, 1990.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

Additionally, the legislation annulled and revoked DOE's Monitored Retrievable Storage (MRS) proposal, submitted to Congress on March 31, 1987, to construct an MRS facility in Oak Ridge, Tennessee. However, the legislation authorized DOE to site, construct and operate one MRS facility subject to certain conditions.

Although the NWPA prohibits the selection of an MRS site through a DOE-directed site-survey process until the repository site is recommended to the President, it allowed for expedited siting to proceed via a Nuclear Waste Negotiator, authorized to negotiate a proposed agreement with a State or Indian Tribe that would agree to host a repository or MRS facility. The Negotiator was to submit to Congress proposed agreements. No volunteer hosts were identified, and the Office of the Nuclear Waste Negotiator expired in January 1995.

(2) Significant Accounting Policies

Basis of Presentation – The standards used in the preparation of the accompanying financial statements are issued by the Office of Management and Budget pursuant to recommendations of the Federal Accounting Standards Advisory Board. On October 19, 1999, the governing Council of the American Institute of Certified Public Accountants (AICPA) amended the AICPA's Code of Professional Conduct to designate the Federal Accounting Standards Advisory Board as the body authorized to establish Generally Accepted Accounting Principles for Federal Government entities. Accordingly, the accompanying financial statements are in accordance with Generally Accepted Accounting Principles.

Prior to the AICPA Council's action, the AICPA considered Federal accounting standards as representing a comprehensive basis of accounting other than Generally Accepted Accounting Principles.

These financial statements include all activity related to OCRWM, including the Nuclear Waste Fund (NWF) and the Defense Nuclear Waste Disposal appropriation, used for the disposal of spent nuclear fuel and high-level radioactive waste. They have been prepared from the books and records of OCRWM in accordance with the form and content for agency financial statements, specified by the Office of Management and Budget (OMB) in OMB Bulletin No. 97-01, as amended

Basis of Accounting – OCRWM's financial statements are prepared using the accrual method of accounting. Under the accrual method, revenues are recognized when earned and expenses are recognized when a liability is incurred, without regard to receipt or payment of cash. OCRWM also uses budgetary accounting to facilitate compliance with legal constraints and to monitor its budget authority.

Revenue Recognition – A one-time fee (see note 5) was recorded by the NWF as of April 7, 1983, for spent nuclear fuel generated prior to that date. Fees recognized by the NWF are based upon kWh of

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

electricity generated and sold by civilian nuclear reactors on or after April 7, 1983. Fees are recognized as revenue to the extent of expenses incurred, subject to congressional authorization (also see note 8). Revenue in excess of current expenses is deferred. The life cycle of the program is expected to extend over a period of over 100 years.

The most recent contractor estimate, completed in December 1999, of the total cost of a surrogate single repository system (without interim storage) examined two cases, both reflecting the adoption of the Enhanced Design Alternative II (EDA II) (see Report to Update the Total Systems Life Cycle Cost (TSLCC) for Site Recommendation/License Application). Case 1 assumed that closure and decommissioning activities begin 50 years after the beginning of waste emplacement. In Case 2, closure and decommissioning activities begin 125 years after the beginning of waste emplacement, when it is expected that the temperature of the emplacement drift wall will remain below the boiling point of water. Based on the contractor estimate for Case 1, the total system life cycle cost in FY 1999 dollars would be \$51,570,000; for Case 2, the contractor estimate is \$56,890,000. The design effort is continuing and will likely impact the cost estimates contained in this report. As such, the assessment represents a snapshot in time that will be updated about the time of the release of the Site Recommendation Consideration Report. Yucca Mountain, Nevada, was assumed as the location for the repository since it is the only site that DOE is authorized by law to characterize, but this does not constitute a pre-decision that Yucca Mountain is a suitable repository site. Contractor cost estimates for a two-repository system were not developed since DOE does not have current cost information or designs for a second repository.

To estimate the share of the total system costs that should be allocated to the disposal of DOE's high-level waste and spent nuclear fuel, the methodology announced by DOE in the Federal Register in August 1987 was used. Based on the December 1999 contractor estimate, DOE's share of the total system life cycle cost in FY 1999 dollars would be \$14,590,000 for Case 1 and \$16,350,000 for Case 2. DOE funding provided through FY 1999 totaled \$1,122,830, which is less than its share of the total system costs incurred through September 30, 1999. Interest accruing on this outstanding balance totaled \$833,291.

The most significant Program changes affecting costs that distinguish the December 1999 contractor estimate from the 1998 Analysis of the Total System Life Cycle Cost (TSLCC) of the Civilian Radioactive Waste Management Program are inclusion of drip shields, increased underground excavation to meet the lower thermal load requirements, and increased waste handling building pool capacity for fuel blending. Also, in the 1998 TSLCC, the period of operations was 100 years. For Case 1, this was decreased to 50 years and for Case 2 it was increased to 125 years.

OCRWM entered into an agreement with the Office of Environmental Management in September 1999, stipulating DOE's current and future liability for the disposal of DOE-owned spent nuclear fuel and high-level radioactive waste (DW). DOE's share of total Program cost cannot be determined finally until the program is completed and the final program costs are known. However, DOE's DW total cost share to date is estimated to be approximately \$2,604,815, including interest

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

amounting to \$833,291, based on the methodology published in the Federal Register in August 1987. As of September 30, 1999 and 1998, the NWF was due \$1,484,912 and \$1,175,211 from DOE, respectively.

For fiscal year 1999 and 1998, Congress appropriated \$189,000 and \$190,000, respectively, from the Defense Nuclear Waste Disposal appropriation to be used for nuclear waste disposal activities. Of the fiscal year 1996 appropriation, \$85,000 was restricted to obligation and expenditure for an interim storage facility. None of this restricted portion was used in fiscal year 1999 nor 1998, as statutory authority for an interim storage facility was not enacted. As of September 30, 1999, OCRWM had used the remaining fiscal year 1998 appropriation of \$5,660, and \$186,073 of the current year appropriation. Also, at September 30, 1999, OCRWM had obligated \$2,927 of the fiscal year 1999 appropriation for payment in 2000.

Investments – Investments, which consist of U.S. Treasury securities, are classified as available-for-sale and are reported at fair value in accordance with Statement of Financial Accounting Standards (SFAS) No. 115, *Accounting for Certain Investments in Debt and Equity Securities*, with unrealized gains and losses excluded from earnings and reported as a separate component of net position. OCRWM uses the effective interest rate method in determining book value of OCRWM investments.

General Property, Plant, and Equipment – Purchases of general property, plant, and equipment (PP&E) exceeding \$25 are capitalized if they have a useful life greater than two years. PP&E is depreciated on a straight-line basis over the estimated useful lives of the assets which range from 5 to 30 years. Maintenance costs are borne by OCRWM for equipment either on loan from or shared with other programs.

Costs of construction are capitalized as construction work in process. Upon completion or beneficial occupancy, the cost is transferred to the appropriate property account.

Accounts Receivable – Payment of accounts receivable will not be complete until OCRWM starts accepting waste. An allowance for doubtful accounts related to one-time spent fuel fees has not been recorded as of September 30, 1999, as OCRWM is not obligated to accept waste without payment of fees. Also see note 1.

Liabilities – Liabilities represent the amount of monies or other resources that are likely to be paid by OCRWM as the result of a transaction or event that has already occurred. However, no liability can be paid by OCRWM absent an appropriation. Liabilities for which an appropriation has not been enacted are therefore classified as liabilities not covered by budgetary resources and there is no certainty that the appropriation will be enacted. Also, liabilities of OCRWM arising from other than contracts can be abrogated by the government, acting in its sovereign capacity.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

Accrued Annual Leave – Federal employees’ annual leave is accrued as it is earned, and the accrual is reduced annually for actual leave taken and increased for leave earned. Each year, the accrued annual leave balance is adjusted to reflect the latest pay rates and unused annual leave balances. To the extent that current or prior year appropriations are not available to fund annual leave earned but not taken, funding will be obtained from future financing sources. Sick leave and other types of nonvested leave are expended as taken.

Tax Status –OCRWM, as a part of the Department of Energy which is a Federal agency, is not subject to Federal, State, or local income taxes.

Changes in Accounting Principle – In 1998, OCRWM implemented Statement of Federal Financial Accounting Standards (SFFAS) No. 4, *Managerial Cost Accounting Concepts and Standards for the Federal Government* effective October 1, 1997. The effect of this standard is the creation of a new financial statement – the statement of net cost.

In 1998, OCRWM also implemented Statement of Federal Financial Accounting Standards (SFFAS) No. 7, *Accounting for Revenue and Other Financing Sources and Concepts for Reconciling Budgetary and Financial Accounting*, effective October 1, 1997. SFFAS No. 7 requires that the NWF properly classify, recognize, and measure resource inflows to the cost of services performed and identify total budgetary resources. As a result, OCRWM ensured that the full cost of providing goods and services to other federal entities and the public is captured and identified. SFFAS No. 7 also requires two new financial statements – the Statement of Budgetary Resources and the Statement of Financing.

First Repository Costs – For the years ended September 30, 1999 and 1998, first repository costs consist primarily of Yucca Mountain costs.

(3) Fund Balance with Treasury

A summary of fund balance with the U.S. Treasury as of September 30, 1999 and 1998 is as follows:

	1999	1998
Nuclear Waste Fund	\$ 174	\$ 105
Defense Nuclear Waste Disposal Appropriation	87,927	90,660
	\$ 88,101	\$ 90,765

The Defense Nuclear Waste Disposal appropriation is provided by Congress in lieu of direct payments by DOE into the NWF for disposal of defense waste. \$85,000 of this appropriation remained restricted to obligation and expenditure on an interim storage facility.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

(4) Investments

For the years ended September 30, 1999 and 1998, the NWF received proceeds of \$2,813,364 and \$1,954,979, respectively, from the sale of securities. The realized gain on the sale using the specific identification method for the years ended September 30, 1999 and 1998 was \$118,730 and \$50, respectively. From September 30, 1998 to 1999, and from 1997 to 1998, the (decrease) increase in net unrealized gain on available-for-sale securities included in net position was (\$1,246,704) and \$774,018, respectively.

Accrued interest receivable on investments as of September 30, 1999 and 1998 totaled \$81,388 and \$83,857, respectively.

The gross unrealized gain (loss) on available-for-sale securities was (\$352,723) and \$893,981 for the years ended September 30, 1999 and 1998, respectively.

Investments in U.S. Treasury securities held as of September 30 of each year consisted of the following:

	1999			
	Cost	Amortized (premium) discount, net	Investments, net	Investments at fair value
Intragovernmental securities available for sale:				
Marketable	\$ 232,293	(21,311)	210,981	212,901
Due after 1 year but within 5 years	1,578,553	(95,440)	1,483,113	1,482,076
Due after 5 years but within 10 years	1,017,044	(38,554)	978,490	969,036
Due after 10 years	5,947,816	213,527	6,161,344	5,817,192
	<u>\$ 8,775,706</u>	<u>58,222</u>	<u>8,833,928</u>	<u>8,481,205</u>
	1998			
	Cost	Amortized (premium) discount, net	Investments, net	Investments at fair value
Intragovernmental securities available for sale:				
Marketable	\$ 857,056	5,958	863,014	868,115
Due after 1 year but within 5 years	1,523,205	(86,329)	1,433,751	1,501,540
Due after 5 years but within 10 years	459,905	(34,533)	428,497	463,732
Due after 10 years	4,964,906	26,517	4,991,423	5,777,279
	<u>\$ 7,805,072</u>	<u>(88,387)</u>	<u>7,716,685</u>	<u>8,610,666</u>

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

(5) Receivables Due from Utilities

Owners and generators of civilian spent nuclear fuel and high-level radioactive waste have entered into contracts with DOE for disposal services and for payment of fees to the NWF.

The NWPA specifies two types of fees to be paid to the NWF for disposal services: (a) a one-time charge per kilogram of heavy metal in solidified high-level radioactive waste or spent nuclear fuel existing prior to April 7, 1983; and (b) a one mil per kWh fee on all net electricity generated and sold by civilian nuclear power reactors on or after April 7, 1983. The Secretary shall annually review the adequacy of the fees established. In the event the Secretary determines either insufficient or excess revenue is being collected, the Secretary shall propose an adjustment to the fee to ensure full cost recovery. The contracts between DOE and the owners and generators of the waste provide three options for payment of the one-time spent fuel fee, one of which must have been selected by June 30, 1985, or within two years of contract execution. The options were:

- Payment of the amount due, plus interest earned from April 7, 1983, in 40 quarterly installments, with the final payment due on or before the first scheduled delivery of spent fuel to DOE;
- Payment of the amount due, plus interest from April 7, 1983, in a single payment, any time prior to the first delivery of spent fuel to DOE; or
- Payment of the amount due, any time prior to June 30, 1985, or two years after contract execution, in the form of a single payment, with no interest due.

Under options (1) and (2), interest accrues from April 7, 1983, to date of first payment, at the 13-week Treasury bill rate compounded quarterly. Under option (1), beginning with the first payment, interest is calculated at the 10-year Treasury note rate in effect at the time. Since NWF's scheduled date of nuclear waste acceptance is not until year 2010, the utilities which selected option (1) were not required to make installments during 1999 or 1998. During 1999 and 1998, there were no utilities that selected the option (3).

During 1999 and 1998, there were no payments or adjustments of one-time spent fuel fees by owners and generators of civilian high-level radioactive waste and spent nuclear fuel.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

Public and intragovernmental receivables from utilities at September 30 of each year were as follows:

	1999	1998
Current portion of accounts receivable:		
Kilowatt hour fees:		
Public	\$ 153,258	\$ 144,321
Intragovernmental	11,298	9,848
	164,556	154,169
Total current portion of accounts receivable		
Public one-time spent fuel fees:		
Option (1)	143,531	143,531
Option (2)	736,958	736,958
	880,489	880,489
Public interest on one-time spent fuel fees:		
Option (1)	249,110	231,533
Option (2)	1,274,245	1,183,812
	1,523,355	1,415,345
Total long-term accounts receivable from Public	2,403,844	2,295,834
Total accounts receivable	\$ 2,568,400	\$ 2,450,003

(6) General Property, Plant, and Equipment, Net

General property, plant, and equipment and related accumulated depreciation consisted of the following at September 30, 1999 and 1998:

	1999	1998
General property, plant and equipment	\$ 87,365	\$ 87,479
Less accumulated depreciation	(64,998)	(59,367)
Net book value	\$ 22,367	\$ 28,112

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

(7) Unexpended Appropriations

	1999	1998
Unexpended appropriations		
Unobligated and unavailable	\$ 85,000	\$ 85,000
Undelivered orders	2,663	4,256
Net book value	\$ 87,663	\$ 89,256

(8) Financing

The NWPA provides that financing for the NWF consist of:

- Unexpended balances available on the date of enactment for functions or activities incident to the disposal of civilian high-level radioactive waste or civilian spent nuclear fuel.
- Funds appropriated by Congress.
- Fee payments.
- Investment income from authorized investments.

Expenditures are made from the NWF subject to congressional appropriation. Investments are made in U.S. obligations from funds in excess of current needs. If, at any time, monies available in the NWF are insufficient to discharge responsibilities under the NWPA, borrowings may be made from the U.S. Treasury. The NWPA limits the NWF from incurring expenditures, entering into contracts and obligating amounts to be expended, except as provided in advance by appropriation acts.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

(9) Costs

A summary of first repository costs for the years ending September 30, 1999 and 1998 is as follows:

	1999	1998
Costs:		
First repository costs at Yucca Mountain	\$ <u>278,552</u>	\$ <u>343,902</u>
All other first repository costs:		
Program support	70,717	55,444
Transfer appropriation	19,600	21,600
Waste acceptance, storage and transportation	725	7,096
Imputed costs	<u>1,072</u>	<u>1,102</u>
Total all other first repository costs	<u>92,114</u>	<u>85,242</u>
Total cost of first repository operations	<u>\$ 370,666</u>	<u>\$ 429,144</u>

During 1999 and 1998, Congress authorized certain funds to be transferred directly from the NWF to various entities to pay for necessary expenses of OCRWM. Amounts transferred consisted of:

	1999	1998
Nuclear Regulatory Commission	\$ 17,000	\$ 19,000
Nuclear Technical Review Board	<u>2,600</u>	<u>2,600</u>
Net book value	<u>\$ 19,600</u>	<u>\$ 21,600</u>

The Nuclear Waste Technical Review Board (Board) was established under the Amendments Act. The Board, an independent establishment within the executive branch of the U.S. government, was established to evaluate the technical and scientific validity of activities undertaken by the Secretary, including site characterization activities and activities relating to the packaging or transportation of high-level radioactive waste or spent nuclear fuel.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

(10) Pension Plan

DOE employees working for OCRWM are covered by the Civil Service Retirement System (CSRS) or the Federal Employees Retirement System (FERS). As required by law, employees make contributions to the plans based on a percentage of their salaries with an amount contributed by OCRWM in accordance with the required retirement system regulations. Data regarding the CSRS and the FERS actuarial present value of accumulated benefits, assets available for benefits, and unfunded pension liability are not available to individual departments and agencies and therefore are not disclosed by OCRWM. As such, reporting is the responsibility of the U.S. Office of Personnel Management.

Under Statement of Federal Financial Accounting Standards (SFFAS) No. 5, *Accounting for Liabilities of the Federal Government*, an employer entity is required to recognize an expense for its employees' retirement benefits equal to the service costs for these employees for the year based on the plans' actuarial cost methods and assumptions. The difference between the retirement benefit expense and contributions made by the entity is reported as an imputed financing source as these costs will ultimately be funded by the Office of Personnel Management (OPM). As a result, OCRWM recognized total retirement expense of \$1,309 and \$1,373, as of September 30, 1999 and 1998, respectively, and an imputed financing source of \$1,072 and \$1,102 to reflect the portion of 1999 and 1998 retirement expense to be paid by OPM, respectively. The retirement benefit expenses were computed in accordance with cost factors provided by OPM.

(11) Transactions With Other Government Agencies

The NWPA established OCRWM within DOE to carry out the provisions of the NWPA and created a separate fund in the Treasury of the United States. All of the investment and borrowing powers of the NWF are limited to transactions with the U.S. Treasury. In discharging its obligations under the NWPA, DOE contracts for services with numerous contractors including other Federal Government agencies. Further, significant administrative services are provided by DOE.

As of September 30, 1999 and 1998, OCRWM owed other government agencies \$5,249 and \$4,253, respectively, for services and costs provided to OCRWM. For the years ended September 30, 1999 and 1998, OCRWM had incurred costs of \$14,343 and \$16,606, respectively, for services and costs provided by other government agencies.

As discussed in note 2, OCRWM is owed \$1,486,056 and \$1,175,211 as of September 30, 1999 and 1998, respectively, from DOE for the disposal of defense high-level waste in civilian repositories. This receivable as of September 30 1999 and 1998 is comprised of current portions of \$116,071 and \$194,660 and long-term portions of \$1,369,985 and \$980,551, respectively.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

(12) Litigation

DOE's Waste Acceptance Obligation

OCRWM is involved with various matters of litigation relating to its obligation in a standard contract (Standard Contract) with utilities to initiate waste acceptance by January 31, 1998, the date specified in the NWPA of 1982, as amended. A summary of those actions is included below.

Indiana Michigan and Northern States Cases

The Court of Appeals for the District of Columbia Circuit has ruled that the Standard Contract for Disposal of Spent Nuclear Fuel entered into with utility generators of SNF (1) imposes an unconditional obligation on DOE, reciprocal to the utilities' obligation to pay fees, to initiate waste acceptance by January 31, 1998 and (2) offers a potentially adequate remedy for the failure of DOE to meet this obligation. Indiana Michigan Power Co. v. U.S. Department of Energy, 88 F.3d 1272 (D.C. Cir. 1996); Northern States Power Co. v. U.S. Department of Energy, 128 F.3d 754 (D.C. Cir. 1997). In addition, the Northern States decision precludes DOE from invoking the unavoidable delays clause of the Standard Contract and from asserting traditional sovereign acts defenses in any suits for damages in the Court of Federal Claims. DOE did not appeal the decision in the Indiana Michigan case. DOE and the State of Michigan filed petitions for certiorari in the Northern States case, which the Supreme Court denied on November 30, 1998.

These cases do not present a direct impact on the NWF because no contractual damages were sought and the Court denied equitable relief, such as an escrow of funds. All other cases discussed in this section, however, are based on the holdings in these two cases. Claims based on the decisions in Indiana Michigan and Northern States could affect the NWF in various ways. If the court determines that a contract holder must pursue its contractual remedies and proceed under the delays clause of the Standard Contract, the contract holder may be found eligible to receive equitable adjustments of its nuclear waste fees, thereby reducing revenues to the NWF. Alternatively, if a court were to determine that a contract holder can pursue a damage suit for breach of contract, the contract holder may obtain a judgment against DOE for money damages. It is unclear whether such a judgment would be paid out of the Judgment Fund, the NWF, or some other source of funds. If the size of the NWF were to be substantially affected by either equitable adjustments or payments of judgments, DOE might then be obligated to propose fee adjustments pursuant to the NWPA's "full cost recovery" provision, 42 U.S.C. 10222(a)(4). Any such fee adjustments would be "across the board" and applicable to all utilities with currently operating reactors.

It is too early to evaluate the ultimate impact on OCRWM of claims based upon the decisions in the Indiana Michigan and Northern States cases. Resolution of any such claims will involve highly fact-specific and individualized decisions about the incremental costs incurred by each contract holder as a direct result of the delay of DOE in meeting its obligations under the Standard Contract. Estimating any such potential impacts is further complicated by recent, and apparently conflicting,

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

decisions rendered by the Court of Federal Claims. Although these decisions are being appealed, and are therefore not final, a preliminary analysis suggests that contract holders may not be entitled to any remedy other than those provided for in the Standard Contract. Thus, DOE may have no liability to make payments to contract holders to address the delay of DOE in meeting its obligations under the Standard Contract. However, contract holders may be eligible to receive credits against future payments into the NWF. It is not possible at this time to forecast accurately the potential impact on the NWF because of the large number of variables that cannot now be quantified with sufficient certainty. Any forecast at this time must necessarily be based on many assumptions concerning the current and future situations of the contract holders. For the most part, these assumptions relate to general categories of contract holders rather than individual contract holders. DOE currently has little data for individual contract holders as to their actual and projected storage costs, the extent to which such costs would not be incurred but for the delay of DOE in meeting its obligations under the Standard Contract and the extent to which those incremental costs could be mitigated. Last year, DOE estimated that its potential liabilities for credits against future payments might be between \$500 million and \$1 billion. While DOE is not changing that estimate for this report, it should be noted that the experience of DOE during the past year indicates that there is a very high degree of uncertainty about the assumptions upon which that estimate is based.

Cases Brought in the U.S. Court of Appeals for the District of Columbia Circuit

Consolidated Edison Company of New York and Illinois Power v. U.S. Department of Energy, case no. 98-1358.

These two utilities filed a petition for review of DOE's fee adequacy determination. In addition, they sought damages and specific relief for DOE's failure to commence disposal of their spent nuclear fuel. On April 16, 1999, the D.C. Circuit granted DOE's motion to dismiss on the ground that the petitioners' arguments were precluded by the decision in Northern States and were moot. On June 1, 1999, Consolidated Edison filed a petition for rehearing en banc on the ground that the Court did not address the issue of its jurisdiction to hear Standard Contract cases. The Court of Appeals dismissed the petition on August 2, 1999. Consolidated Edison filed a petition for certiorari on November 1, 1999, asking the U.S. Supreme Court to examine, inter alia, the question of the Court of Appeals' jurisdiction. The petition is pending.

Arizona Public Service Commission v. U.S. Department of Energy, case no. 98-1346; General Electric Co. v. U.S. Department of Energy and STP Nuclear Operating Co. v. U.S. Department of Energy, consol. case nos. 98-1356 and 98-1348.

These petitions were filed in the Court of Appeals for the District of Columbia Circuit for review of DOE's failure to commence disposal of spent nuclear fuel in an attempt to ensure that the decision in Northern States applies to utilities that were not parties to that case. On January 5, 1999, the Court of Appeals ordered that the petitioners show cause why their petitions should not be dismissed in light of the decision in Northern States that the Standard Contract provides a potentially adequate remedy. On

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

April 16, 1999, the Court of Appeals dismissed the petitions for review on the grounds that the petitioners have potentially adequate remedies in other fora and are bound by the ruling in Northern States. The petitioners did not appeal the ruling.

Wisconsin Electric Power Company v. U.S. Department of Energy, case no. 98-1342.

On August 21, 1999, the Wisconsin Electric Power Company (WEPCO) submitted to DOE's Contracting Officer a "Proposed Bilateral Modification and Request for Equitable Adjustment" under DOE Contract No. DE-CR01-83NE44425. The proposal requests non-monetary and monetary relief for DOE's delay in disposing of spent nuclear fuel generated by WEPCO's Point Beach Nuclear Plant (Point Beach).

On September 24, 1999, WEPCO filed a petition for review with the U.S. Court of Appeals for the District of Columbia Circuit in which it asserts that DOE's failure to accept WEPCO's proposal is inconsistent with the mandate in Northern States. In October 1999, DOE filed a motion to dismiss the petition on the ground that WEPCO has failed to exhaust its administrative remedies under the contract as directed by the Court in Northern States. On November 24, 1999, the Court determined to postpone consideration of the motion to dismiss until the case has been briefed on the merits. Oral argument has not yet been scheduled.

Cases Brought in the U.S. Court of Federal Claims

A total of eleven contract holders have sued the United States in the U.S. Court of Federal Claims for damages due to breach of contract caused by DOE's failure to commence disposal by January 31, 1998. Two trial judges have reached different conclusions concerning the Court's jurisdiction to entertain breach of claims and cross appeals of these decisions are now pending in the U.S. Court of Appeals for the Federal Circuit.

Northern States Power Co. v. United States, case no. 98-484C

The Northern States Power Company filed a complaint on June 8, 1998, alleging that it had incurred and continues to incur substantial costs for extended on-site storage of spent nuclear fuel and wastes because of DOE's failure to commence disposal by January 31, 1998. Northern States maintained that DOE's projected twelve-year delay in commencing disposal represented a time departure beyond the risks of delay reasonably foreseeable at the time of contract formation and that therefore the administrative "Delays" and "Disputes" clauses of the Standard Contract should not control. Northern States also argued that remedies under the Standard Contract do not offer complete relief, and therefore it should be permitted to by-pass the contractual disputes procedure in favor of an action for breach of contract in court.

On April 6, 1999, Judge Wiese granted the Department's motion to dismiss Northern States' claim and concluded that Northern States must exhaust the Standard Contract's equitable adjustment remedy for

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

any delay caused by the Government. On May 20, 1999, Northern States filed a notice of appeal to the U.S. Court of Appeals for the Federal Circuit.

Yankee Atomic Electric Co. v. United States, case no. 98-126C, Connecticut Yankee Atomic Power Company v. United States, case no. 98-154C, and Maine Yankee Atomic Power Co. v. United States, case no. 98-474C.

On February 18, 1998, the Yankee Atomic Power Electric Company filed suit seeking damages for breach of contract based upon the extended storage of its spent nuclear fuel at its shut-down nuclear plant because of the delay in beginning spent nuclear fuel acceptance by DOE. Yankee asserted that while it had paid its contractual fees in full, DOE had not commenced disposal and had thus breached the Standard Contract. DOE argued that any delay in acceptance of Yankee's spent nuclear fuel was redressable under the "Avoidable Delays" clause of the Standard Contract and that Yankee had failed to exhaust its contractual remedies. Similar suits invoking the same issues were filed by Connecticut Yankee and Maine Yankee.

On October 29, 1998, Judge Merow of the U.S. Court of Federal Claims granted summary judgment for Yankee Atomic on the issue of liability because, in his view, Yankee Atomic had no adequate contractual remedy. The Court stated that a controversy is subject to a "Disputes" clause only where complete relief is available under the contract. In considering the adequacy of a remedy under the Standard Contract, the Court held that an adjustment to the contract charges was unavailable to Yankee Atomic as the contract permits only a prospective adjustment to the post April 7, 1983 fees, 10 C.F.R. 961.11, Art. VIII, A.2. Since Yankee had already paid all of its fees, it could not obtain a prospective fee adjustment. The Court further held that statutory restrictions on the use of contract payments precluded DOE from retroactively adjusting Yankee's charges to reflect its on-site storage costs. Thus, the Court reasoned that the Standard Contract provided no adequate contractual remedy for Yankee. The Court also issued orders finding that, for the same reasons stated in the Yankee Atomic decision, DOE is liable to Connecticut Yankee and Maine Yankee for breach of contract.

Because of the apparently inconsistent decisions of the two Claims Court Judges on a controlling issue of law, the Department filed a motion to certify for interlocutory appeal Judge Merow's orders and for a stay of proceedings in the Yankee cases and the Northern States case. On October 6, 1999, the Court issued orders staying the cases while the Yankee and Northern States interlocutory appeals are briefed, argued and finally decided by the Federal Circuit.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

Commonwealth Edison Co. v. United States, case no. 98-621C; Southern Nuclear Operating Co., including Alabama Power Co. and Georgia Power Co. v. United States, case no. 98-614C; Duke Power Co., a Division of Duke Energy Corporation v. United States, case no. 98-485C; Florida Power and Light Co. v. United States, case no. 98-483C; Indiana Michigan Power Co. v. United States, case no. 98-486C; Boston Edison Co. v. United States, case no. 99-447C; Sacramento Municipal Utility District v. United States, case no. 98-488C.

These utilities with currently-operating reactors have filed suit in the U.S. Court of Federal Claims. DOE has filed motions to dismiss on the ground that the utilities have not exhausted their contractual remedies by applying for equitable adjustment of their ongoing fees. All of these cases are stayed pending the appeals in the Yankee and Northern States Power cases.

Cases Brought in the U.S. District Court, District of Minnesota

Patrick Roedler v. U.S. Department of Energy, case no. 98-1843.

On August 7, 1998, the plaintiffs in this case, ratepayers of the Northern States Power Company who are not signatories to the Standard Contract, filed suit alleging essentially the same breach of contract claims asserted in the cases above. Plaintiffs contend that the Department's failure to commence accepting spent nuclear fuel by January 31, 1998, has caused them substantial damages due to continuing onsite storage costs at Northern States' Monticello and Prairie Island nuclear generating plants. They assert that, if off-site disposal of Prairie Island's spent nuclear fuel does not begin before 2004, the facility's on-site storage capacity will be exhausted and that ratepayers will incur substantial payments associated with a premature shutdown of the Prairie Island plant. The plaintiffs claim that they are entitled to recover over \$340 million.

A hearing was held on March 11, 1999 on the Department's motion to dismiss on the ground that the plaintiffs have no contractual rights and that plaintiffs are attempting to litigate the same breach of contract claim that the utility itself has directly advanced in the Northern States' case. On December 23, 1999, the Court granted DOE's motion to dismiss. The plaintiffs have until February 22, 2000, to file an appeal, if they choose.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

(13) Additional Waste

In November 1993, DOE's Office of Environmental Safety and Health issued a report that identified additional waste owned by the Department, from both commercial and defense projects, that may require disposal in a repository for spent nuclear fuel and high-level radioactive waste. Since the issuance of this report, the Department has issued formal decisions with regard to the disposition of DOE-owned spent nuclear fuel and executed a Memorandum of Agreement providing for the acceptance of DOE-owned spent fuel and high-level waste in a monitored geologic repository. The December 1999 contractor estimate of the total cost of a surrogate single repository system (without interim storage) included a comprehensive estimate of the costs to dispose of this DOE-owned spent nuclear fuel. The estimate was based on the design and operating assumptions, at the time, to transport this material to a repository and to construct, operate, monitor, and eventually close the repository. The Defense Nuclear Waste Disposal appropriation was established by the Congress in 1993, in lieu of direct payment of fees by DOE into the NWF for the disposal of defense-related spent nuclear fuel and high-level radioactive waste. The estimate of DOE's share of the total Program cost reflects the costs associated with the disposition of these materials. In accordance with the Memorandum of Agreement, OCRWM will only accept DOE-owned spent fuel and HLW if all past financial obligations, prior to initial acceptance, are paid in full. As of the end of fiscal year 1999, the Department's outstanding obligation was \$1.5 billion. As decisions are made with regard to the disposition of additional materials and additional information becomes available, OCRWM will revise its cost estimates.

High-level radioactive waste owned by the State of New York and currently stored at the West Valley Demonstration Project site, is of a type that may be disposed of in a Federal repository if the State of New York were to enter into a contractual agreement with DOE, similar to the provisions of 10 CFR Part 961. To date, the State of New York has not entered into such an agreement. No amount has been recorded in the financial statements as of September 30, 1999, because, at this time, DOE is not legally required to take title to or dispose of the West Valley high-level waste, nor is the State of New York required to enter into a disposal contract with DOE if it does not plan to dispose of the high-level waste in a Federal repository.

**UNITED STATES DEPARTMENT OF ENERGY
OFFICE OF CIVILIAN RADIOACTIVE WASTE MANAGEMENT**

Notes to Financial Statements

September 30, 1999 and 1998

(Dollars in thousands unless otherwise noted)

(14) Deferred and Earned Revenue

As described in note 2, all fees, both kWh fees and Defense high-level waste fees, as well as the related interest, are recognized as revenue to the extent of expenses incurred. Revenue in excess of current expenses is deferred.

Deferred revenue at September 30, 1999 and 1998 was as follows:

	1999	1998
Fees collected:		
kWh fees:		
Public	\$ 631,298	\$ 567,343
Intragovernmental	41,337	41,039
Defense high-level waste fees, intragovernmental	319,818	210,024
Interest on one-time spent fuel fees, public	108,010	115,606
Interest, intragovernmental:		
Income on investments	519,669	466,653
Defense high-level waste fees	181,616	156,072
Net gain on sale of investments	118,730	50
Other revenue	12	71
	1,920,490	1,556,858
Total revenues		
Less – earned revenue	(369,594)	(428,042)
Add – prior period adjustment	226,085	
	1,776,981	1,128,816
Change in deferred revenue		
Deferred revenue – beginning balance	11,167,902	10,039,086
Deferred revenue – ending balance	\$ 12,944,883	\$ 11,167,902

(15) Prior Period Adjustment

The prior period adjustments reflected in the statement of changes in net position represent reclassifications required to properly present the cumulative results of operations. The adjustments are presented in the period recognized in accordance with OMB 97-01 and SFFAS No. 7.



2001 M Street, N.W.
Washington, D.C. 20036

Independent Auditors' Report on Internal Control Over Financial Reporting

Office of Civilian Radioactive Waste Management
United States Department of Energy:

We have audited the financial statements of the Office of Civilian Radioactive Waste Management (OCRWM) as of and for the years ended September 30, 1999 and 1998, and have issued our report thereon dated January 14, 2000. We conducted our audit in accordance with generally accepted auditing standards; the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States; and Office of Management and Budget (OMB) Bulletin No. 98-08, *Audit Requirements for Federal Financial Statements*, as amended. Our audit report included a paragraph emphasizing contingencies arising from several matters of litigation.

The management of OCRWM is responsible for establishing and maintaining internal control over financial reporting. In fulfilling this responsibility, estimates and judgments by management are required to assess the expected benefits and related costs of internal control policies and procedures. The objectives of internal control are to provide management with reasonable, but not absolute, assurance that (1) transactions are executed in accordance with laws governing the use of budget authority and other laws and regulations that could have a direct and material effect on the financial statements, and certain other laws, regulations, and government-wide policies identified by the OMB as applicable to OCRWM; (2) assets are safeguarded against loss from unauthorized acquisition, use, or disposition; (3) transactions are properly recorded, processed, and summarized to permit the preparation of financial statements in accordance with applicable accounting principles described in Note 2 to the financial statements; and (4) transactions and other data that support reported performance measures are properly recorded, processed, and summarized to permit preparation of performance information in accordance with criteria stated by management. Because of inherent limitations in internal control, fraud may nevertheless occur and not be detected. Also, projection of any evaluation of internal controls to future periods is subject to the risk that procedures may become inadequate because of changes in conditions or that the effectiveness of the design and operation of policies and procedures may deteriorate.

In planning and performing our audit, we considered OCRWM's internal control over financial reporting by obtaining an understanding of OCRWM's significant internal controls, determined whether these internal controls had been placed in operation, assessed control risk, and performed tests of controls in order to determine our auditing procedures for the purpose of expressing our opinion on the financial statements. We limited our internal control testing to those controls necessary to achieve the objectives described in OMB Bulletin 98-08, as amended. We did not test all internal controls relevant to operating objectives as broadly defined by the Federal Managers' Financial Integrity Act of 1982, such as those controls relevant to ensuring efficient operations. The objective of our audit was not to provide assurance on the internal control over financial reporting. Consequently, we do not provide an opinion on internal controls.

Our consideration of internal control over financial reporting would not necessarily disclose all matters in the internal control over financial reporting that might be reportable conditions, under standards issued by the American Institute of Certified Public Accountants and OMB Bulletin No. 98-08, as amended, and, accordingly, would not necessarily disclose all reportable conditions that are material weaknesses. Reportable conditions are matters coming to our attention relating to significant deficiencies in the design or



operation of the internal controls that, in our judgment, could adversely affect OCRWM's ability to record, process, summarize, and report financial data consistent with the assertions by management in the financial statements. Material weaknesses are reportable conditions in which the design or operation of one or more of the internal control components does not reduce to a relatively low level the risk that misstatements, in amounts that would be material in relation to the financial statements being audited, may occur and not be detected within a timely period by employees in the normal course of performing their assigned functions. We noted no matters involving the internal control and its operation that we considered to be material weaknesses as defined above.

With respect to internal controls related to performance measures determined by management to be key and reported in the Overview to the financial statements, our evaluation was limited to obtaining an understanding of relevant internal control policies and procedures designed to permit preparation of reliable and complete performance information, and assessing control risk (the risk that a material misstatement in a reported performance measure could occur and not be prevented or detected on a timely basis by OCRWM's internal controls). Our procedures were not designed to provide assurance on internal control over reported performance measures, and accordingly, we do not provide an opinion on such controls.

However, we noted other matters involving internal controls and their operation that we have reported to management of OCRWM in a separate letter.

This report is intended solely for the information and use of the management of OCRWM and the United States Department of Energy and is not intended to be and should not be used by anyone other than these specified parties.

KPMG LLP

January 14, 2000



2001 M Street, N.W.
Washington, D.C. 20036

Independent Auditors' Report on Compliance with Laws and Regulations

Office of Civilian Radioactive Waste Management
United States Department of Energy:

We have audited the financial statements of the Office of Civilian Radioactive Waste Management (OCRWM) as of and for the years ended September 30, 1999 and 1998, and have issued our report thereon dated January 14, 2000. We conducted our audit in accordance with generally accepted auditing standards; the standards applicable to financial audits contained in *Government Auditing Standards*, issued by the Comptroller General of the United States; and Office of Management and Budget (OMB) Bulletin No. 98-08, *Audit Requirements for Federal Financial Statements*, as amended, except for those portions of the Bulletin that relate to the Federal Financial Management Improvement Act (FFMIA) of 1996. The Department of Energy Office of Inspector General is responsible for determining compliance with FFMIA. Our audit report included a paragraph emphasizing contingencies arising from several matters of litigation.

The management of OCRWM is responsible for complying with laws and regulations applicable to the NWF. As part of obtaining reasonable assurance about whether OCRWM's financial statements are free of material misstatement, we performed tests of its compliance with certain provisions of laws and regulations, noncompliance with which could have a direct and material effect on the determination of financial statement amounts, and certain other laws and regulations specified in OMB Bulletin No. 98-08, as amended. However, providing an opinion on compliance with certain provisions of laws and regulations was not an objective of our audit. Accordingly, we do not express such an opinion.

The results of our tests of compliance with the laws and regulations described in the preceding paragraph disclosed no instances of noncompliance that are required to be reported herein under *Government Auditing Standards* and OMB Bulletin No. 98-08, as amended.

This report is intended solely for the information and use of the management of OCRWM and the United States Department of Energy and is not intended to be and should not be used by anyone other than these specified parties.

KPMG LLP

January 14, 2000



Appendix B

Program Profile

Statutory Authorities and Mission

The Nuclear Waste Policy Act of 1982 (the Act) (Public Law 97-425) established the Office of Civilian Radioactive Waste Management (OCRWM) within the U.S. Department of Energy (DOE) to develop and manage a Federal system for disposing of all spent nuclear fuel from commercial nuclear reactors and high-level radioactive waste resulting from atomic energy defense activities. The statute provides detailed direction for the scientific, technical, and institutional development of the system, and it requires that waste management facilities be licensed by the U.S. Nuclear Regulatory Commission (NRC).

Under the Act, commercial spent nuclear fuel is to be permanently emplaced in a deep geologic repository. In 1985, under provisions of the Act, the President determined that a separate repository for defense-related high-level radioactive waste would not be required; this waste could be disposed of along with commercial spent nuclear fuel in the civilian repository. The Nuclear Waste Policy Amendments Act of 1987 (Public Law 100-203) directed the Secretary of Energy to characterize only the Yucca Mountain site in Nevada as a potential location for a repository. Under OCRWM's current schedule, if a repository at Yucca Mountain were recommended for development and approved for licensing, waste emplacement would begin there in 2010.

The Act authorized the Secretary to enter into contracts with the generators and owners of commercial spent nuclear fuel and high-level radioactive waste, for acceptance of legal title to the waste, subsequent transportation, and disposal. A *Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste* was promulgated in 1983 in 10 CFR Part 961. Individual contracts based on the *Standard Contract* have been executed between the Department and those parties. The Act also directs OCRWM to develop a nationwide system for transporting commercial spent nuclear fuel to Federal facilities, utilizing private industry to the fullest extent possible.

OCRWM's *Program Plan, Revision 2*, issued in July 1998, covers the planning period 1998 through 2003. It describes the Program's strategic objectives and strategies, defines success measures, and identifies the work needed to meet them. A *Total System Description* provides a top-level description of the waste management system OCRWM is developing. The latest revision was issued in Fiscal Year 1999.

Section 304(c) of the Act requires OCRWM's Director to submit to Congress each year a comprehensive report on the activities and expenditures of the Office. This is the sixteenth Annual Report.

Sources of Funding

The Nuclear Waste Policy Act provides that the costs of disposing of spent nuclear fuel and high-level radioactive waste are to be borne by the parties responsible for their generation. Fees levied on the owners and generators of

commercial spent nuclear fuel are defined in the *Standard Contract*. Fees paid are deposited in the Nuclear Waste Fund, a separate account in the U.S. Treasury that is managed and administered by DOE. OCRWM can only expend monies from the Fund that are appropriated by Congress. Amounts not appropriated for current expenses are invested in U.S. Treasury securities and managed strategically to ensure that the long-term costs of waste disposal can be met.

The Act directed that if civilian and defense wastes are emplaced in the same repository, each party must pay its proportional share of costs. The Department developed a methodology for allocating civilian and defense costs and published the result in the *Federal Register* in August 1987. Funding to meet the costs of disposing of defense wastes in a repository is provided through a Defense Nuclear Waste Disposal appropriation from the general (taxpayer-supported) fund of the U.S. Treasury. Those costs are currently estimated to be about 28 percent of total costs.

The Fiscal Year 1999 appropriation for the Program was \$358 million.

Program Organization

OCRWM is headquartered in Washington, D.C., in the Department of Energy's Forrestal Building. Its Director reports to the Secretary through the Under Secretary.

OCRWM carries out its mission through two projects and a management center:

- The Yucca Mountain Site Characterization Project, located in Las Vegas, Nevada, is responsible for all work leading up to and including licensing of a geologic repository.
- The Waste Acceptance, Storage, and Transportation Project, located at OCRWM headquarters, is responsible for all work leading up to and including acceptance and transportation of spent nuclear fuel and high-level radioactive waste.
- The Program Management Center consists of the Office of Quality Assurance, the Office of Program Management and Administration, and the Systems Engineering and International Division of the Office of Acceptance, Transportation and Integration. The former is located in Las Vegas, the latter two organizations, in Washington, D.C.

At the end of Fiscal Year 1999, OCRWM's Federal staff numbered 170 full-time equivalents. Of these, 61 worked at headquarters; 109 worked at the Yucca Mountain Site Characterization Project.

Appendix C

Program Drivers: Materials Destined for Geologic Disposal

Spent nuclear fuel generated by commercial nuclear reactors constitutes by far the largest stock of nuclear materials destined for geologic disposal. But a repository is also essential to the disposition of an array of other nuclear materials that are managed by the Department of Energy. This appendix summarizes current planning assumptions about how the disposal capacity of the repository would be allocated among all waste forms. It also consolidates some historical, technical, and policy information about these DOE-managed nuclear materials, and reports current and projected inventories of those materials and of commercial spent nuclear fuel.

Allocation of Repository Capacity: Current Planning Assumptions

Projected inventories and the statutory limit on the quantity of waste emplaced

The Nuclear Waste Policy Act of 1982 places a statutory limit of 70,000 metric tons heavy metal (MTHM) on the quantity of waste that can be emplaced in the first repository until a second repository is in operation. The 1987 Amendments Act requires the Secretary to report to the President and to Congress on or after January 1, 2007, but not later than January 1, 2010, on the need for a second repository. OCRWM's current projections of waste inventories extend through the year 2035, a date beyond both the expiration of all commercial reactor operating licenses in effect when the projections were made (licenses for two plants at one site have since been extended) and the last year for which DOE's Office of Environmental Management believes it can reliably project its operations for planning purposes. The total inventory of commercial spent nuclear fuel and DOE-managed nuclear materials requiring geologic disposal, projected through 2035, exceeds 70,000 MTHM.

Based on a Presidential decision to use disposal capacity at repositories developed pursuant to the Act for disposal of high-level radioactive waste resulting from atomic energy defense activities, OCRWM planning basis allocates 7,000 MTHM of the 70,000 MTHM statutory limit to DOE-managed nuclear materials. Of that 7,000 MTHM, DOE has specified that two-thirds would be high-level radioactive waste and one-third would be DOE and naval spent nuclear fuel.

For planning purposes, we analyze a range of design and operational capacities. The lower bound of the proposed repository capacity for spent fuel is consistent with the 70,000-MTHM statutory limit. The upper bound is based on projections of the total quantity of spent nuclear fuel and high-level radioactive waste requiring disposal. Analyses of the upper bound enable us to evaluate the actual physical capability of a potential repository at the Yucca Mountain site to safely isolate these wastes. The analyses of lower and upper bounds support site characterization, design work, a site recommendation, the environmental impact statement, preparation of a license application, and definition of repository operations.

Description of Materials Destined for Geologic Disposal

This section provides background information on projected quantities of material destined for geologic disposal. The projections are subject to change as decisions on materials disposition are made and carried out.

Consistent with information presented in the draft environmental impact statement (EIS) for the proposed repository at Yucca Mountain, this section divides the materials destined for geologic disposal into three groups: (1) commercial spent nuclear fuel, (2) DOE-managed spent nuclear fuel, and (3) DOE-managed high-level radioactive waste.

The table and figure at the end of this appendix provide an overview of the quantities of nuclear materials destined for geologic disposal and indicate the sources of data for information presented throughout this appendix.

Commercial spent nuclear fuel

Background

Commercial spent nuclear fuel is fuel that has been withdrawn from a nuclear reactor following irradiation. The fuels discussed in this section are those discharged from commercial reactors. Nuclear power reactors store spent nuclear fuel in spent fuel pools under NRC licenses; they can use a combination of storage options: (1) in-pool storage and (2) above-grade dry storage in an independent spent fuel storage installation.

The final form of commercial spent nuclear fuel to be disposed of in the proposed repository would be reactor fuel assemblies as they are discharged from reactors. The repository would receive spent fuel assemblies or spent nuclear fuel packaged in canisters. In the *DOE Record of Decision for the Surplus Plutonium Disposition Final Environmental Impact Statement*, issued in January 2000, DOE decided that up to 33 metric tons of the up to 50 metric tons of surplus plutonium would be converted to a mixed oxide fuel that would subsequently be burned in commercial reactors and disposed of in the repository as spent nuclear fuel.

Current and projected inventories

By December 1999, spent nuclear fuel containing approximately 40,000 MTHM was stored at 72 commercial power reactor sites and one independent storage site, as indicated in the figure below. Those sites are located in 33 States. Of the 118 reactors at these 72 sites, 14 are no longer in operation. Ten operating sites have added on-site above-grade dry storage to supplement their in-pool storage capacity; others are approaching full pool capacity and will require additional storage.

Based on current projections, by 2035, when the last of the existing 118 commercial power reactors will have completed its initial 40-year license period, spent nuclear fuel containing a total of about 85,000 MTHM will have been generated. This inventory includes spent nuclear fuel resulting from burning approximately 33 MTHM of surplus weapons-usable plutonium in the form of mixed-oxide fuel in commercial nuclear reactors. The resulting spent nuclear fuel would be stored at the reactor sites until it was transported to the repository for disposal.

DOE-managed spent nuclear fuel

Background

DOE stores most of its spent nuclear fuel at three locations: (1) the Hanford Site in Washington State, (2) the Idaho National Engineering and Environmental Laboratory, and (3) the Savannah River Site in South Carolina. A relatively small amount is stored at the Fort St. Vrain dry storage facility in Colorado. Small quantities remain at

other locations. The inventory of spent nuclear fuel created by the U.S. Navy from propulsion of its submarines and surface vessels is included in the DOE spent nuclear fuel inventory.

Over the past 40 years, DOE and its predecessor organizations have generated more than 200 varieties of spent nuclear fuel from weapons production, nuclear propulsion, and various research endeavors. Because there are so many varieties of DOE spent nuclear fuel and to facilitate total system performance assessments, fuel was grouped into 16 categories. To define the categories, regulatory requirements were used to identify the parameters that would affect the performance of DOE spent nuclear fuel in a repository and that would support analyses needed for a license application. A list of these 16 categories is included in Appendix A of the draft EIS for the proposed geologic repository at Yucca Mountain.

Current and projected inventories

Through the year 2035, the total inventory of DOE spent nuclear fuel is projected to be approximately 2,500 MTHM. The following paragraphs provide an overview of the materials and their respective quantities that constitute the total inventory.

- **Hanford Site.** Most of the DOE inventory of spent nuclear fuel, 2,100 MTHM, is now at the Hanford Site in Washington State, where spent nuclear fuel was generated in the N-Reactor for use in the weapons program. The Department plans to continue with plans to move this fuel, which is metallic-based, from wet storage to dry storage at the Hanford site.
- **Idaho National Engineering and Environmental Laboratory (INEEL).** The DOE spent nuclear fuel stored at this site originated in activities to promote the peaceful uses of atomic energy, beginning with the passage of the Atomic Energy Act of 1954. (The naval spent nuclear fuel stored at this site is discussed below.) The approximately 240 MTHM inventory, projected to remain essentially unchanged through 2035, includes spent nuclear fuel from demonstration reactors, from research and development activities, and from activities to demonstrate storage technologies and characterization for disposal. The research reactor fuel stored at this site is not aluminum-based; it will include 1.0 MTHM of foreign research reactor spent nuclear fuel. Debris from the Three Mile Island reactor is also stored at this site. Under a consent agreement between DOE, the Navy, and the State of Idaho, DOE shall remove spent nuclear fuel stored in that State by January 1, 2035.
- **Savannah River Site.** Spent nuclear fuel from production reactors has been stored at this South Carolina site, and some of it has been converted to high-level radioactive waste for disposal. The 44 MTHM of spent nuclear fuel in storage includes remaining unprocessed production reactor fuel and some domestic research reactor fuel. This inventory is projected to remain unchanged through the year 2035. The Department has also designated this site for storage of aluminum-clad spent nuclear fuel from domestic and foreign research reactors. The uranium in foreign reactor fuel was originally exported by the U.S. Government under the Atoms for Peace Program. In keeping with nuclear nonproliferation policies, foreign research reactor fuel is being returned to this country and placed under DOE management. Up to 16 MTHM is projected to be returned, of which approximately 15 MTHM will be stored at the Savannah River Site.
- **Naval spent nuclear fuel.** The Department of the Navy fabricates its own nuclear fuel for its nuclear-powered vessels using highly enriched uranium. For many years, naval spent nuclear fuel was shipped to the Idaho Chemical Processing Plant, where DOE reprocessed it to recover the uranium. Following DOE's termination of reprocessing activities in 1992, an agreement was reached in October 1995 between the Federal Government and the State of Idaho to allow the temporary storage of naval spent nuclear fuel

at INEEL. Under the consent agreement, naval spent nuclear fuel will be among the early shipments to a repository. In 1996, the Navy decided that it would store its spent nuclear fuel in dual-purpose canisters in Idaho prior to shipping it to a geologic repository for disposal. The current inventory consists of approximately 14 MTHM and is projected to total approximately 65 MTHM by 2035.

The total projected inventory of DOE spent nuclear fuel includes approximately 15 MTHM stored at other sites, including some commercially irradiated spent nuclear fuel now managed by DOE. In addition to the quantities of DOE-managed spent nuclear fuel discussed above, 60 metric tons of sodium-bonded spent nuclear fuel, most of it stored at INEEL and Argonne National Laboratory-West, are being evaluated to determine whether it requires treatment to make it suitable for disposal. The Department is preparing an environmental impact statement for proposed disposition of this spent nuclear fuel, as required by the National Environmental Policy Act. If the fuel is treated, it could be disposed of as high-level radioactive waste.

High-level radioactive waste

Background

High-level radioactive waste inventories have resulted from prior reprocessing spent nuclear fuel to recover plutonium and uranium. DOE originally intended to reprocess most of its spent nuclear fuel, and reprocessing began at a number of Federal sites as early as the 1940s. In 1985, when President Reagan decided that high-level radioactive waste resulting from atomic energy defense activities could be disposed of in the civilian repository, DOE and naval spent nuclear fuel were still being reprocessed, and reprocessing continued until 1992, when the Administration discontinued the practice.

In the *DOE Record of Decision for the Surplus Plutonium Disposition Final Environmental Impact Statement*, issued in January 2000, DOE decided that up to approximately 17 metric tons of the up to 50 metric tons of surplus plutonium would be immobilized in a ceramic form to be disposed of in canisters of vitrified high-level waste.

Current and projected inventories

Wastes from reprocessing are stored as aqueous solutions, sludges, and calcines at DOE's INEEL, Hanford, and Savannah River sites. If the decision is made to send these wastes to the repository, the Department will solidify them as borosilicate glass in canisters prior to transport. The canisters will be safely stored near the vitrification site until they are transported to the repository for disposal. At the Savannah River site, the production of borosilicate glass canisters has already begun. A total of approximately 22,000 canisters of high-level radioactive waste are projected to be produced at DOE sites through 2035. In addition, the West Valley Demonstration Project in New York State, a facility now managed by DOE, is vitrifying high-level radioactive waste that resulted from commercial reprocessing of spent nuclear fuel. Approximately 300 canisters of vitrified waste will be produced at West Valley.

Other nuclear materials no longer essential to national security needs

Through the work of its Nuclear Materials Stewardship Initiative, the Department is examining whether certain nuclear materials no longer essential to national security needs should be maintained as a national resource or disposed of, possibly in the geologic repository that OCRWM would develop.

These materials include curium and americium, now in solutions, metals and oxides of neptunium-237 at the

Savannah River Site, and uranium-233-rich materials at Oak Ridge and INEEL. If the Department determines that disposal in the repository is warranted, total system performance assessment analyses would evaluate the impacts on repository system performance of disposing of these materials in the repository.

Summary of Quantities of Materials Intended for Geologic Disposal

The table below is based on references that support both the Yucca Mountain repository viability assessment and the recently released DEIS for the proposed repository at Yucca Mountain. They identify quantities of materials requiring geologic disposal that are projected through 2035 and quantities allocated to the first repository for planning purposes. The map in the Introduction to this report indicates the location of these materials.

In the table below, quantities of spent nuclear fuel are expressed in MTHM. But other measures are also important for expressing quantities of spent nuclear fuel and high-level radioactive waste. The table expresses quantities of high-level radioactive waste in terms of canisters of vitrified high-level radioactive waste, and it identifies the number of waste packages that would be required for spent nuclear fuel and high-level radioactive waste.

In addition, the table reflects the Department's current plans to dispose of 50 metric tons of surplus weapons-usable plutonium by both immobilizing it in ceramic, to be disposed of in containers of vitrified high-level radioactive waste, and irradiating it in mixed oxide fuel that would become part of the commercial spent nuclear fuel inventory. Accordingly, the table identifies the number of canisters containing immobilized plutonium and high-level radioactive waste, and it counts the spent mixed oxide fuel as part of the inventory of commercial spent nuclear fuel.

Overview of Nuclear Materials Inventory ¹						
Waste Type	TOTAL Quantities Projected Through 2035			Planning Allocation for Repository under the 70,000 MTHM Statutory Limit		
	MTHM	Canisters	Disposal Containers Required	MTHM ²	Canisters	Disposal Containers Required
Commercial Spent Nuclear Fuel ⁴	85,000	N/A	10,000	63,000	N/A	7,600
DOE Spent Nuclear Fuel	2,500	4,000 ³	300 for Naval SNF 2,400 for HLW only	2,333	3,800 ³	290 for Naval SNF 910 for HLW only
High-Level Radioactive Waste	12,000 ³	22,000	1,300 in Co-disposal	4,667	8,300	1,300 in Co-disposal

Sources of data for this table:
 Basis for the VA and TSLCC Cost Estimate Operational Waste Stream, June 1998, CRWMS M&O: A80-01717-1710-0002, Rev. 00
 Drawn from references to Appendix A of the Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada

Notes:
¹ All values, unless otherwise noted, are based on the best available data and are rounded to 2 significant figures.
² Calculated allocations based on the statutory limit.
³ Calculated using DOE-accepted method for determining MTHM equivalence.
⁴ Figures for commercial SNF assume no new reactor construction and no license extensions or renewals.

Materials intended for geologic disposal

This page is intentionally left blank.

Appendix D

Key Federal Laws and Regulations

OCRWM must comply with the requirements of the Nuclear Waste Policy Act and other laws. OCRWM must also comply with the regulations of other Federal agencies, including the Nuclear Regulatory Commission (NRC), the Department of Transportation (DOT), and the Environmental Protection Agency (EPA), and with State laws and regulations.

This Appendix summarizes the most important Federal requirements. OCRWM's Program Plan presents a much fuller account of statutory requirements, as well as a history of the Program.

The Nuclear Waste Policy Act of 1982

This Act established basic policies to govern development of a Federal radioactive waste management system.

- **Development of geologic repositories.** The Act established a framework for siting, characterizing, constructing, operating and monitoring, and closing two permanent geologic repositories for disposal of spent nuclear fuel and high-level radioactive waste.
- **Storage.** It provided the authority for the Federal Government to contract for a limited amount of emergency Federal interim storage; that authority has expired. It also provided for development of a proposal to site and construct a monitored retrievable storage facility on a firm schedule.
- **Intergovernmental relations.** It established requirements for interactions between the Federal Government and States, local governments, and Native American Tribes.
- **Other Federal responsibilities.** It assigned other Federal agencies responsibilities for helping carry out this mission. Most notably, it required that radioactive waste management facilities be licensed by the Nuclear Regulatory Commission.
- **Nuclear Waste Fund.** It required that the owners and generators of wastes to be disposed of in a repository cover the costs of disposal, and it established a fund into which utilities operating nuclear reactors pay fees on electricity generated by those reactors and sold by them.
- **Office of Civilian Radioactive Waste Management.** It established the Office within the Department of Energy.

The Nuclear Waste Policy Amendments Act of 1987

This Act retained the basic policies set forth in the 1982 Act regarding Federal responsibilities, the Nuclear Waste Fund, and the Office of Civilian Radioactive Waste Management. However it significantly modified the original Act.

- **Site characterization.** The Amendments Act directed the Department to characterize only the Yucca Mountain site in Nevada as a potential repository site, and to postpone consideration of the need for a second repository until no sooner than 2007 and no later than 2010. It established a process that would lead to a determination by the Secretary of Energy on whether to recommend that the President approve Yucca Mountain for development as a geologic repository.
- **Monitored retrievable storage.** It authorized the siting, construction, and operation of a monitored retrievable storage facility subject to certain conditions that link the construction and operation of the facility to construction and licensing of a repository. It also prohibited siting it in a State in which a site has been approved for repository site characterization or repository construction. This provision has expired.
- **State and Tribal involvement.** It provided financial incentives for States and Native American Tribes on whose land a repository or monitored retrievable storage facility is sited. It authorized States, Native American Tribes, and units of local government within whose jurisdictions a candidate site is located to designate on-site oversight representatives, and it provided that the reasonable expenses of those representatives be paid from the Nuclear Waste Fund.
- **Local government involvement.** It also authorized the Secretary to designate other units of local government as *affected* and, therefore, entitled to exercise oversight of site characterization activities and to receive financial assistance to cover the costs of that oversight.
- **External oversight.** It increased external oversight of OCRWM's work by establishing the Nuclear Waste Technical Review Board.
- **Nuclear Waste Negotiator.** It established the Office of the Nuclear Waste Negotiator and directed the Negotiator to attempt to reach an agreement with a State or Native American Tribe willing to host a repository or monitored retrievable storage facility. These provisions have expired.

The Energy Policy Act of 1992

This Act includes key elements of the National Energy Strategy proposed by the Administration in 1990. One provision affects OCRWM.

Section 801 of the Act directed the Environmental Protection Agency to contract with the National Academy of Sciences to provide "findings and recommendations on reasonable standards for protection of the public health and safety" that would govern the long-term performance of a high-level radioactive waste repository at the Yucca Mountain site. Within 1 year of receiving the Academy's recommendations, the Environmental Protection Agency was to promulgate public health and safety standards that "shall prescribe the maximum annual effective dose equivalent to the individual members of the public from releases to the accessible environment from radioactive

materials stored or disposed of in the repository.” The Nuclear Regulatory Commission is also required to modify its technical requirements and criteria to be consistent with the Environmental Protection Agency’s standards.

Key Regulations

Federal regulations are published in the Code of Federal Regulations, which is divided into volumes organized by Title and Part. For example, *10 CFR 60* refers to Title 10, Code of Federal Regulations, Part 60.

10 CFR 2 (NRC) Rules of Practice for Domestic Licensing Procedures and Issuance of Orders. Specifies the licensing process and requires an electronic record-keeping system to preserve data needed for licensing.

10 CFR 50, Appendix B (NRC) Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants. Establishes quality assurance requirements.

10 CFR 60 (NRC) Disposal of High-Level Radioactive Wastes in Geologic Repositories. Sets forth technical requirements governing development of a permanent geologic repository for spent nuclear fuel and high-level radioactive waste. Includes NRC oversight and licensing duties.

Proposed 10 CFR 63 (NRC), Disposal of High-Level Radioactive Wastes in a Proposed Geological Repository at Yucca Mountain. In 1999, the NRC issued a proposed rule with licensing criteria specific to a repository at Yucca Mountain.

10 CFR 71 (NRC) Packaging and Transportation of Radioactive Material. Defines Department of Transportation requirements for packaging and transporting spent nuclear fuel and high-level radioactive waste.

10 CFR 72 (NRC) Licensing Requirements for the Independent Storage of Spent Fuel and High-Level Radioactive Waste. Sets forth technical requirements for licensing private storage facilities to receive, transport, and store spent nuclear fuel, and outlines procedures for licensing the Department of Energy to receive, transport, and store spent nuclear fuel at a temporary facility.

10 CFR 73 (NRC) Physical Protection of Plants and Materials. Prescribes requirements for physical protection systems to protect against radiological sabotage of special nuclear materials.

10 CFR 74 (NRC) Material Control and Accounting of Special Nuclear Material. Establishes requirements for control and accounting of special nuclear material, including documentation of transfer of material.

10 CFR 75 (NRC) Safeguards on Nuclear Material—Implementation of US/IAEA Agreement. Establishes a system to implement the agreement between the U.S. and the International Atomic Energy Agency on the application of safeguards.

10 CFR 960 (DOE) General Guidelines for the Recommendation of Sites for Nuclear Waste Repositories. Establishes guidelines to compare candidate sites; used as the basis for the 1988 Site Characterization Plan for the Yucca Mountain Site Characterization Project. In 1996 the Department issued proposed amendments to these rules. In 1999, the Department issued a revised proposal, which included site-specific guidelines for Yucca Mountain as 10 CFR 963.

10 CFR 961 (DOE) Standard Contract for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste. Outlines the Department's contract with utilities to receive, transport, and dispose of spent nuclear fuel and high-level waste.

40 CFR 191 (EPA) Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes. Originally issued in 1985 pursuant to the Nuclear Waste Policy Act, the regulations were remanded in 1987. The disposal section does not apply to Yucca Mountain. Pursuant to Section 801 of the Energy Policy Act of 1992, the Environmental Protection Agency has proposed a site-specific radiation protection standard applicable to the Yucca Mountain site.

Proposed 40 CFR 197 (EPA) Establishes limits on doses received by individual members of the public from repository releases. Also establishes standards for groundwater contamination and limits doses from releases from human intrusion.

49 CFR 171-179 (DOT) Hazardous Materials Regulations. Specifies Department of Transportation requirements for the transportation of radioactive materials.

Appendix E

Relations with External Parties

Because of the unprecedented nature of OCRWM's mission, Congress designed the Civilian High-Level Radioactive Waste Management Program to be one of the most closely scrutinized in the public arena, subject to exceptionally broad and intensive review, regulation, and oversight. This appendix presents an overview of the formal interactions in which we are engaged.

Review, Regulation, and Oversight

Parties that regulate, formally review, and oversee our Program are identified below, followed by a list of the hearings, briefings, and meetings they held in Fiscal Year 1999 and the topics discussed at each. Appendix F includes a list of selected publications issued by some of these parties in Fiscal Year 1999.

- ***Congress*** – Congress defines our statutory basis, appropriates funds, and monitors our progress. The congressional committees that exercise primary oversight of our work are the: Senate Committee on Energy and Natural Resources, Subcommittee on Energy Research, Development, Production and Regulation; the House Commerce Committee, Subcommittee on Energy and Power; and the Energy and Water Development Subcommittees of the House and Senate Appropriations Committees.
- ***General Accounting Office*** – Under the Nuclear Waste Policy Act, the General Accounting Office is authorized to audit our Program. It also reviews and reports on Program activities in response to specific congressional inquiries and requests.
- ***Nuclear Regulatory Commission*** – The Nuclear Regulatory Commission (NRC) exercises a statutory role under the Nuclear Waste Policy Act. It defines regulatory standards for the protection of the public and the environment from radioactive releases associated with storage and disposal of high-level radioactive waste and spent nuclear fuel. It is responsible for certifying and licensing the components of the waste management system, including the repository, facilities for storing spent nuclear fuel, and transportation casks. NRC also mandates quality assurance requirements and content requirements for license applications.

We engage in prelicensing consultations with NRC's Division of High-Level Waste and its Spent Fuel Projects Office. The former interacts frequently with our Yucca Mountain Site Characterization Project Office on matters related to site characterization and the repository. The latter has interacted with our Waste Acceptance, Storage, and Transportation Project on non-site-specific issues associated with interim storage. Both offices interact with our Office of Program Management and Administration.

We also provide information to the Commission's Advisory Committee on Nuclear Waste (ACNW), which reviews the work of Commission staff and makes recommendations to the NRC regarding the adequacy of that work.

- ***Nuclear Waste Technical Review Board*** – The Nuclear Waste Technical Review Board exercises a statutory and independent role established in the Nuclear Waste Policy Amendments Act of 1987. It must evaluate the technical and scientific validity of activities related to site characterization and to the packaging and transportation of high-level radioactive waste and spent nuclear fuel.

The Board is required to report its findings, conclusions, and recommendations to Congress and the Secretary of Energy at least twice a year.

The Board's meetings provide the public with an opportunity to observe and comment on technical exchanges between the Board, Program and contractor staff, and other scientists.

- ***National Academy of Sciences*** – The National Academy of Sciences' Board on Radioactive Waste Management reviews our Program on an as-requested basis, offering technical expert review and advice on Program issues.
- ***Environmental Protection Agency*** – The Energy Policy Act of 1992 directs the Environmental Protection Agency to promulgate a site-specific radiation protection standard for the management and disposal of spent nuclear fuel and high-level radioactive waste at the Yucca Mountain site. The proposed rule was released for public comment in August 1999.
- ***Department of Transportation*** – The Department of Transportation regulates transportation of highly radioactive materials, including spent nuclear fuel. Its regulations govern handling of shipping containers, labeling of containers and placarding of transport vehicles for identification purposes, driver training and certification, and highway routing.
- ***State of Nevada and affected units of local government*** – Under the Nuclear Waste Policy Act of 1982, the State of Nevada and Nye County, the county within which the Yucca Mountain site is located, are entitled to exercise oversight of site characterization activities and to receive financial assistance for this purpose. Pursuant to the Amendments Act of 1987, the Secretary of Energy designated nine counties contiguous to Nye County (including Inyo County in California) as *affected units of local government* and, therefore, eligible to receive Federal financial assistance to review and monitor site characterization activities.

The Amendments Act also gave the State and Nye County the right to designate on-site representatives to oversee site characterization and to receive funding for associated "reasonable expenses." The State has never designated such a representative; Nye County has.

In Fiscal Year 1999, by congressional direction, \$250,000 was provided to support the State's oversight functions, and \$5.54 million was designated for affected units of local government.

*Fiscal Year 1999 Congressional Testimony
and Meetings with Regulators and Oversight Bodies*

Congressional Hearings

Senate

Date	Committee/Subcommittee	Witness(es)
September 15, 1999	Energy and Natural Resources Committee	Nominee for OCRWM Director, Dr. Ivan Itkin
March 24, 1999	Energy and Natural Resources Committee	Acting OCRWM Director, Lake H. Barrett; NRC Chairman, Shirley Jackson
February 25, 1999	Energy and Natural Resources Committee	Secretary Bill Richardson

House of Representatives

Date	Committee/Subcommittee	Witness(es)
March 16, 1999	Appropriations Subcommittee on Energy and Water Development	Acting OCRWM Director, Lake H. Barrett
March 12, 1999	Commerce Subcommittee on Energy and Power	Secretary Bill Richardson
February 24, 1999	Commerce Subcommittee on Energy and Power	Under Secretary Ernest Moniz
February 10, 1999	Commerce Subcommittee on Energy and Power	Acting OCRWM Director, Lake H. Barrett; NRC Chairman, Shirley Jackson; NWTRB Chairman, Jared Cohon; EPA Assistant Administrator for Air & Radiation, Robert Perciasepe; DOJ Deputy Assistant Attorney General, Stuart Schiffer

Nuclear Regulatory Commission (NRC) Meetings

Date	Topic
September 14-15, 1999	112 th Advisory Committee on Nuclear Waste Meeting; plans for Yucca Mountain DEIS review; dose modeling; plans for proposed Nevada public outreach sessions; near-field chemistry considerations; strategic planning activities within Division of Waste Management
August 11, 1999	DOE/NRC Management/Quality Assurance Meeting
July 19-21, 1999	111 th Advisory Committee on Nuclear Waste Meeting; plans for improving risk communications ability for public interactions; proposed Nevada public outreach meetings; repository design; near-field chemistry considerations; site recommendation design; license application design selection; revised repository design; NRC licensee casework; transportation studies; DOE presentation on scope of DEIS and planned review process
June 28-30, 1999	110 th Advisory Committee on Nuclear Waste Meeting; Yucca Mountain review plan; risk informing the planning and prioritizing process; ACNW and NRC review capabilities; evaluating and explaining contributions to risk; risk insights from performance assessment; technical basis for and uncertainties in probability; repository design and thermal-mechanical effects; thermal effects on flow; evolution of near-field environment; container life and source term; DEIS review guidance; defense-in-depth
June 22, 1999	DOE/NRC Quarterly Technical Meeting
June 15, 1999	DOE/NRC Spent Nuclear Fuel Meeting
June 3, 1999	DOE/NRC Technical Exchange on the 3-dimensional geologic framework model
May 25, 1999	DOE/NRC Technical Exchange on total system performance assessment
May 11-13, 1999	109 th Advisory Committee on Nuclear Waste Meeting; working group on risk-informed regulation; Yucca Mountain review plan; risk communication; preparation of ACNW reports on low levels of ionizing radiation, repository design, waste-related research and technical assistance
April 22, 1999	DOE/NRC Management/Quality Assurance Meeting
March 31, 1999	DOE/NRC Technical Exchange Videoconference; level of detail in license application; design basis events
March 23-25, 1999	108 th Advisory Committee on Nuclear Waste Meeting; low levels of ionizing radiation: remarks, presentations, panel discussion; clearance rule; ACNW reports on: the viability assessment, ACNW self-assessment, report on NRC's waste-related research, repository design, and low levels of ionizing radiation
March 16-17, 1999	107 th Advisory Committee on Nuclear Waste Meeting, briefing to Commission

March 16-17, 1999	Commission briefing on status of viability assessment from ACNW, NRC staff, the Nuclear Waste Technical Review Board, State of Nevada, and Indian Tribes
February 23-25, 1999	106 th Advisory Committee on Nuclear Waste Meeting; DOE's presentation on license application design selection; discussion with NRC Director of the Division of Waste Management's Office of Nuclear Material Safety & Safeguards on developments at Yucca Mountain, rules and guidance under development, human resources; waste related research at the NRC; DOE presentation on: future course of Yucca Mountain Project, license application plan, waste package corrosion, seepage in drifts, unsaturated zone flow and transport; NRC's programmatic and technical issues with viability assessment; Nuclear Energy Institute's presentation of 1999 high-level waste initiatives
February 8, 1999	OCRWM Acting Director's briefing to NRC Commissioners
December 15-16, 1998	105 th Advisory Committee on Nuclear Waste Meeting; developments at Yucca Mountain; rules and guidance under development; potential topics for future ACNW reports; repository safety strategy; total system performance assessment overview; comparative analyses; waste package degradation; prioritization of technical work needed to complete post-closure safety case; post-closure and defense-in-depth considerations
December 9, 1998	DOE/NRC Management/Quality Assurance Meeting
October 22, 1998	DOE/Affected Units of Local Government videoconference
October 20-21, 1998	104 th Advisory Committee on Nuclear Waste Meeting; Yucca Mountain field trip; ACNW strategic plan; effectiveness of ACNW; lessons learned on ACNW effectiveness; review of ACNW operational processes; role of ACNW in upcoming year; topics of regulatory interest to Nevada; Nye County drilling program

Nuclear Waste Technical Review Board: Full Board

Date	Topic
September 14-15, 1999	Perspectives on Program and Yucca Mountain Project; proposed environmental standard for repository; repository safety strategy: implementation, performance assessment, process model reports and analysis model reports, testing and analysis for site recommendation, unsaturated zone model validation, and waste package degradation model validation; update on scientific and technical investigations
June 29-30, 1999	Repository design and the scientific program; license application design selection, process and uncertainties; enhanced design alternatives: assumptions, descriptions, evaluation process, future plans; near-field environment and coupled processes; effects of uncertainty; subsurface design; thermal testing; drift scale test; materials

and performance modeling; corrosion tests and process modeling; Total System Performance Assessment modeling plans; geochemistry and hydrology; Nye County drilling program; chlorine-36 and chloride data to determine hydrologic pathways; unsaturated zone transport test at Busted Butte

January 26-27, 1999

Viability Assessment of a Repository at Yucca Mountain; overview of viability assessment; site characteristics; preliminary design concept for repository and waste package; total system performance assessment; license application plan and costs; costs to construct and operate repository; alternative repository designs; report on tunnel stability workshop; site investigation; early warning drilling program; 10 CFR Part 63

National Academy of Sciences, National Research Council: Board on Radioactive Waste Management

Date

Topic

May 27-28, 1999

Disposition of high-level radioactive waste through geological isolation development – current status and technical and policy challenges

Accelerator Transmutation of Waste (ATW) Technology Roadmapping Team

Date

Topic

July 21-22, 1999

Steering committee meetings in Albuquerque on ATW overview report; conclusions paper; recommendation paper; requirements table; costs

July 15-16, 1999

International ATW workshop of international and domestic experts on ATW system scenarios for U.S. roadmap; separation technology and waste forms; target/blanket technology and ATW fuel; technical approach of the ATW roadmap; perspectives on the European multilateral accelerator driven sub-critical system; ATW world experts meeting; perspectives of the ADNA Corporation, the French, Japanese, Italians, Russians and Swedes on U.S. ATW program

May 6, 1999

Steering committee teleconference on performance assessment assumptions; total system life-cycle cost process; philosophy for the ATW report to Congress; planning for July 21-22 meeting

- April 21, 1999 Steering committee teleconference on status of system scenarios/integration; accelerator technology; target/blanket technology technical working groups
- February 19, 1999 Steering committee meeting in Washington, DC, on committee charter; focus for ATW technology roadmapping; identification of ATW technical working groups and group leads
- February 17-18, 1999 International ATW workshop of international and domestic experts; status of ATW technologies in international programs; perspectives of ADNA-HYTEC, MINATOM, Sweden, JAERI, Russian Academy of Sciences, and the French on the status of the ATW technology; separation issues; programs in Italy; technology options; HYTEC engineering capabilities
- February 5, 1999 Steering committee teleconference on committee responsibilities; presentation by Under Secretary Moniz; itinerary for February 19 meeting

This page is intentionally left blank.

Appendix F

Publications from OCRWM and Other Organizations in Fiscal Year 1999

This appendix lists publications released by OCRWM during Fiscal Year 1999 that are relevant to work discussed in this Annual Report. The appendix also lists selected publications issued by other parties whose work bears on OCRWM's Program, as well as a number of trade publications that report on OCRWM's work and related activities on a regular basis. Those publications were identified in the course of a limited survey; the list is not intended to be comprehensive.

OCRWM Publications

Site Environmental Report for Calendar Year 1997, Yucca Mountain Site, Nye County, Nevada, October 1998 (DOE/YMP-99001417) [<http://apollo.osti.gov/waisgate/ocrwm.html>]

Civilian Radioactive Waste Management System Total System Description, Rev. 1, October 1998 (DOE/RW-0500) [www.rw.doe.gov/techrep/techrep.htm]

Viability Assessment of a Repository at Yucca Mountain, December 1998 (DOE/RW-0508) [www.rw.doe.gov]

Nuclear Waste Fund Fee Adequacy: An Assessment, December 1998 (DOE/RW-0509) [www.ymp.gov/va.htm]

Analysis of the Total System Life Cycle Cost of the Civilian Radioactive Waste Management Program, December 1998 (DOE/RW-0510) [www.ymp.gov/va.htm]

CRWMS Modular Design/Construction and Operation Options Report, Rev. 2, December 1998 (A00000000-01717-4600-00022) [www.rw.doe.gov]

Impact of Radioactive Waste Heat on Soil Temperatures, January 1999 (LA-UR-99-111) [<http://apollo.osti.gov/waisgate/ocrwm.html>]

Reference Design Description for a Geologic Repository, Rev. 2, January 1999 (DOE/RW-99002018) [<http://apollo.osti.gov/waisgate/ocrwm.html>]

OCRWM Fiscal Year 1998 Annual Report to Congress, June 1999 (DOE/RW-0513) [www.rw.doe.gov]

The OCRWM Enterprise, June 1999 (DOE/RW-0514) [www.rw.doe.gov/progdocs/progdocs.htm]

Site Characterization Progress Report: Yucca Mountain, Nevada, Number 19, July 1999 (DOE/RW-0512) [www.ymp.gov]

Draft Environmental Impact Statement for a Geologic Repository for the Disposal of Spent Nuclear Fuel and High-Level Radioactive Waste at Yucca Mountain, Nye County, Nevada, July 1999 (DOE/EIS-0250D) [www.rw.doe.gov]

Office of Civilian Radioactive Waste Management Business Plan, August 1999 (A00000000-01717-4600-00023) [www.rw.doe.gov]

Report to Congress: A Roadmap for Developing Accelerator Transmutation of Waste (ATW) Technology, October 1999 (DOE/RW-0519) [www.pnl.gov/atw/reporttocongress]

Publications from Other Organizations

Note: OCRWM makes no warranty, express or implied, concerning the authenticity, accuracy, completeness, or usefulness of the information contained in any of the publications listed below:

Nuclear Waste Technical Review Board

Report to the U.S. Congress and the Secretary of Energy, November 1998 [www.nwtrb.gov/reports/reports.html]

Report to the U.S. Congress and the Secretary of Energy, April 1999 [www.nwtrb.gov/reports/reports.html]

Report to the U.S. Congress and the Secretary of Energy: Moving Beyond the Viability Assessment, April 1999 [www.nwtrb.gov/reports/reports.html]

Environmental Protection Agency

Environmental Radiation Protection Standards for Yucca Mountain, Nevada, 40 CFR 197 – Proposed Standards, August 1999 [www.epa.gov/rpdweb00/yucca/index.html]

Nuclear Regulatory Commission

Information Digest 1998, November 1998 [www.nrc.gov/NRC/reference.html]

U.S.-Specific Schedules of Requirements For Transport of Specified Types of Radioactive Material Consignments (NUREG-1660, RAMREG-002), November 1998 [www.nrc.gov/NRC/NUREGS/indexnum.html]

Generic Environmental Impact Statement for License Renewal of Nuclear Plants: Main Report, Section 6.3 – Transportation – Draft Report for Comment (NUREG-1437, Volume 1, Addendum 1), February 1999 [www.nrc.gov/NRC/NUREGS/indexnum.html]

Risk-Informed and Performance-Based Regulation (White Paper), March 1999 [www.nrc.gov/NRC/COMMISSION/POLICY/whiteppr.html]

1998 Annual Report (NUREG-1145, Volume 15), September 1999 [www.nrc.gov/NRC/NUREGS/indexnum.html]

Advisory Committee on Nuclear Waste

Advisory Committee on Nuclear Waste 1999 Action Plan and Priority Issues, January 1999 [www.nrc.gov/ACRS/rrs1/Trans_Let/Recent.html]

Comments on the Regulatory Uses of Importance Measures for Waste Management and Possible Application to the Proposed High-Level Radioactive Waste Repository at Yucca Mountain, Nevada, January 1999 [www.nrc.gov/ACRS/rrs1/Trans_Let/Recent.html]

Comments on the Department of Energy's Viability Assessment for the Proposed High-Level Radioactive Waste Repository at Yucca Mountain, Nevada, April 1999 [www.nrc.gov/ACRS/rrs1/Trans_Let/Recent.html]

Linear No Threshold Hypothesis, June 1999 [www.nrc.gov/ACRS/rrs1/Trans_Let/Recent.html]

Comments on DOE's License Application Design Selection Process and Recommended Repository Design, August 1999 [www.nrc.gov/ACRS/rrs1/Trans_Let/Recent.html]

U.S. Geological Survey

U.S.G.S. Circular 1184 – Yucca Mountain as a Radioactive-Waste Repository, 1999 [wrgis.wr.usgs.gov/circular/c1184]

General Accounting Office

Major Management Challenges and Program Risks: Department of Energy, June 1999 [www.access.gpo.gov/su_docs/aces/aces160.shtml]

State of Nevada

State of Nevada – Background Paper: The Yucca Mountain Site is Not Suitable for Development as a Repository, December 1998 [www.yuccamountain.org/pub.htm]

Summary Report of Proceedings, Workshop on Ventilated Repository Design, Las Vegas, Nevada, December 1998 [www.nyecounty.com/Reports.htm]

Affected Units of Local Government, Yucca Mountain Project: 1998 Annual Report, May 1999 [www.yuccamountain.org/pub.htm]

Series of White Papers from the Nye County Department of Natural Resources and Federal Facilities, May 1999 [www.nyecounty.com/White_papers.htm]

Nuclear Waste Update, Eureka County Yucca Mountain Information Office, Summer 1999 [www.yuccamountain.org/newslet.htm]

Nuclear Waste Update, Special EIS Edition, Eureka County Yucca Mountain Information Office, June/July 1999 [www.yuccamountain.org/newslet.htm]

Summary Annual Report – May 1998 – April 1999 – Nye County Nuclear Waste Repository Project Office, Independent Scientific Investigations Program. Grant DE-FG08-96NV12027, July 1999
[www.nyecounty.com/Reports.htm]

Inyo County Yucca Mountain Repository Assessment Office, 1999 Work Plan, 1999 [www.sdsc.edu/Inyo/yucca-pg.htm]

Organizations with which the Department has Cooperative Agreements

Radiological Health Risks from Transportation of Radioactive Materials, Conference of Radiation Control Program Directors, November 1998 [www.crcpd.org]

Final Comments to DOE on the Development of Transportation Protocols, Letter from the Western Interstate Energy Board, March 1999 [www.westgov.org/wieb/reports/protocol.htm]

Criteria for an Adequate Radiation Control Program, Conference of Radiation Control Program Directors, April 1999 [www.crcpd.org]

Nuclear Energy Institute

Nuclear Energy: 2000 and Beyond, 1999 Update to a Strategic Direction for Nuclear Energy in the 21st Century, May 1999 [www.nei.org/new/keypubs.html]

1998 Annual Report, Rediscovering Nuclear Energy: A New Consensus Emerges, 1999 [www.nei.org/new/keypubs.html]

Other Offices within the Department of Energy

Guidance for the Spring Update to the EM Corporate Database: Life-Cycle Planning Data, FY 2001 Budget Formulation Information, and Paths to Closure, Office of Environmental Management, December 1998 [www.em.doe.gov/closure]

Annual Report to the President on the Status of Safeguards and Security at Domestic Nuclear Weapon Facilities, Office of Nonproliferation and National Security, March 1999 [www.nn.doe.gov]

EM Corporate Data Collection Guidance for the Interim Data Management System (IDMS) and the Analysis and Visualization System (AVS), Office of Environmental Management, April 1999 [www.em.doe.gov/closure]

Record of Decision for Department of Energy's Waste Management Program: Storage of High-Level Radioactive Waste, Office of Environmental Management, August 1999 [www.em.doe.gov/em30/hlwrod.html]

Trade Publications

A number of trade publications report on OCRWM and related activities on a regular basis.

Arms Control Today [www.armscontrol.org]

Bulletin of Atomic Scientists [www.bullatomsci.org]

Energy Daily [www.kingpublishing.com/pubs.html]

Greenwire [www.edf.org/links/greenwire]

Inside Energy with Federal Lands [www.mhenergy.com/products/feden]

Inside NRC [www.mhenergy.com/products/nuclear]

National Radioactive Waste Management Exchange [www.exchangemonitor.com/newsletters.htm]

NuclearFuel [www.mhenergy.com/products/nuclear]

Nuclear News Flashes [www.mhenergy.com/products/nuclear]

Nuclear Waste Monitor [www.exchangemonitor.com/newsletters.htm]

Nuclear Waste News [www.bpinews.com/enviro/pages/nwn.htm]

Nuclear Weapons & Materials Monitor [www.exchangemonitor.com/newsletters.htm]

Nucleonics Week [www.mhenergy.com/products/nuclear]

Science [www.sciencemag.org]

Weapons Complex Monitor: Waste Management & Cleanup [www.exchangemonitor.com/newsletters.htm]