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NUCLEAR WASTE

Storage Issues at DOE's Waste Isolation Pilot Plant in New Mexico



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Resources, Community, and
Economic Development Division

B-202377

December 8, 1989

The Honorable Mike Synar
Chairman, Environment, Energy,
and Natural Resources Subcommittee
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

As requested, we have reviewed the Department of Energy's plans for a 5-year program at its Waste Isolation Pilot Plant near Carlsbad, New Mexico, to demonstrate safe disposal of transuranic wastes produced at its atomic energy defense activities. This report discusses the results of our review of proposed experiments and plant operations that would involve storing wastes in the facility.

Unless you publicly announce its contents earlier, we plan no further distribution of this report until 30 days from the date of this letter. At that time, we will send copies to appropriate congressional committees, the Secretary of Energy, the Secretary of the Interior, and other interested parties. We will also make copies available to others upon request.

This work was performed under the direction of Keith O. Fultz, Director of Planning and Reporting, while he served as the Director, Energy Issues. If you have any questions, please call Victor S. Rezendes, Director, Energy Issues, who may be reached at (202) 275-1441. Major contributors to this report are listed in appendix II.

Sincerely yours,



J. Dexter Peach
Assistant Comptroller General

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Executive Summary

Purpose

At a cost of \$700 million, the Department of Energy (DOE) has built a mined geologic repository near Carlsbad, New Mexico—the Waste Isolation Pilot Plant (WIPP)—to dispose of transuranic waste produced and stored at its defense facilities in 10 states. DOE is seeking legislation that would withdraw the land from public use and permit waste storage to begin. The discovery of brine (saltwater) seeping into the repository, however, has raised questions about its suitability for nuclear waste disposal. As requested by the Chairman, Environment, Energy, and Natural Resources Subcommittee, House Committee on Government Operations, GAO reviewed DOE's experiments and initial storage operations with wastes in WIPP. GAO testified on the preliminary results of its review at the Subcommittee's hearings in September 1988 and June 1989.

Background

The New Mexico site for WIPP was selected in part because the underlying salt formation was expected to be dry. However, the discovery of brine has raised the possibility that within a few hundred years brine and transuranic waste might form a liquid—pressurized by gases generated from waste materials—capable of reaching the environment. In February 1988 DOE, the National Academy of Sciences, and others agreed that additional research was needed to address this possibility.

In April 1989, DOE issued a draft plan for a 5-year test program at WIPP. DOE plans to perform experiments on brine seepage, gas-generation, and other technical issues to help determine if WIPP complies with waste disposal standards set in 1985 by the Environmental Protection Agency (EPA). Among other things, the standards limit releases of radioactive materials to the environment for 10,000 years. EPA is revising the standards under court order and expects to reissue them in 1991.

DOE also plans to demonstrate safe waste handling, transport, and storage operations. DOE would store 18,300 drums over a 3-year period for this purpose and, if supported by a preliminary determination of compliance with EPA's disposal standards, would then continue storage operations. DOE would decide in about 5 years if WIPP meets all repository requirements. In late June, the Secretary of Energy announced that storage would not begin until independent reviews have been completed in 1990. Further, because of an investigation into alleged violations of environmental laws at DOE's Rocky Flats Plant in Colorado, a major generator of transuranic wastes, DOE will revalidate the contents of the plant's waste drums. An October decision plan for WIPP shows that the facility will not be ready to receive wastes before July 1, 1990.

Results in Brief

WIPP is a key part of DOE's plan to clean up its aging defense facilities. By moving transuranic wastes from these facilities to WIPP, DOE would be able to address what has become a contentious issue in federal-state relations—continued “temporary” storage of the wastes. However, by storing waste in WIPP years before determining compliance with disposal standards that are as yet uncertain, DOE might have to either abandon WIPP, if it does not comply with the new standards, or remove and/or rehandle wastes in order to comply with the standards. In making a decision on DOE's request to withdraw the land and permit storage to begin, the Congress' choices range from authorizing waste storage in WIPP either with or without restrictions to deferring action until DOE has determined that WIPP complies with EPA's revised standards. The Congress needs to weigh several factors:

- If WIPP does not comply with EPA's standards, DOE would either have to remove the wastes from the site, retrieve them for additional processing, or rehandle them to modify the facility and achieve compliance. DOE, however, has not addressed these contingencies in its draft test plan.
- DOE could defer a demonstration of waste storage operations. Deferring the demonstration, however, would delay DOE's removal of transuranic waste from other facilities, and states hosting these facilities vigorously oppose additional storage at the facilities.
- The National Academy of Sciences agrees that DOE's planned gas-generation experiments are warranted and should begin but recommends deferring the demonstration of storage operations.

Principal Findings

Disposition of Stored Waste

If DOE determines that WIPP cannot comply with the disposal standards, as revised by EPA, it may have to remove wastes stored in the facility. Although DOE believes that additional waste treatment or development of engineered modifications in the repository could bring WIPP into compliance, these steps might require removing wastes stored in WIPP. Further, if WIPP complies with the standards, waste rehandling may be required to prepare for permanent storage. DOE's analysis of such contingencies is insufficient for comparing the benefits of storage operations with the risk that WIPP may not comply with EPA's standards.

Risks and Benefits of Demonstration

DOE plans to gradually increase the pace of storage operations over the first 3 years. Although this approach is consistent with industrial practice, its implementation in the near future would increase the amount of waste that DOE may have to remove for additional treatment or other disposition if WIPP does not initially comply with the standards. It also increases the amount of waste that DOE may have to rehandle even if WIPP complies with the standards.

DOE acknowledges that its experience in handling simulated waste drums provides a sufficient basis for a decision that it can safely and efficiently store waste in WIPP. It believes, however, that demonstrating storage operations using drums of transuranic waste will help ensure public confidence in a future decision to operate the facility as a repository. The Academy has recommended against starting the demonstration program until important issues have been resolved. Also, DOE could damage the credibility of its nuclear waste management programs if, after storing a significant quantity of waste in WIPP, it determines that the facility does not comply with EPA's standards.

On the other hand, early waste storage at WIPP would enable DOE to begin removing wastes from its defense facilities. Rocky Flats, for example, has limited storage space. For many years, DOE has shipped these wastes to its facility in Idaho. Although continuation of this interim storage arrangement is not constrained by physical limitations at the Idaho facility, both the states of Idaho and Colorado oppose additional storage at these facilities and seek prompt removal of existing wastes. The Governor of Idaho, for example, temporarily banned such shipments into that state in late October 1988 and reimposed the ban in August 1989.

Support for Experiments

DOE has not yet issued its test plan in final form. However, on the basis of the draft plan, supplemented by other documents, the Academy agrees that DOE's proposed experiments on gas-generation are warranted and should begin without delay.

Land Withdrawal

DOE's access to the WIPP site is governed by a temporary (8-year) withdrawal of federal land from public use issued by the Department of the Interior in 1983. Because the withdrawal explicitly prohibits waste storage, DOE is seeking legislation from the Congress that would permanently

withdraw the land and authorize storage of wastes. As a backup measure, DOE has asked Interior for waste storage authority. Interior's position has been that authority to store waste in WIPP should come from the Congress.

Recommendations to the Secretary of Energy

GAO recommends that DOE provide the Congress with (1) technical justification for storing waste in WIPP, including the quantity of such waste, in advance of determining if the facility can be used as a repository; (2) contingency plans for disposing of wastes stored in WIPP for experimental and operational purposes in case DOE finds that the facility does not comply with disposal standards; and (3) options for continued waste storage at other DOE facilities while DOE is completing its assessment of WIPP's compliance with the standards. (See ch. 3.)

Matters for Congressional Consideration

If DOE adopts GAO's recommendations, the Congress, in deciding on the future of WIPP, should consider the material that DOE provides. If DOE does not accept GAO's recommendations, the Congress may wish to require DOE to provide this material.

The Congress may also wish to include a provision in any eventual legislation that would specify the amount of wastes DOE could store in WIPP before determining that the facility complies with the standards. Finally, the Congress may wish to condition permanent land withdrawal upon a positive determination of compliance with the standards. (See ch. 3.)

Agency Comments

GAO discussed the facts presented in this report with DOE officials and incorporated their suggested clarifications where appropriate. However, as agreed with the requester, GAO did not obtain written agency comments on this report.

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Abbreviations

DOE	Department of Energy
EEG	Environmental Evaluation Group
EPA	Environmental Protection Agency
GAO	General Accounting Office
NRC	Nuclear Regulatory Commission
RCED	Resources, Community, and Economic Development Division
RCRA	Resource Conservation and Recovery Act
TRU	transuranic
WIPP	Waste Isolation Pilot Plant

Introduction

Since the beginning of the federal government's atomic energy defense program in the 1940s, defense activities have created waste by-products known as transuranic (TRU) waste. TRU waste is discarded material (machinery, tools, filters, rubber gloves, paper, rags, sheet metal, glassware, and sludge from reprocessing of nuclear fuels) contaminated with man-made radioactive elements having atomic numbers greater than uranium. These elements, such as plutonium and americium, decay slowly and remain radioactive for thousands of years.

TRU waste forms are similar to low-level waste, which typically contains small amounts of radioactivity; however, because TRU waste is made up of long-lived radioactive elements, it is hazardous enough to require isolation from the environment. Until 1970 the Atomic Energy Commission—a predecessor to the Department of Energy (DOE)—buried TRU waste with low-level waste in shallow pits 4 to 20 feet below the ground. At that time, however, the Commission began packaging TRU wastes in containers that could be stored for 20 years or more pending permanent disposal. Most of this stored waste is contained in 55-gallon metal drums.

TRU waste is stored in a retrievable manner at six DOE sites: Hanford Reservation, Washington; Idaho National Engineering Laboratory, Idaho; Los Alamos National Laboratory, New Mexico; Nevada Test Site, Nevada; Oak Ridge National Laboratory, Tennessee; and Savannah River Site, South Carolina. These sites generate TRU waste and/or receive it from other DOE facilities, such as the Rocky Flats Plant, in Colorado. According to DOE, about one-half of all its TRU waste is generated at Rocky Flats. Other generating sites include Lawrence Livermore National Laboratory, California; Argonne National Laboratory, Illinois; and Mound Laboratory, Ohio. Table 1.2 shows the total estimated TRU waste inventory at each of the six storage sites.

Table 1.1: TRU-Contaminated Wastes at Storage Locations

Location	Cubic Meters in Thousands			Total
	Stored	Buried	Contaminated soil	
Hanford	10	109	32	151
Idaho	36	57	56 ^a	149
Los Alamos	7	14	1	22
Nevada	1	0	0	1
Oak Ridge	2	6	12 ^a	20
Savannah River	3	5	38	46
Total	59	191	139	389

^aEstimate given in ranges. Figure shown is lower estimate.

Source: DOE.

According to DOE, it is beginning to run out of existing storage capability at five of the six sites. DOE estimated in September 1988 that, at current storage rates, it can continue to store additional TRU wastes for 1 to 2-1/2 years at Hanford, Idaho, Los Alamos, and Savannah River, and 7 years at Oak Ridge. Although DOE estimated it can continue storing additional waste at the Nevada Test Site for 30 to 40 years, the estimate was based on a storage rate of only 60 to 70 drums per year.

As a result of the relatively long period of "temporary" storage of these wastes and rapidly diminishing storage capability, the permanent, safe disposal of TRU waste has become an increasingly important and visible issue.

Waste Isolation Pilot Plant

A search for a repository site for permanent disposal of TRU waste has been underway since the 1950s. In November 1975, DOE selected locations in southeastern New Mexico and, shortly thereafter, settled on a site about 26 miles from the city of Carlsbad. The underground repository is about 2,150 feet beneath the surface in a salt formation called the Salado formation. Salt rock was recommended for nuclear waste disposal by the National Academy of Sciences in the mid-1950s. According to DOE, the principal advantages of salt are (1) its location in areas with little earthquake activity, (2) the absence of circulating groundwater (any water present would have dissolved the salt beds), (3) its ease of mining, and (4) its plastic quality that allows it to heal voids in the rock (salt will move or "creep" to fill a void or to seal a waste repository).

In 1974, DOE planned to demonstrate the adequacy of salt formations for isolating TRU waste and provide a facility for experiments with, and

capable of the disposition of, high-level waste.¹ The Energy Reorganization Act of 1974 required that disposal of defense high-level waste be licensed and regulated by the Nuclear Regulatory Commission (NRC). Therefore, DOE notified NRC in November 1977 of its intention to request a license to construct and operate a radioactive waste repository. DOE also considered the possibility of disposing of a limited quantity of spent (used) nuclear fuel from commercial nuclear power plants at the repository.

The House and Senate Armed Services Committees objected to licensing and regulation of the proposed repository, an atomic energy defense-related facility, by NRC, which regulates commercial nuclear activities—including disposal of commercial nuclear wastes. Therefore, in authorizing DOE to build and operate the facility, the Congress specifically exempted it from licensing and prohibited DOE from spending project funds for licensing activities related to defense-generated radioactive wastes. The exemption and prohibition effectively foreclosed the storage of NRC-regulated commercial spent fuel. Subsequent legislation, enacted in December 1979, authorized the project, called the Waste Isolation Pilot Plant (WIPP),

“for the express purpose of providing a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States.”²

The licensing exemption effectively eliminated disposal of defense high-level waste as well as commercial spent fuel at WIPP because of the Energy Reorganization Act’s requirement that disposal of defense high-level waste be licensed and regulated by NRC.

In January 1981, DOE decided to proceed with development of WIPP. DOE stated then that it would use the facility for disposal of TRU wastes stored in a retrievable manner at its Idaho National Engineering Laboratory. Thereafter, the facility would be available for disposal of TRU waste from other DOE facilities. DOE added that WIPP would include an underground facility for conducting experiments on defense wastes, including small volumes of high-level waste. The high-level waste would

¹High-level waste is created by chemically processing spent or used nuclear reactor fuel. Although the waste contains many radioactive materials, the most prominent are the long-lived fission products strontium, cesium, and small quantities of plutonium that cannot be economically recovered.

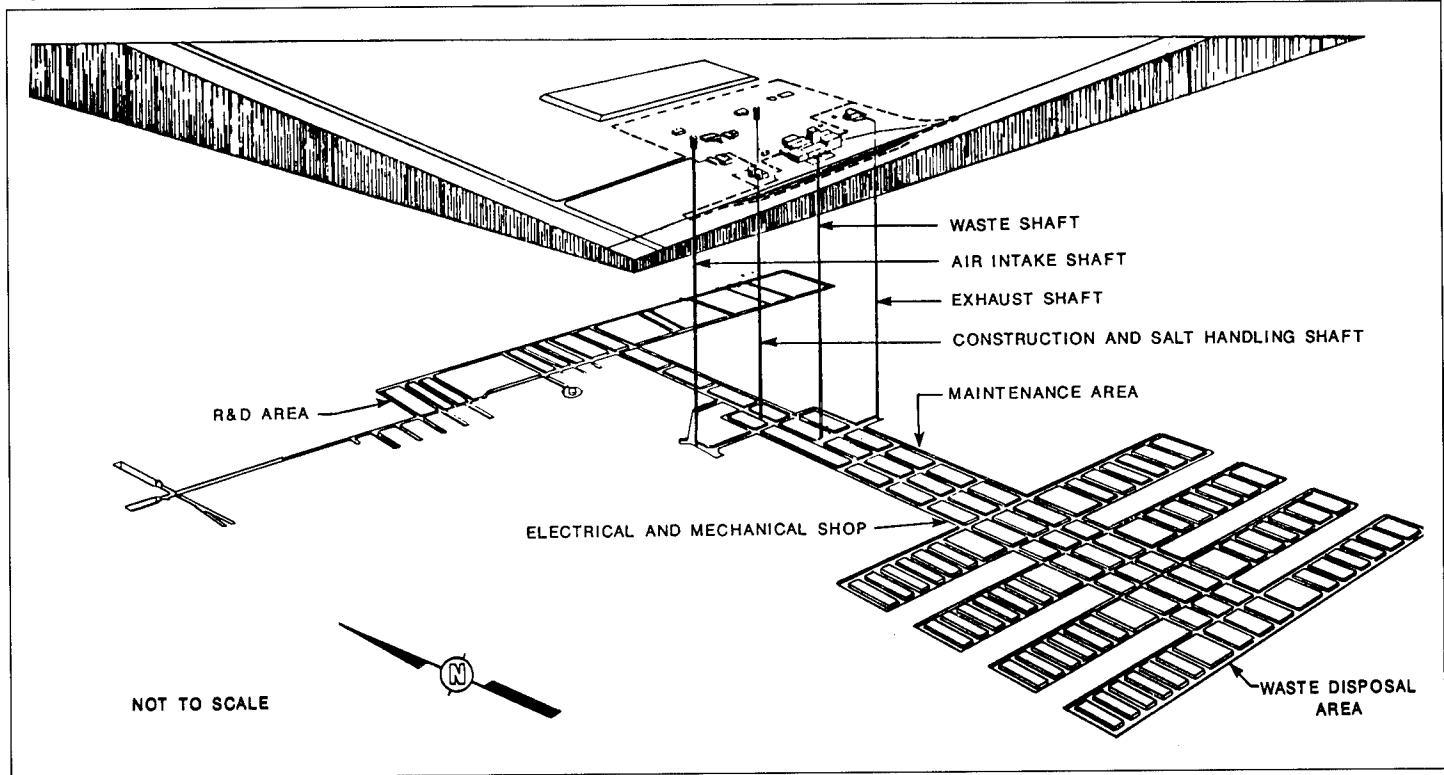
²Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980 (P.L. 96-164).

be removed after the experiments and before the WIPP facility is decommissioned.

WIPP Configuration

The WIPP facility may be roughly broken down into surface facilities, mine shafts, and an underground repository area consisting of tunnels, experimental rooms, and TRU waste storage rooms. The surface facilities and mine shafts are constructed. The repository area will consist of 56 storage rooms arranged in 8 panels. Each panel will consist of seven waste storage rooms surrounded by access tunnels. Each storage room will be about 300 feet long, 33 feet wide, and 13 feet high. DOE has mined experimental rooms and the first seven-room waste storage panel. DOE expects to continue mining operations simultaneously with TRU waste storage operations. About 100 acres underground at a depth of 2,150 feet will eventually be used for TRU waste disposal. The experimental rooms are in a separate area underground that DOE has completed and is using. Figure 1.1 shows an aboveground and underground view of WIPP.

Figure 1.1: Schematic of the WIPP Repository



Source: DOE.

WIPP Operational Plans

According to DOE, about 96 percent of the TRU waste volume to be disposed of in WIPP will contain so little radioactive material that it can be handled by workers without special shielding precautions. DOE plans to store this waste (referred to as contact-handled waste) in the disposal rooms and tunnels. The other 4 percent of the waste volume will require remote handling. This waste will be shipped to WIPP in thick-walled steel canisters. The canisters will be stored in horizontal holes drilled into the salt pillars separating the disposal rooms.

In 1983 DOE designated the first 5 years of WIPP operations as a research and development phase for the purpose of demonstrating the safe disposal of TRU waste at near full-scale waste receipt rates. DOE had originally planned to start receiving contact-handled TRU waste at WIPP in October 1988. During the 5-year period it intended to store up to 15 percent—about 125,000 drums of contact-handled TRU waste—of the repository's capacity. Of this amount, DOE planned to use up to 25,000 drums for experiments designed to gather technical information for use in assessing the facility's long-term performance as a repository. The assessment is necessary for DOE to determine if WIPP satisfies disposal standards for TRU waste repositories issued by the Environmental Protection Agency (EPA). The start date has now slipped into 1990.

DOE's Office of Defense Waste and Transportation Management, Assistant Secretary for Defense Programs, has overall responsibility for defense waste management, including WIPP. The office has delegated responsibility for day-to-day management of the WIPP project to DOE's Albuquerque Operations Office. In addition, DOE has contracted with the National Academy of Sciences for reviews of project-related issues by a panel, called the WIPP Panel, comprised of Academy members.

Finally, under a cooperative agreement with the state of New Mexico, DOE funds the independent WIPP review activities of that state's Environmental Evaluation Group (EEG). This organization was established in 1978 for the express purpose of monitoring the WIPP project. EEG consists of a group of nine scientists and engineers, representing the disciplines of geology, hydrology, health physics, environmental engineering, and environmental monitoring. According to EEG, its work has resulted in several recommendations, generally accepted by DOE, for changes in WIPP plans or for additional studies to resolve questions about the long- and short-term safety of WIPP. At EEG's suggestion, for example, DOE relocated WIPP by a little more than a mile because of the presence of a brine reservoir beneath the former repository location.

The total cost of the project through fiscal year 1988 was about \$700 million (in year-of-expenditure dollars).

Prerequisites to TRU Waste Storage at WIPP

In April 1989 DOE issued a draft report describing its plans for the first 5 years of WIPP operations. At that time, however, there were several matters that DOE needed to complete before it could begin waste storage operations. They included

- obtaining NRC certification of TRU waste shipping containers,
- completing final safety and environmental reviews,
- meeting requirements of the Resource Conservation and Recovery Act (RCRA), and
- obtaining authority to store TRU wastes in WIPP from either the Congress or the Department of the Interior.

Although DOE had planned to complete these actions by September 1989, the Secretary of Energy announced late in June that waste storage operations would not begin until early in 1990. Prompted in part by disclosures at the June 12, 1989, hearing of the Environment, Energy, and Natural Resources Subcommittee, House Committee on Government Operations, and reports by the Academy, the Secretary announced that DOE will establish a "blue-ribbon panel" to review current plans for WIPP. Also, according to the Secretary, DOE must revalidate the contents of TRU waste drums produced at its Rocky Flats Plant as a result of an investigation into alleged criminal violations of environmental laws at the plant.

Subsequently, in October 1989 DOE prepared a "draft decision plan" laying out the steps that must be completed, and related milestone dates, for the Secretary of Energy to decide on WIPP's readiness. According to the decision plan, WIPP could not be ready to receive waste for test purposes until at least July 1, 1990.

Certification of Shipping Containers

DOE agreed with the state of New Mexico to obtain certification from NRC that TRU waste shipping containers meet NRC standards. Its shipping container contractor, Nuclear Packaging, Inc., submitted a partial certification application to NRC on March 3, 1989. The partial application addressed the TRU waste contents that will be loaded into the containers. Additional data on the shipping container were submitted to NRC in May.

On August 30, NRC certified DOE's shipping container. The certification does not cover all TRU wastes that DOE may eventually ship to WIPP. According to an official in NRC's transportation section, NRC's review and certification of the container will permit DOE to ship about 80 percent of the TRU wastes that are being generated. Also, about 30 percent of the TRU waste temporarily stored in drums at DOE's Idaho National Engineering Laboratory can be shipped under the new certification. In the future, NRC expects that DOE's container contractor will apply for amendments to the certification that would permit DOE to ship additional types of TRU wastes.

**Environmental, Safety,
and Health Requirements**

DOE must formally determine that WIPP complies with all applicable safety, environment, and health standards and requirements. In June 1989 DOE issued the draft final safety analysis report for WIPP. This document is the formal evaluation of WIPP facilities and operations to systematically identify the hazards of operations; to describe and analyze the adequacy of the measures taken to eliminate, control, or mitigate identified hazards; and to analyze and evaluate potential accidents and their associated health risks. DOE's Environmental, Safety, and Health Office and the DOE Advisory Committee on Nuclear Facility Safety are reviewing the report and, according to DOE, all comments should be resolved and the report approved by January 1990.

DOE is also preparing a supplemental environmental impact statement that will update and analyze new information pertaining to WIPP that has become available since the final environmental statement was issued in October 1980. DOE issued a draft of the supplement in April 1989 and has held public hearings on it in several states. DOE expects to issue the final version of the supplemental statement in January 1990.

**Resource Conservation and
Recovery Act**

Because WIPP will receive TRU waste that is also contaminated with chemicals listed or otherwise identified as hazardous wastes under RCRA, DOE must comply with requirements of that act. Carbon tetrachloride, a carcinogenic chemical, is an example of one such hazardous waste. RCRA provides for regulation, by EPA or EPA-authorized states, of the generation, transportation, treatment, storage, and disposal of hazardous waste. EPA's regulations implementing RCRA prohibit land disposal of certain hazardous wastes, and WIPP qualifies as a land disposal facility. However, an exemption from the land disposal prohibitions is possible if DOE can demonstrate that hazardous wastes to be stored in WIPP will not

migrate beyond the facility boundary for as long as they remain hazardous.

DOE submitted a "No-Migration Variance Petition" to EPA in March 1989 and an addendum to the petition in October. In June 1989, EPA said its plan was to issue a tentative determination in November 1989 and a final determination in February 1990. This schedule, according to EPA, was ambitious and dependent upon receipt of additional information from DOE and prompt resolution of any issues raised during the public comment period beginning in November 1989. According to DOE, EPA's schedule for tentative and final determinations has slipped to January and late April 1990, respectively.

DOE has decided that until it receives a favorable determination on its petition from EPA, only TRU wastes that do not also contain hazardous wastes, and are, therefore, not restricted from land disposal, can be shipped to WIPP.

Land Withdrawal and Storage Authority

Before DOE can begin TRU waste storage operations at WIPP, it must obtain waste storage authorization, in the form of land withdrawal, from either the Department of the Interior, which owns most of the land on which WIPP is located, or the Congress. Under the Federal Land Policy and Management Act of 1976, Interior can withdraw federal lands from public use for up to 20 years (with extensions allowed).³ Only the Congress can permanently withdraw federal lands.

DOE's access to the 10,240 acres of federal land where WIPP is located is governed by an 8-year land withdrawal issued by Interior in June 1983. Under that administrative action, DOE has exclusive use of 640 acres, and the remaining land is administered by Interior's Bureau of Land Management. The present administrative land withdrawal, however, prohibits DOE's use of the land for transportation, storage, or disposal of radioactive wastes. Consequently, to store TRU wastes in WIPP, DOE must obtain such authorization either from Interior or by means of legislation permanently withdrawing the land from public use and authorizing waste storage.

The 100th Congress considered, but did not pass, land withdrawal legislation. DOE is seeking legislation again in the 101st Congress. Although DOE prefers to obtain legislative authorization to begin storing wastes in

³Public use means settlement, sale, location, or entry, under some or all of the general land laws.

WIPP, as a backup measure it has filed an application with Interior for modification of the existing administrative land withdrawal. The application requests that DOE be permitted to use radioactive waste at WIPP for "the conducting of a test program by the DOE using radioactive waste at the site." So that the Congress would have an opportunity to act on land withdrawal legislation, DOE also requested that Interior make the modification effective no earlier than when the Congress adjourns its 1989 session. Interior's position has consistently been that authority to store waste in WIPP should come from the Congress through permanent land withdrawal legislation, because the planned period of site usage extends well beyond the 20-year periods that Interior may authorize.

Objectives, Scope, and Methodology

In 1986 a member of the Academy's WIPP Panel presented an analysis showing that brine (saltwater) seeping into WIPP underground excavations might saturate waste storage rooms in a few hundred years. Then, early in 1988 the Scientists Review Panel on WIPP, a group composed primarily of scientists at the University of New Mexico, published a report concluding that the salt formation at WIPP contains more water than DOE had anticipated. The Scientists Review Panel also concluded that a liquid mixture of brine and nuclear waste could form over time and, under pressure from gases generated by waste materials, eventually reach the environment through unintentional human intrusion (such as exploratory drilling). Under such conditions, the Scientists Review Panel said, WIPP would not comply with EPA's disposal standards for repositories.

On January 29, 1988, the Chairman, Environment, Energy, and Natural Resources Subcommittee, House Committee on Government Operations, asked us to evaluate (1) the events surrounding the seepage of brine into WIPP and (2) DOE's ongoing and planned activities at the facility on defense high-level waste. After DOE officials told us, and we confirmed, that there are no ongoing or planned activities at WIPP involving storage of high-level waste, the Subcommittee requested that we focus our review on the brine seepage issue, including DOE's plans to address and resolve the issue in the context of DOE's proposed 5-year demonstration program at WIPP.

On September 13, 1988, we testified before the Subcommittee on the preliminary results of our review of the brine seepage issue.⁴ We testified before the Subcommittee again on June 12, 1989, on our review of DOE's April 1989 draft plan for a 5-year test phase at WIPP.⁵

As requested by the Chairman, we reviewed DOE's plans to begin storing wastes in WIPP for experimental and operational test purposes. We reviewed documentation from DOE and its contractors on DOE's plans for a 5-year test phase. This documentation included review of DOE's April 1989 "Draft Plan for the Waste Isolation Pilot Plant Test Phase: Performance Assessment and Operations Demonstration" and its April 1989 draft supplement to the 1980 final environmental impact statement on WIPP. (See ch. 2 for a discussion of DOE's draft test plan. Our analysis is presented in ch. 3. See app. I for a discussion of the brine seepage issue.) In addition, we reviewed DOE's proposed experiments using TRU waste in WIPP, as described in the draft plan for the test phase and modified in June 1989, to determine if the test plan provided sufficient data—either within the plan or incorporated by reference—to support storage of the wastes in WIPP in the amounts proposed by DOE. We did not review the technical basis for the proposed experiments.

We also interviewed DOE and contractor officials at DOE's headquarters, Albuquerque Operations, and WIPP Project offices responsible for oversight and management of the WIPP project, and we reviewed scientific and technical reports prepared by these organizations. We toured the WIPP surface facilities and the underground TRU waste storage and experiment areas in August 1988 and May 1989. In addition, we interviewed officials of, and reviewed scientific and technical reports prepared by, EEG, the Academy's WIPP Panel, and the Scientists Review Panel.

We discussed EPA's nuclear waste management and disposal standards as they pertain to WIPP with an official in EPA's Office of Radiation Programs. Finally, to obtain information on the legislative background and development of the WIPP facility, we reviewed WIPP authorizing legislation and related nuclear waste disposal legislation.

⁴Nuclear Waste: Status of the Department of Energy's Waste Isolation Pilot Plant (GAO/T-RCED-88-63, Sept. 13, 1988).

⁵Nuclear Waste: Status of the Department of Energy's Waste Isolation Pilot Plant (GAO/T-RCED-89-50, June 12, 1989).

We discussed the facts presented in the report with DOE officials at headquarters and at the WIPP project and incorporated their views where appropriate. However, as requested by the Subcommittee, we did not obtain written comments from DOE or other parties on this report. Our review was conducted between February 1988 and June 1989 in accordance with generally accepted government auditing standards.

DOE Issues Draft Plan for 5-Year Test Phase

In April 1989 DOE issued a draft plan for a 5-year test phase at WIPP beginning in September 1989. DOE subsequently delayed the beginning of the test phase until at least July 1990. During the test program, according to the plan, DOE would fill about 8 percent of WIPP's capacity with TRU waste for experiments related to determining compliance with EPA's disposal standards and for a demonstration of safe and effective operation of the waste disposal system. Subsequently, in June 1989 DOE amended its draft plan by (1) limiting TRU waste storage to less than 3 percent of capacity for the first 3 years of the test phase, (2) leaving the scope of the operations demonstration over the last 2 years undecided until the first 3-year period is complete, and (3) specifying an alternative approach if EPA does not approve (consistent with DOE's schedule) storage of mixed (radioactive and chemically hazardous materials) waste required for experiments.

Concurrent with the experiments, DOE would ship TRU wastes to WIPP for storage to demonstrate that waste handling, transportation, and storage activities can be performed safely and at near-capacity operating levels.

DOE has provided the plan and its June 1989 amendments to the National Academy of Sciences' WIPP Panel, EPA, and EEG for their review and comment. The Academy's WIPP Panel met to review the plan on June 6-8, 1989, and the Academy's panel issued on July 19, 1989, a report on its review of the plan. EEG also reported on its interim evaluation of DOE's draft test plan on July 9, 1989.

WIPP Must Comply With EPA's Nuclear Waste Disposal Standards

When DOE decided to proceed with WIPP and introduced the 5-year demonstration concept in the early 1980s, EPA was writing environmental standards for the management and disposal of spent nuclear waste in repositories. The agency issued proposed standards for public comment in December 1982. The Nuclear Waste Policy Act of 1982 (effective January 7, 1983) directed EPA to issue, within 1 year, standards for protection of the general environment from off-site releases of radioactive material in nuclear waste repositories. EPA issued its final environmental standards in September 1985.¹ Like the proposed standards, they apply to disposal of spent fuel from commercial nuclear power plants as well as spent fuel, high-level waste, and TRU waste generated by DOE.

¹Environmental Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes, Final Rule (40 C.F.R. part 191).

The final environmental standards consisted of two subparts. Subpart A set limits for human exposure to radiation from the management and storage of waste prior to disposal. For WIPP, this is the operational period of about 25 years (including the 5-year test phase) during which DOE would emplace TRU waste in the facility.

Subpart B established several different types of requirements for disposal of radioactive waste. The primary disposal standards are long-term containment requirements that limit projected releases of radioactivity to the accessible environment for 10,000 years after disposal. The standards also contain a set of qualitative assurance requirements to provide adequate confidence that the containment requirements would be met. A third set of requirements establish limitations on exposures to individual members of the public for 1,000 years after disposal. Finally, a set of groundwater protection requirements limit the release of radiation from a disposal facility to nearby groundwater that (1) currently supplies drinking water for thousands of persons and (2) is irreplaceable; i.e., no reasonable alternative source of drinking water is available to that population.

EPA did not require demonstration beyond all doubt that a proposed repository would meet its disposal standards. Rather, it required "reasonable expectation" that the standards would not be exceeded. This standard of proof recognizes the uncertainty inherent in predicting events over such long periods of time.

In supplementary information accompanying the December 1982 publication of its proposed environmental standards, EPA stated that the standards could only be implemented in the repository's design phase—by setting design principles or by analytically projecting disposal system performance. When it published the final standards in September 1985, EPA also stressed that the standards should be implemented during the design of a nuclear waste disposal system, because reliance cannot be placed on surveillance of a repository filled with nuclear waste to identify radiation release problems.² By this time, however, DOE was completing its investigation of the WIPP site and was preparing to begin constructing the facility.

²DOE and NRC are taking EPA's approach in DOE's repository project at Yucca Mountain, Nevada, for commercial spent fuel and defense high-level waste. NRC, before granting DOE the authority to construct one or more repositories for disposal of these nuclear wastes, will require DOE to assess the performance of the proposed repository as a key step in demonstrating compliance with EPA's standards.

DOE Plans Experiments With TRU Waste to Help Determine Compliance With Standards

Determining if WIPP complies with EPA's disposal standards involves conducting a computer-simulated performance assessment. Specifically, using assumptions on the total inventory of various radioactive elements to be disposed of in WIPP, DOE will identify and analyze processes and events that could affect the repository's performance. Such analyses employ computer models to predict cumulative releases of radioactive elements to the environment and potential doses to individuals over the time periods covered in EPA's standards. These models describe the repository, and the geologic and hydrologic conditions of the area around the repository, derived from data collected in investigating the site. Predicted releases and doses must then be compared to the release and dose limits contained in the standards.

According to the plan, over 100 scenarios coupling significant events (such as human intrusion by drilling into the repository) and processes that could affect the performance of the repository have been initially identified. By screening these scenarios against the 1985 EPA standards, DOE has reduced the number of scenarios to 76. It anticipates that about 10 scenarios will eventually require full evaluation in the performance assessment. The plan states that preliminary sensitivity studies have identified those scenarios involving human intrusion by means of drilling of boreholes through waste storage rooms as critical to the performance assessment.

To obtain the information needed to determine compliance with EPA's regulations, according to the draft plan, two basic sets of activities will be performed. One set of activities is performance assessment. These activities focus on the development of models that will be used to predict the consequences of credible processes and events that could potentially lead to (1) releases of radioactive materials from the WIPP disposal system (the repository, shafts, and the surrounding controlled area) and (2) doses of radiation to individual members of the public. DOE's plan states that it will demonstrate compliance with the groundwater protection requirements of the standards by documenting that there are no "special sources of groundwater" (as defined in EPA's disposal standards) near WIPP. No additional data acquisition or analysis, according to the plan, is necessary for compliance with this requirement.

The second set of activities—disposal system characterization—focuses on obtaining the information necessary to provide input data to the performance assessment models. DOE's program for experiments using TRU waste in WIPP to gather data on generation of gases is but one aspect of characterizing and modeling the behavior of the disposal system at WIPP.

Experiments Using TRU Waste in WIPP Would Address Gas-Generation

According to DOE's draft test plan, the test phase is scheduled to begin in September 1989 (DOE has subsequently let this date slip to at least July 1990) and continue for as long as 5 years. After about 3 years of the test period, DOE would make a preliminary determination on whether WIPP complies with EPA's disposal standards. DOE would make the final determination about 4 years into the test phase. According to the plan, five factors affect the long-term performance of the waste disposal system. They are as follows:

- Storage room closure rates: The natural closing of storage rooms observed by DOE is more rapid (about three times original expectations) and complex than anticipated prior to underground investigations.
- Brine seepage: Although DOE originally assumed that the rock formation at WIPP contained no free water, it detected brine in the rock adjacent to repository room excavations, and currently several technical uncertainties exist about the hydraulic characteristics of the formation.
- Gas-generation in waste storage rooms: Present knowledge of gas behavior within the repository suggests that the amount of gas generated may be significantly greater than expected in 1980 (when DOE issued the WIPP final environmental impact statement). As a result of limited data about gas behavior, DOE and others are uncertain if future gas pressures could be great enough to provide an impetus for moving the waste through the repository in the event of inadvertent human intrusion.
- Shaft and panel seals: The purpose of the seals is to minimize migration of radioactive materials from the repository. A comprehensive evaluation of the sealing system identified no reason to revise current design concepts. However, the sealing system requires additional work to reduce uncertainty and corroborate the earlier findings.
- Hydrology and transport of radioactive materials: Site characterization (investigation) activities at the WIPP site have updated or refined the overall conceptual model of the geologic, hydrologic, and structural behavior of the site, with the objective of providing data adequate for performance assessment.

The plan states that the existing WIPP data base will be expanded during the 5-year test phase to address these factors and the performance of backfill technology.³

³If WIPP becomes a repository for permanent disposal of TRU waste, DOE intends to backfill the spaces between drums of waste, and between stacks of drums and storage room walls and ceilings, with a material such as crushed salt rock.

All experiments with TRU waste in WIPP would address the gas-generation factor. Gas-generation experiments are proposed in WIPP using TRU wastes stored in about 100 metal bins that would be placed in one repository storage room. In addition, DOE proposes to collect gas-generation data by storing contact-handled TRU waste in five specially constructed and sealed rooms about one-fourth the volume of regular waste storage rooms. Altogether, DOE proposes to store the equivalent of about 7,100 drums of contact-handled TRU waste in WIPP for gas-generation test purposes. Because in April 1990 DOE will begin compacting TRU waste generated at Rocky Flats, the actual number of drums containing these wastes will be less—about 4,600 drums. The number of drums that, according to the test plan, DOE plans to store for experiments is shown in table 2.1. These numbers may change as DOE firms up its test plans. No experiments using remote-handled TRU waste are planned in WIPP.

Table 2.1: Drums of TRU Waste to Be Stored in WIPP for Experiments

Experiment	Equivalent drums of waste	Actual drums of waste
First 3 years		
Bin tests	600	600
Room 1 test	1,100	1,100
Room 2 test	1,100	1,100
Room 3 test	1,600	350
Room 4 test ^a	0	0
Subtotal	4,400	3,150
Last 2 years		
Room 5 test	1,100	1,100
Room 6 test	1,600	350
Subtotal	2,700	1,450
Total	7,100	4,600

^aDOE will seal an empty room to collect baseline gas-generation data.

Bin Experiments

Over approximately the first year of the demonstration program, DOE would load about 100 specially constructed and instrumented metal bins, each with a combination of contact-handled TRU waste (the equivalent of about 6 drums in volume), drum metals, backfill materials (including salt), and brine. The bins will be leakproof and have a closely controlled and sealed internal atmosphere. Each bin would be equipped with instruments, such as pressure gauges and gas sampling and relief valves, and would have multiple brine injection and sampling valves. Bins would be prepared and filled at waste generator sites (brine will be injected into bins at WIPP) and shipped to WIPP for testing.

The bin-scale experiments are to be conducted in two phases. For the first phase, DOE would put about 32 bins of different waste compositions, as well as 4 empty bins for collecting baseline data, into the first waste storage room of panel 1—the panel that has already been mined. This phase will incorporate the simpler system tests that are applicable to WIPP's 25-year operating life. Each of 12 bins would contain one of three types of TRU waste without other additives. Twenty other bins would each contain one of three types of TRU waste covered with a backfill material.

In the second phase, DOE would put another 68 bins in the storage room. (Another 8 bins containing the equivalent of 48 drums of TRU waste would be prepared for possible experimental use.) All of these bins would contain added moisture, various waste combinations, and backfill and “getter”⁴ materials. The tests conducted in this phase are intended to address conditions anticipated in the repository over the long term. In total, DOE expects to store the equivalent of 600 to 648 drums of TRU waste in WIPP for bin-scale tests.

The draft test plan states that further details on the waste-mix compositions, exact types and quantities of wastes, backfill and getter materials, and other aspects of the bin-scale experiments are being prepared.

According to DOE's plan, the technical objectives of the bin-scale tests are to

- quantify gas composition, generation, and depletion (by migration into surrounding rock) rates from actual TRU wastes as a function of time, waste type, and other conditions, with a high degree of control;
- provide a larger-scale, repository-relevant confirmation of the laboratory-scale test results;
- evaluate data on the kinds and amounts of radioactive materials and/or hazardous chemicals that make up the source of a potential release as a function of several environmental variables;
- evaluate the interrelated effects of bacterial action, waste compaction, and other factors on the gas-generation capacity of TRU waste;
- evaluate the effectiveness of getters in a bin-scale, controlled series of tests; and
- provide data and information necessary for performance assessment analyses and computer modeling.

⁴“Getters” are materials that selectively absorb and hold other materials.

Room-Scale Experiments

The performance assessment part of DOE's draft plan states that tests on TRU waste in the repository will provide data on production, depletion, and composition of gases resulting from degradation of contact-handled waste stored in the repository environment. Such data are needed, the plan states, to support assessment of long-term repository behavior. Also, because of uncertainties introduced when laboratory, small-scale, or even bin-scale results are extrapolated to the full-scale repository configuration, it is necessary to confirm computer models of gas-generation and consequences predicted in the performance assessment by conducting room-scale gas-generation tests in WIPP. There is no credible alternative, the plan states, to conducting room-scale tests in the WIPP repository area in such a manner as to fully support the confidence level required of performance assessment.

The specific objectives of the room-scale tests are to

- determine gas-generation, composition, and depletion for various mixtures of contact-handled TRU wastes under conditions representative of the operational (25 years) and post-operational (permanent disposal) periods;
- confirm on a room scale the gas-generation results and interpretations of laboratory and bin-scale tests; and
- provide sufficient confidence in the related performance assessment calculations and help validate assumptions used in performance assessment modeling.

DOE plans to store the equivalent of about 6,500 drums of contact-handled TRU waste (or about 4,000 actual drums of compacted and uncompacted waste) in three alcoves, or small rooms, constructed adjacent to waste storage panel 1 and two alcoves that will be constructed adjacent to waste storage panel 2 after it has been mined. Each alcove will be about one-fourth the volume of a regular storage room. A sixth alcove, adjacent to panel 1, would also be constructed, but it would be left empty, instrumented, and sealed to provide baseline gas composition data. After preparation and storage of selected wastes, each alcove would be sealed with an inflatable seal containing instrumentation and access ports.

The first part of the room-scale test is intended to demonstrate that DOE can successfully seal the alcoves and measure gases in the WIPP facility. Following successful demonstration of the empty (baseline) alcove, DOE would emplace about 1,100 drums of TRU waste (with no special preparation, backfill, or getter materials) in an alcove adjacent to panel 1 and

then seal it. DOE's plan states that gas-generation data collected from this phase would be representative of WIPP's 25-year operating life.

Gas measurement testing in the other two alcoves in panel 1 and two alcoves in panel 2 is to be the major source of information for confirming and validating data for performance assessment. Throughout most of 1990, DOE would store the equivalent of about 2,700 waste drums, including drums of both uncompacted and compacted wastes, in two alcoves in panel 1. The wastes in these drums will be specially prepared; specifically, there will be layers of TRU wastes, container metals, and backfill and getter materials within the drums, and small amounts of brine will be injected into the drums at WIPP. In addition, the equivalent of 1,600 of the 2,700 drums of waste will be compacted and actually stored in about 350 drums.

Also, sometime after October 1992, when DOE has finished mining waste storage panel 2 and the two connected alcoves, it would store the equivalent of another 2,700 drums (physically contained in 1,100 drums of uncompacted waste and 350 drums of compacted waste) of the same types of waste in each of the two new alcoves. In these rooms, however, backfill and getter materials would be used to cover the tops, sides, and gaps between each drum, following completion of waste emplacement operations. An additional benefit of this backfilling approach, according to the draft plan, is that it will provide an operational demonstration of the technology.

DOE's draft plan states that the details of the room-scale experiments, including types and quantities of waste, are being prepared and will be available in mid-fiscal year 1989. DOE released a draft of the detailed test plan at the National Academy of Sciences' June 6-8, 1989, meeting to review the draft plan for the 5-year test phase.

DOE Would Store TRU Waste in WIPP to Demonstrate Waste System Operations

To satisfy congressional intent, according to DOE, it plans to demonstrate safe and efficient waste system operations at WIPP while it conducts underground experiments to determine if the repository will comply with EPA regulations. DOE's April draft plan states that DOE could decide to establish WIPP as a permanent repository based on nonradioactive simulated operational demonstrations and other appraisals completed to date. However, the plan adds that industrial practice suggests that it is prudent to test the entire system at increasing storage rates. It further states that the planned operational demonstration provides increased assurance that the facility and related waste management system can

support full-repository operations. Finally, DOE states in the plan that, on the basis of past public concerns, it believes the absence of operational tests using radioactive materials could be an impediment to full public confidence in a decision to use WIPP as a disposal facility.

DOE's four proposed demonstration objectives are as follows:

- continue with a phased approach to satisfying congressional intent by demonstrating safe disposal of TRU waste and determining through experiments if the repository is suitable for waste disposal;
- incorporate, within the demonstration of safe operations, the handling of waste to support the TRU waste gas-generation tests;
- complete the demonstration of safe waste management system operations at rates typical of planned routine operations, including both contact- and remote-handled TRU wastes; and
- demonstrate WIPP facility compliance with the requirements of DOE orders, RCRA, and subpart A (management) of EPA's nuclear waste standards.

DOE's current plans are to store about 18,300 drums of TRU waste in WIPP for operational demonstration purposes over the first 3 years of the test phase. Its April draft plan states that to achieve the four demonstration objectives, about 33,000 drums (about 4 percent of WIPP's capacity) of contact-handled TRU waste would be shipped to WIPP for storage in six waste storage rooms during the first 3 years of the test phase. These wastes would be shipped primarily from the Rocky Flats Plant and the Idaho National Engineering Laboratory. As discussed earlier, however, DOE subsequently decided to limit the total amount of waste stored in WIPP to 2.7 percent—about 22,900 drums—of its capacity until it has issued the draft report on compliance with EPA's 1985 disposal standards. The report would be issued after about 3 years of the 5-year test phase.⁵ About 4,600 of the 22,900 drums would be for gas-generation experiments. For demonstrating operations, therefore, about 18,300 drums of waste would be stored in WIPP through September 1992, when DOE expects to issue its draft report on compliance with EPA's standards. To maintain ability to retrieve the waste drums, DOE would not backfill rooms containing the wastes.

⁵Although EPA's disposal standards have been vacated and remanded for reconsideration (see ch. 3), DOE has agreed with the state of New Mexico that, in the absence of effective standards, DOE will initially determine if WIPP complies with the Sept. 1985 standards.

If DOE's draft compliance report shows a high level of confidence that WIPP meets EPA's 1985 standards, DOE would then ship an additional amount of waste to WIPP. DOE now states that the waste quantities for this latter part of the test phase would be determined at that time. The April draft plan, however, illustrates one possibility for the last 2 years. The plan states that approximately 27,500 drums of contact-handled TRU waste would be shipped to WIPP over the 2-year period, as well as 50 canisters of remote-handled TRU waste.

The plan describes the operations that would be demonstrated at waste generation and storage sites, during transit, and at WIPP. For example, TRU waste generating and storage facilities would gain experience in certifying that TRU wastes meet WIPP waste acceptance standards and that all waste packaging and shipping container loading requirements are met. Although DOE facilities that ship TRU wastes to other sites for interim storage routinely manage and ship wastes in accordance with applicable requirements, these shipping operations are based on use of a specially designed railcar for waste shipments. In addition, the Idaho National Engineering Laboratory, where most TRU waste is stored, is experienced in receiving—but not shipping—the wastes.

DOE's plan states that transportation of TRU wastes from DOE facilities to WIPP will demonstrate the safety of the transportation system. It will also demonstrate the system's capacity and adequacy, including reliability and availability. Finally, the demonstration program will address institutional and public safety concerns that may develop along shipping routes and a new DOE satellite tracking system for monitoring each shipment while in route to WIPP.

At WIPP, according to the plan, the operations demonstration program will permit evaluation of overall safety and productivity. It will also ensure that operations are consistent with environmental considerations and demonstrate compliance with all applicable regulations and orders. The operational tests at WIPP will be used to

- test waste handling process, personnel, and equipment, and confirm the capability to store wastes at required rates;
- provide a sound basis for projecting occupational radiation exposures that would result from full-scale operations;
- test the effectiveness of administrative controls, controls over the potential spread of contamination, and responses to abnormal events (such as spills) that might occur;
- confirm the reliability of key WIPP operating systems;

- develop operational data required to demonstrate the ability to maintain the facility in a radiologically "clean" status;
- evaluate the interactions between mining and waste handling operations; and
- demonstrate compliance with applicable federal regulations and DOE orders.

As part of a final evaluation of the results of the 5-year test phase, according to the draft test plan, DOE will document demonstration results as input to the late-1994 decision on whether to operate WIPP as a repository for disposal of TRU wastes.

The operational demonstration activities described above are subject to change on the basis of DOE's ongoing review. According to DOE's October 1989 decision plan for WIPP, the Secretary of Energy is to decide on operational demonstration plans for the facility in December 1989.

Benefits of Early Waste Storage Should Be Balanced With Potential Noncompliance With Repository Standards

Before DOE can begin storing TRU waste in WIPP, it must obtain storage authority in the form of withdrawal of WIPP land from public use. DOE has requested that the Congress enact land withdrawal legislation, and it has also applied to the Department of the Interior for administrative withdrawal of the land that would authorize waste storage for 8 years. DOE's preference is for legislation. The central land withdrawal issue facing the Congress is whether to authorize DOE to store TRU wastes in WIPP before DOE has determined, in accordance with EPA's disposal standards, if the facility is suitable for disposal of these wastes. The Congress has five alternative courses of action:

- authorize waste storage in WIPP without restriction;
- accept DOE's proposal as described in its final test plan, when issued;
- restrict waste storage to the amount justified for essential experiments until DOE has made a preliminary determination that WIPP complies with EPA's standards;
- restrict storage authority to the amount, if any, justified for experiments essential to determining that WIPP complies with EPA's standards (until compliance with the standards has been established); or
- defer action on land withdrawal legislation until DOE determines that WIPP complies with EPA's standards.

DOE has not, however, developed all of the information that is important to addressing land withdrawal. Specifically, DOE has not yet justified storage of TRU wastes in WIPP in the quantities that it has proposed, prepared contingency plans for disposition of these wastes if the facility does not meet EPA's standards, nor developed options for continued waste storage at other DOE facilities.

What Are the Key Issues and What Facts Must Be Carefully Weighed?

From the outset of the WIPP project, WIPP's ultimate purpose has been to serve as a repository for permanent disposal of DOE's TRU wastes. What is currently at issue is how much, if any, TRU waste DOE should be permitted to store in WIPP in advance of a determination that the facility complies with EPA's disposal standards and, therefore, is suitable for its intended purpose. There are four key aspects of this issue:

- the disposition of wastes if WIPP does not meet EPA's standards and, if the standards are eventually met, the likelihood that DOE will have to rehandle wastes stored in WIPP to facilitate backfill operations;
- the merits of an operational demonstration with 18,300 drums of waste through the first 3 years and, perhaps, additional drums thereafter;

- in view of the risk of noncompliance with the standards, whether early storage is appropriate so DOE can begin to clean up other defense facilities; and
 - the technical justification for experiments with 4,600 drums TRU waste.
-

How Will DOE Dispose of Stored Wastes at the End of the Test Phase?

It is possible that WIPP might not comply with EPA's disposal standards. For example, at an April 21, 1989, meeting of EEG, DOE, and Sandia (DOE's lead contractor for performance assessment), Sandia officials concluded that the current data, and its assessment of the data, indicate that WIPP may not meet EPA's 1985 disposal standards when the potential for human intrusion is considered. These officials stated that their preliminary assessment calculations suggested that human intrusion into the repository, as currently designed, may give rise to releases of radioactive materials that could violate the disposal standards. This issue is critical for two reasons. First, EPA is revising its disposal standards; therefore, what the applicable standards will be is uncertain. Second, if WIPP does not comply with EPA's revised standards, DOE might have to remove for additional processing all TRU wastes stored in the facility, make other arrangements for their disposition, or rehandle stored waste drums to facilitate additional modifications to bring WIPP into compliance with the standards.

EPA Is Revising Disposal Standards

In July 1987 the U.S. Court of Appeals (First Circuit) vacated and remanded the disposal standards to EPA to reconcile provisions related to groundwater contamination with its safe drinking water standards. The Court stated that in developing the repository disposal standards, EPA had not adequately considered requirements of the Safe Drinking Water Act. The Court found that in establishing the requirements to provide additional assurance that release limits contained in the disposal standards would be met, EPA had established, without a suitable explanation, permissible radiation levels for groundwater that exceeded those levels permitted under its drinking water standards. The Court directed EPA to either reconcile the differences between the two standards or explain why they are different.

EPA plans to publish proposed new standards for public review and comment by the end of 1989. After considering the comments it receives, the agency will issue the revised standards. It anticipates issuing the new standards in September 1991. According to EPA, a number of important and complex issues will be analyzed in the rule-making process. The issues include the relationship of the disposal standards to standards for

radioactive materials under other statutes, the time frame that the standards should consider for individual exposures, and the updating of radiation risk factors from the time that the original standard was developed. Thus, it appears that EPA does not intend to limit revisions to the standards to the narrow issue of reconciling the difference between the groundwater protection requirements contained in the disposal standards and the drinking water standards.

**Waste Removal or Rehandling
Could Be Required If WIPP Does
Not Meet EPA's Standards**

DOE and its contractors originally predicted that salt "creep" would not close storage rooms fast enough to potentially begin to crush TRU waste drums for at least 15 years. This creep rate would have permitted DOE to store and backfill TRU wastes during the initial 5-year operational period and, if necessary, remove the backfill and retrieve the wastes over the following 10 years. According to Sandia, backfilling waste storage rooms can add substantially to the margin of safety for TRU waste disposal. Specifically, backfilling can

- minimize the vacant space remaining in storage rooms after storage operations have been completed that could cause undesirable changes in site hydrologic characteristics;
- shorten the time to consolidate storage room contents into a mechanically stable and erosion-resistant state well before disruptive events, such as human intrusion, are likely to occur; and
- reduce the potential release rate for radioactive materials from the repository and absorb gases generated by the wastes.

After DOE had excavated some of the rooms in the experimental area, however, it discovered that the rooms were closing approximately three times faster than predicted. This observed rate of salt creep would not permit easy retrieval of wastes surrounded by backfill, because the pressure from the more rapid rate of room closure on the backfill material would crush the waste drums. For this reason, DOE would store waste in WIPP in a retrievable manner, without backfill, during the test phase. DOE believes that it could then retrieve the waste, if necessary, by essentially reversing waste emplacement procedures.

If, after its 5-year test phase, DOE determines that WIPP will not comply with EPA's new disposal standards, it might have to retrieve TRU waste stored in WIPP and either store or dispose of the waste elsewhere. DOE's April draft plan does not discuss such a contingency, how it might be carried out, and what the associated costs might be. DOE did raise the issue of waste retrieval in its April 1989 draft supplemental environmental statement. The statement notes that if WIPP does not comply with

EPA's standards, DOE would have a number of technical options that might permit it to bring the facility into compliance with the standards. These options generally include some type of additional waste treatment, such as compaction, or engineered barriers in the repository, such as getter materials added to absorb gases generated by the contents of waste drums.

Neither the supplemental statement nor the test plan, however, addresses whether this would require waste retrieval or rehandling within the storage area. The environmental statement states only that additional environmental documentation would be prepared after DOE would make an initial determination of noncompliance with EPA's standards. The draft test phase plan states that DOE is considering "systems analysis" of potential engineered modifications. Finally, neither document discusses the potential disposition of the wastes in the event that DOE would have to abandon WIPP because the facility would not comply with EPA's standards. According to EPA, it will need to consider DOE's plans for waste retrieval as part of its review of DOE's petition requesting authority to store hazardous wastes in WIPP.¹

Also, according to DOE's WIPP operating contractor, if the test phase leads to a decision to use WIPP as a disposal facility, DOE will probably need to move wastes already stored in the facility to other rooms to cover the wastes with backfill. An alternative that DOE is considering is to cover the waste drums in place with backfill if a potential technology for this operation can be demonstrated.

EEG has stated that, in view of the probability that DOE will have to rehandle wastes stored in WIPP during the 5-year test phase, it makes sense to store a large quantity of waste underground only after a decision to leave the waste permanently has been made and in conjunction with backfill operations.

The Academy's WIPP Panel took a position similar to EEG's in its comments on DOE's draft test plan. Although the panel concluded that a demonstration of operational readiness is an important phase of the overall WIPP program, it recommended that DOE defer the demonstration until several important issues concerning storage of waste for permanent isolation at WIPP have been resolved. The issues include (1) appropriate methods of dealing with gases generated from waste containers stored

¹As shown in DOE's October decision plan for WIPP, according to defense program officials, DOE is now preparing a waste retrieval plan and an engineering enhancement plan to address these issues.

underground, (2) appropriate backfill composition and backfilling procedures that may be considered necessary, and (3) other engineering modifications that may prove necessary for the safe isolation of TRU waste.

What Are the Merits of Demonstrating Waste Storage Operations?

As discussed in chapter 2, DOE's stated objectives for the planned operational demonstration relate to satisfying congressional intent to demonstrate safe disposal of TRU waste. Demonstrating safe disposal operations concurrent with completing the performance assessment for WIPP, DOE states, is consistent with industrial practice and will help ensure public confidence in an eventual decision to use the facility for disposal of TRU waste. Because of the risk that WIPP, as designed, might not comply with EPA's standards, however, the benefits of the operational demonstration need to be weighed against the risk of noncompliance with the standards. Demonstrating the suitability of the facility to dispose of TRU wastes involves completing the performance assessment and, on the basis of the assessment, determining if WIPP complies with EPA's disposal standards. DOE's proposed demonstration program, however, is not a part of this assessment. The results of the program, therefore, are not important to the fundamental decision on whether to use the facility as a repository. Finally, in attempting to build public confidence in WIPP during the test phase, DOE could damage the credibility of its waste management programs if it finds, after storing over 18,000 drums of waste in the facility, that WIPP does not comply with EPA's standards.

WIPP Mission Limited to Disposal of TRU Waste

On the basis of an October 1980 final environmental statement on the WIPP facility, DOE decided, in January 1981, to proceed with WIPP. In the record of that decision, DOE stated that the facility would dispose of TRU waste stored at its Idaho National Engineering Laboratory and would then be available to dispose of TRU waste from other DOE facilities. DOE added that WIPP would include an experimental underground facility for conducting experiments on defense wastes, including small volumes of high-level waste. The high-level waste would be removed after the experiments have been completed. On the basis of these statements, it appears DOE intended that the facility be used for the disposal of TRU wastes and research and development on the disposal of other defense waste, such as high-level waste.

Since 1981, nuclear waste legislation and a related presidential decision have essentially limited WIPP's role to TRU waste disposal. Specifically, under a provision contained in the Nuclear Waste Policy Act of 1982, the President decided in April 1985 that high-level defense waste would

be disposed of in one or more repositories to be developed for the disposal of spent fuel from commercial nuclear power plants.

When the President made this decision, DOE was considering various rock formations as potential sites for a repository for commercial spent fuel, including a salt formation located in Deaf Smith County, Texas. Therefore, research in the salt formation at WIPP may have been useful in relation to the Deaf Smith site. In December 1987, however, the Congress amended the Nuclear Waste Policy Act to, among other things, direct DOE to limit its investigation of potential repository sites to Yucca Mountain, Nevada.² The Congress also directed DOE to terminate all site-specific activities at the Deaf Smith County site and another site at DOE's Hanford Reservation in Washington. Yucca Mountain is composed of compressed volcanic ash, called tuff, rather than salt. DOE is no longer investigating any salt formation for a repository for commercial spent fuel and high-level defense waste; consequently, WIPP now has no potentially significant role as a research facility for disposal of high-level defense waste.

Benefits of Demonstration Are Limited

DOE's proposed demonstration of operations is similar to what would be expected in starting up a major new industrial facility, especially a first-of-a-kind one like WIPP. The demonstration would include all aspects of the TRU waste management system. DOE would initiate waste receipt at the facility with small quantities of waste in support of the experiments and then increase storage operations to assess the TRU waste management system's performance against predictions. However, long-term operation of WIPP as a repository for TRU waste is not yet assured. In view of the possibility that WIPP, as designed, may not comply with EPA's disposal standards, several factors show that an early operational demonstration with TRU waste is not essential.

First, although WIPP would be the first deep geologic nuclear waste repository in this country, DOE has much experience in transporting, handling, and storing a variety of nuclear wastes and materials. For example, although DOE has not yet shipped TRU wastes to WIPP, for many years it has routinely stored and handled nuclear wastes and materials at its facilities and shipped wastes and materials among these facilities. Many of these wastes and other nuclear materials are more hazardous than the TRU wastes that DOE would store in WIPP during the demonstration period. Also, DOE has routinely shipped TRU wastes produced at its

²Title V of the Budget Reconciliation Act for Fiscal Year 1988 (P.L. 100-203, Dec. 22, 1987).

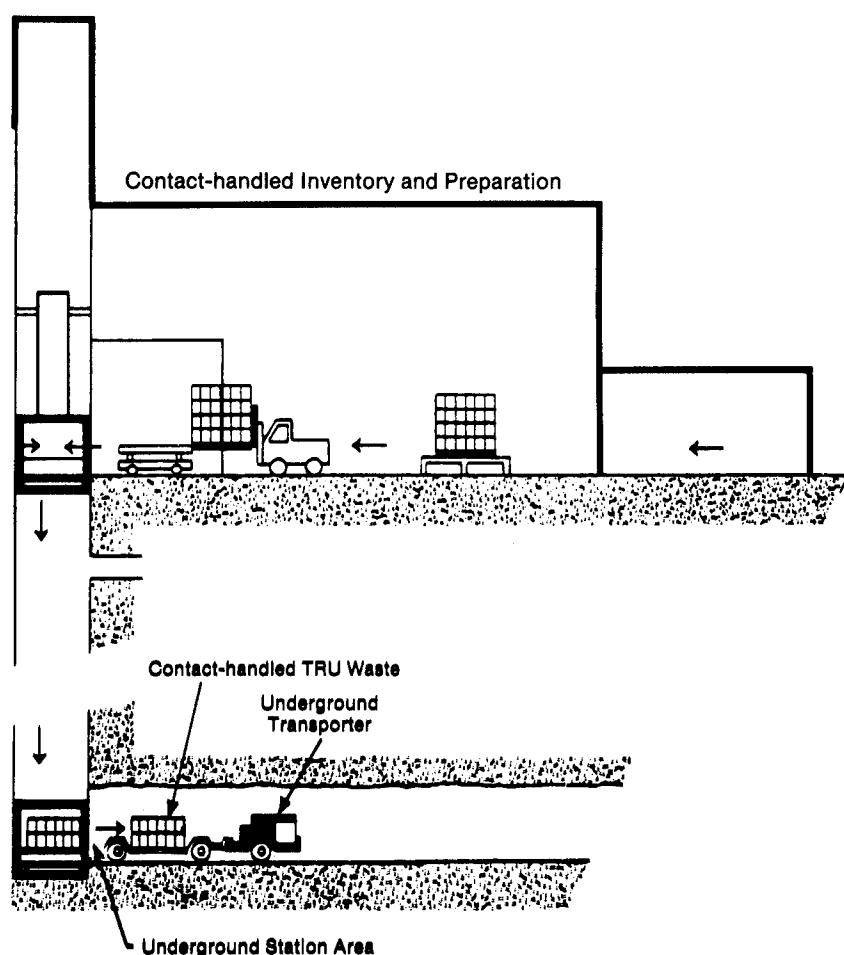
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Rocky Flats and other facilities to its Idaho National Engineering Laboratory and stored the wastes at that facility in a retrievable manner.

Second, waste handling requirements for the facility are accommodated with current technology. About 96 percent of the TRU wastes to be disposed of at WIPP can be handled with minimal protective clothing for workers. This contact-handled TRU waste will be handled on the surface and in underground repository areas in much the same manner as a warehousing operation. Waste drums will be hoisted out of shipping containers and placed on a pallet. The pallet will then be placed on a pallet transfer car and lowered by elevator to the repository level. Pallets of waste drums will be winched onto the bed of a transporter vehicle that will take them to the designated waste storage room, where a specially designed forklift vehicle will remove the drums and stack them in the storage room. Figure 3.1 illustrates this waste handling and storage process.

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Figure 3.1: Illustration of TRU Waste Storage Operations



Source: DOE.

Third, DOE has demonstrated on a small scale that it was capable of emplacing and retrieving both contact- and remote-handled wastes at WIPP. Using nonradioactive waste packages, in June 1988 DOE completed a pre-operational demonstration of contact-handled TRU waste storage operations. During 1 week, DOE processed 10 shipping containers—capable of holding 140 drums of waste—through surface handling and repository storage operations. According to DOE's April plan, the demonstration was completed without incident and confirmed the acceptability of WIPP waste handling equipment and operations to safely receive and emplace waste.

Also, in September 1987 DOE demonstrated that it could retrieve waste drums stored in WIPP. It put 4 boxes and 132 drums of simulated contact-handled TRU waste in a mined storage room. It then retrieved the 4 boxes and 57 of the drums. The demonstration was structured to include a worst-case retrieval situation—simulated contaminated waste packages and crushed drums. Among other things, according to DOE's April plan, the retrieval operations demonstrated that waste in the amount of 15 percent of WIPP's storage capacity could be safely retrieved within 10 years. In May 1987 DOE also emplaced and retrieved two canisters of simulated remote-handled waste. Subsequently, DOE emplaced five canisters of simulated remote-handled waste in WIPP to demonstrate satisfactory worker and equipment performance. According to the April test plan, the full sequence of operations was completed without incident and in accordance with established procedures.

Both the Academy's WIPP Panel and EEG noted in their comments on DOE's draft test plan that DOE would gain significant waste handling experience by emplacement of the waste for the gas-generation experiments. The panel also noted that DOE is not yet ready or able to undertake a demonstration of operations as they will be conducted—complete with backfilling of waste storage rooms—during waste emplacement for long-term isolation. Therefore, the panel did not review DOE's proposed plans for demonstrating operations in any detail. EEG did review DOE's operational demonstration plans. Among other things, EEG concluded that until DOE commits to the actual waste emplacement conditions to be used during disposal operations—including backfill, getters, or other engineering modifications—the proposed demonstration will not represent actual waste emplacement conditions. Therefore, EEG is opposed to an operational demonstration program until DOE has determined that WIPP meets EPA's disposal standards.

Short-term Gain in Public Confidence Could Be Jeopardized in the Long Run

DOE states in its April 1989 draft plan that it could base a decision to operate WIPP as a disposal facility upon demonstrations and appraisals already completed. In support of its proposed operational demonstration, however, DOE's plan states that lack of operations with TRU waste could be an impediment to full public confidence in the decision-making process.

We have completed a large body of work over the last several years addressing environmental, safety, and health problems at DOE's atomic energy defense complex. In our view, WIPP is a key part of any long-range environmental restoration plan for the complex because it may provide a safe place to permanently dispose of TRU wastes generated or

stored on an interim basis at other DOE facilities. It is possible, however, that by implementing the proposed operational demonstration, DOE could be perceived as moving too fast and putting the TRU waste disposal needs of its defense complex ahead of environmental concerns at WIPP. Also, a determination by DOE, after completing the demonstration, that WIPP does not comply with EPA's disposal standards could, in our opinion, cause DOE to lose credibility with the public in the management of its nuclear waste programs.

Is Early Operation Appropriate to Begin Cleaning Up DOE's Facilities?

DOE has noted that its growing interim storage problems in states where it is now storing TRU waste will be exacerbated if WIPP is not allowed to operate. According to DOE, TRU waste generating sites—particularly Rocky Flats—do not have the capability for continued storage of these wastes. The wastes from generating sites would have to be shipped to a storage site, such as the Idaho Laboratory, for temporary storage and shipped to WIPP at a later time. In DOE's view, this "double handling and shipping" would impose unnecessary additional safety risks. DOE's proposed test phase would permit it to begin shipping TRU wastes from these facilities to WIPP. For example, DOE's draft test plan, as modified in June 1989, shows that DOE would make 118 shipments to WIPP in the first 12 months of the test program. Each shipment would contain 42 waste drums, for a total of almost 5,000 drums. DOE would make over 500 shipments, comprising over 20,000 drums of TRU waste, in the first 3 years of the 5-year test period.

Two of DOE's principal TRU waste facilities are the Rocky Flats Plant and the Idaho National Engineering Laboratory. Rocky Flats generates about one-half of DOE's TRU waste; however, because of that facility's limited storage space, DOE has for many years shipped TRU waste from that facility to Idaho.

In June 1989 DOE stated that storage space is available at the laboratory for TRU wastes produced at Rocky Flats until 1992. In part, this is due to DOE's plans to begin operating a waste compaction facility at Rocky Flats in April 1990. The facility will reduce the volume of some TRU wastes produced at that facility by up to a factor of five and, according to DOE, will result in an overall 50-percent reduction in the volume of TRU waste generated at the facility. Thus, consideration of the physical dimensions needed for temporary storage will change significantly. Also, because DOE is recovering certain TRU wastes stored at the Idaho laboratory, it is developing additional space at the facility for interim surface storage of

**States Hosting DOE Facilities
Press for Early Removal of TRU
Waste**

the recovered waste. According to DOE, it could make some of this new storage capacity available for wastes from Rocky Flats.

Affected states, particularly Idaho and Colorado, are resisting additional storage of defense wastes at DOE's facilities within their borders and are seeking removal of existing wastes as a high priority. The position of these states is that DOE has not lived up to prior commitments to remove the wastes from the facilities.

In October 1988, for example, the Governor of Idaho closed that state to further waste shipments for several months because of what he stated were too many promises to remove nuclear waste from the Idaho location that DOE has not kept.³ When the governor subsequently began to allow additional waste shipments from Rocky Flats to the Idaho facility, he stated his intention to prevent further shipments of TRU waste into that state beginning in September 1989. In a letter of August 21, 1989, the governor notified the Secretary of Energy that, with the arrival in Idaho of the last 2 of 12 boxcars of TRU waste shipped from Rocky Flats since February 1989, the state's borders were closed to further shipments.

The return of a shipment to the Rocky Flats Plant as a result of the Governor of Idaho's October 1988 action prompted the Governor of Colorado to indicate that he might shut that plant down if WIPP would not open in early 1989. In June 1989 the Department of Justice announced a criminal investigation into possible violations of federal law at the plant. DOE and the state of Colorado then entered into an agreement that, among other things, limits the amount of TRU waste that DOE may store at the plant. The governor has stated that he will not allow DOE to exceed the limit and will shut the plant down next year if there is still no place to move the waste generated at the plant.

The positions of the governors of the two states and the limited TRU waste storage capacity at Rocky Flats have created a situation in which DOE might have to shut down that plant—a unique plant that manufactures plutonium triggers for nuclear weapons—if it cannot find other storage alternatives. At the time we completed our review, the Secretary of Energy had appealed to the governors of seven states—all containing major DOE defense facilities—to permit additional storage of wastes

³We reviewed the legal basis for the Governor of Idaho's actions. We concluded that there is no legal basis for the Governor's actions and that these actions are in violation of the supremacy clause of the U.S. Constitution. (B-221801.3, June 1, 1989.)

within their boundaries.⁴ The Secretary proposed that between April 1990 and September 1992 each state accept up to the equivalent of seven boxcar loads of TRU waste. The initial public responses of the states to this request were generally negative.

**New Mexico Favors WIPP If
Conditions Are Met**

The state of New Mexico, in which WIPP is located, has supported operation of WIPP once certain conditions have been met. For example, it has supported land withdrawal legislation for the facility and has exchanged state-owned land at WIPP for other federal lands to put the entire facility site under federal ownership. The state has raised concerns in the areas of environmental protection, transportation safety, and emergency response training, which, in its view, have been or are being met satisfactorily. The state also believes, however, that it should be compensated by about \$50 million for lost mineral revenues related to the land withdrawal.

Further, the state is seeking federal funds to help pay for a new road from Los Alamos to Santa Fe and road bypasses around the communities of Artesia, Carlsbad, Hobbs, Roswell, and Santa Fe. These communities are—or, according to the state, may be—along transportation routes for TRU waste shipments to WIPP. The state currently estimates that the new road and bypasses will cost about \$336 million. The state seeks \$200 million in federal funds and will finance the remaining portion from other sources. Of the total amount, by far the largest portion—\$193 million—is for construction of a new road providing a shorter, more direct route between Los Alamos and Santa Fe. According to the state, the road would improve safety conditions in the transport of hazardous wastes from DOE's Los Alamos National Laboratory, provide better access from the Santa Fe area to the laboratory, and provide an emergency route from the laboratory for civil defense and other emergency conditions. The state's earliest estimate for completing the road is 1995.

The major bypass project involves constructing a 14-mile north-south relief route around the center of Santa Fe. New Mexico currently estimates that this project will cost about \$57 million and could be completed as early as 1992. The bypass was not planned in response to DOE's plans to ship TRU waste from Los Alamos or its other defense facilities to WIPP. According to the state, the project has been included in plans for orderly growth in the Santa Fe area for 25 years.

⁴The seven states are Colorado, Idaho, Nevada, New Mexico, South Carolina, Tennessee, and Washington.

**Has DOE Supported
Proposed Experiments?**

DOE's draft test plan does not provide support for the number of drums of TRU waste required for the proposed bin- and room-scale tests or for other technical details of the tests. For example, the plan does not discuss why the equivalent of 6,500 drums would be used in the five small rooms. It states that these details will be contained in individual test plans that are being prepared.

In commenting on the draft plan, the Academy's WIPP Panel stated that several relevant documents, including the detailed individual test plans, were provided to the panel before and during its June meeting. These documents and discussions at the meeting, the panel said, yielded substantial information and insight on the draft plan, and many of the panel's conclusions and recommendations are based on this more complete appreciation of the plan.

One recommendation the WIPP Panel made was that DOE should give urgent attention to defining the combined effects of gas-generation, room closure and sealing, brine inflow, and other effects on the potential for long-term buildup of gases in the repository, and to examining options for modifications to the waste as part of the resolution of the gas-generation issue. Because the time necessary for gas pressure to build up is considerably longer than the 5-year period of DOE's test phase, the panel noted the importance of beginning now to reduce or eliminate concern that gas-generation will affect safety.

With respect to DOE's proposed gas-generation experiments, the panel concluded that determining the rate, quantity, and composition of gases generated by the various mixtures of TRU wastes will require both laboratory and large-scale experiments, including drums of TRU waste. Therefore, the panel recommended that, given the urgent need to resolve questions concerning gas-generation, experiments involving TRU waste in the quantity proposed by DOE are warranted and should begin without delay.

EEG, in a September 1990 report on its evaluation of DOE's proposed experiments, stated that DOE has lost precious time by not starting the bin-scale experiments earlier at one of DOE's waste generator sites (such as Rocky Flats) because the gas-generation issue was identified in 1979 and again surfaced in 1987. According to EEG, the bin-scale tests should yield information on the contribution of various factors in gas-generation. It said that the tests could be expanded in scope to include study of various engineered modifications and that the experiments should begin as soon as possible.

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Repository Standards**

Because the bins are intended to provide a sealed internal atmosphere, storing them in WIPP as opposed to any other location is not important for test purposes. DOE acknowledged this fact in its April draft supplementary environmental statement on WIPP. Therefore, by adopting EEG's suggestion to conduct the bin tests elsewhere, DOE may be able to begin the bin tests earlier. In its draft environmental statement, DOE estimated that it would cost about \$3.5 million to build and operate a bin-preparation facility at the Idaho laboratory as an alternative to bin storage in WIPP. However, DOE's current plans are to prepare the bins at Rocky Flats and ship them to WIPP. A more meaningful analysis than comparing the cost of building a new facility for the bin tests with the cost of storing the bins at WIPP, therefore, would be to compare the current plan to store the bins at WIPP with the alternative of preparing bins at Rocky Flats and storing them at that facility or the Idaho laboratory. Conducting the proposed tests at either location, however, may not be possible unless DOE can resolve the current political impasse with the states of Colorado and Idaho over storage of TRU waste at DOE's defense facilities.⁵

EEG also concluded that DOE's plans for the room test need more refinement to establish that there is a possibility of obtaining quantitative data in time for performance assessment and that experimental problems, such as sealing the rooms, are manageable. Finally, EEG concluded that the results of the bin- and room-scale tests will probably not help in showing compliance with EPA's disposal standards, but, if properly conceived and redesigned, the tests may yield useful information for selecting effective engineered modifications to solve the problems that have already been predicted.

On October 19, 1989, EPA commented on DOE's draft test plan. Overall, EPA stated that it supports the range of experiments described in the plan as an essential component of DOE's program to demonstrate compliance with EPA's standards. A major deficiency in the draft plan, EPA said, is that the plan gives little attention to TRU wastes that have been treated by incineration or immobilization. In EPA's view, DOE needs to give more comprehensive consideration to various types of waste treatments and other engineering modifications in time for them to be seriously considered during the planning stages of WIPP. EPA also recommended that DOE evaluate the feasibility of augmenting its proposed test plans by filling two full-size storage rooms with TRU waste

⁵According to DOE defense waste program officials, DOE is now evaluating alternative locations for preparing bins and conducting bin-scale tests.

and then instrument, backfill, and seal the rooms. The objective of this proposal—to be done either during or immediately after DOE's 5-year test phase—would be to (1) demonstrate how actual operational rooms would be filled, (2) develop appropriate instrumentation, and (3) confirm expected room behavior enough in advance to allow operational adjustments as necessary.

What Choices Does the Congress Have?

So that DOE can begin a 5-year test phase at WIPP, it is seeking legislation permanently withdrawing WIPP land from public use and authorizing storage of TRU waste in the facility. The principal issue the Congress faces in considering land withdrawal legislation is how much, if any, TRU waste it should permit DOE to store in WIPP before DOE determines that the facility complies with EPA's disposal standards. As discussed above, the four key elements of this issue are

- the disposition of wastes stored in WIPP if the facility does not comply with disposal standards as revised by EPA;
- the merits of DOE's operational demonstration program;
- whether waste storage is appropriate years in advance of determining compliance with EPA's standards, to address the essentially political issue of continued temporary storage at DOE's defense facilities in several states; and
- DOE's technical justification for experiments using waste in WIPP.

In addressing this issue, the Congress has five alternative courses of action.

- Authorize waste storage without restriction: This alternative would permit DOE to implement experimental and operational demonstration programs—including the possibility of storing a significant but as yet undetermined quantity of waste in WIPP—in advance of determining compliance with EPA's disposal standards. The approach would provide DOE with the most flexibility in designing and implementing these programs. It would also permit DOE to begin removing TRU waste from interim storage at existing defense facilities, such as its Idaho National Engineering Laboratory.

The major disadvantage of this alternative is that a significant quantity of waste might be stored in WIPP before DOE determines if the facility complies with EPA's standards. If this should occur, DOE would either

have to remove the wastes for storage or disposal elsewhere, or rehandle the wastes to facilitate modifications to achieve compliance with the standards.

- Accept DOE's test plans as proposed in its completed plan, when issued: According to DOE's April draft test plan, as modified by DOE in June, this alternative would permit DOE to store about 22,900 drums of TRU waste in WIPP over the first 3 years of operations, with the possibility of storing more waste in the final 2 years of the 5-year test phase. This approach has the same basic advantages and disadvantages as authorizing unrestricted waste storage.
- Authorize waste storage only for essential experiments until DOE makes a preliminary determination that WIPP complies with EPA's standards: This alternative would permit DOE to begin regular waste storage operations after making a preliminary determination that WIPP complies with EPA's disposal standards (including obtaining and considering independent reviews from parties such as EPA, the Academy's WIPP Panel, and EEG). This process is expected to take about 3 years. The advantage of this approach is that, following a positive preliminary determination, DOE could proceed with waste storage operations with a high degree of confidence that WIPP complies with EPA's standards. The disadvantage is that DOE would not be able to begin shipping significant quantities of TRU waste from its defense facilities to WIPP for the 3-year period and, therefore, may have to find alternative storage arrangements during that period.
- Restrict storage authority to the amount of waste, if any, justified for essential experiments until DOE has determined that WIPP complies with EPA's standards: This alternative would limit storage of TRU waste in the facility to 0.5 percent of its design capacity until DOE has made a final determination that WIPP complies with EPA's disposal standards. Its advantage is keeping to a minimum the amount of waste that DOE would have to either remove from WIPP or rehandle within the facility if, depending on the results of the experiments and DOE's assessment of WIPP's performance, removal or rehandling becomes necessary. The disadvantage of this alternative is that it would delay full-scale operation of WIPP by up to 5 years, thereby requiring DOE to continue storing TRU wastes at its defense facilities or at other locations.
- Defer action on land withdrawal legislation until DOE has determined that WIPP complies with EPA's disposal standards: In this case, DOE would rely on the Department of the Interior to act favorably on DOE's request for administrative land withdrawal for an 8-year period, including authority to store TRU waste in WIPP. How Interior would act on the request is uncertain. In the past, Interior's position has been that land withdrawal authorizing waste storage should come from the Congress.

Conclusions

Storage of TRU waste in WIPP is a significant step in the nation's nuclear program. However, there is risk in beginning to store waste in WIPP before DOE determines that the facility complies with EPA's disposal standards. What the standards will be is uncertain at this time, and DOE eventually might have to remove the stored wastes for other disposition or for additional waste processing or engineered modifications. Nevertheless, DOE is using up its existing temporary storage capacity. Furthermore, continued temporary storage of TRU waste at DOE's defense facilities has become a politically contentious issue between DOE and states hosting these facilities. For example, some states—particularly Idaho and Colorado—vigorously oppose additional storage and are making every effort to get DOE to remove existing wastes from within their boundaries. Thus, some solutions to DOE's interim waste storage problem, while technically feasible, also present political problems.

Deciding under what conditions DOE should be permitted to begin storing TRU wastes in WIPP involves a tradeoff between

- the importance, from a federal-state relations standpoint, of removing TRU wastes from temporary storage at DOE's defense facilities and
- the risk that DOE might eventually determine that WIPP is either unsuitable as a repository or that additional waste processing or facility modifications will be required to comply with EPA's new disposal standards.

Because of the nature and significance of this policy decision, it should have congressional input and direction. In addition, if WIPP is to be used for permanent disposal, legislative action would clearly be required because Interior's authority to withdraw lands from public use is limited to a 20-year renewable period. Therefore, we favor congressional action, rather than administrative action by the Department of the Interior, on land withdrawal.

To adequately consider these elements and make an informed decision on how much TRU waste DOE should be allowed to store in WIPP before determining compliance with EPA's disposal standards, the Congress needs the benefit of DOE's completed plan for the proposed 5-year test program; specific information on alternative actions that might be required if WIPP, as designed, does not meet EPA's standards; and information on available alternatives for continued interim storage of TRU wastes.

Recommendations to the Secretary of Energy

To ensure that the Congress has relevant information to decide on DOE's request for authority to store TRU wastes in WIPP for demonstration purposes, we recommend that the Secretary of Energy analyze and report to the Congress on

- the technical justification for storing TRU wastes in WIPP, and the quantity of such wastes, in advance of determining if the facility can be used as a repository;
- contingency plans for the disposition of any TRU waste stored in WIPP in the event that DOE eventually determines that the facility, as currently designed, does not meet EPA's disposal standards; and
- options for continued temporary storage of TRU waste at other DOE defense facilities while DOE is completing its assessment of WIPP's compliance with EPA standards.

Matters for Consideration by the Congress

DOE does not require legislation permanently withdrawing WIPP land and authorizing storage or disposal of TRU wastes until it has determined that the facility can be used for permanent disposal of these wastes. However, there are significant federal-state relations issues associated with deciding on how much, if any, waste should be stored in the facility until it has met all qualifications for a repository. If DOE adopts our recommendations, the Congress should consider the material that DOE provides in deciding on the future of WIPP. If DOE does not accept our recommendations, the Congress may wish to require DOE to provide it with such material.

Also, the Congress may wish to include a provision in land withdrawal legislation that would specify the amount of TRU wastes DOE can store in WIPP before determining that the facility complies with EPA's disposal standards. Finally, the Congress may wish to make permanent land withdrawal conditional upon a positive determination of compliance.

Events Surrounding Brine Seepage and DOE's Intentions to Emplace TRU Waste at WIPP

Over the past few years an issue surfaced that raised questions about whether WIPP can comply with EPA's standards for the disposal of TRU waste. The issue is whether brine seeping into the repository disposal rooms from the surrounding rock can affect the repository in such a way that a mixture of brine and TRU waste could escape and reach the human environment. A range of views existed among DOE and various scientific groups on both the potential for this to occur and the research necessary to address and resolve the issue. All parties agreed, however, that DOE needs to conduct relevant experiments.

In 1988 DOE issued a draft plan stating that brine seepage and other experiments should be done under conditions approximating actual repository conditions. This was part of DOE's justification at that time for operating WIPP at near-full capacity for a 5-year demonstration period. However, the National Academy of Sciences' WIPP Panel, EEG, and the Scientists Review Panel reviewed DOE's draft plan and found it unsatisfactory. The Academy's Panel and EEG conceded that DOE may need to put some TRU waste in WIPP for research purposes, but they also recommended that DOE limit the amount to the minimum required for well-defined experiments. The Scientists Review Panel concluded that more meaningful TRU waste experiments can be done aboveground under controlled conditions.

Emergence of the Brine Seepage Issue

In the mid-1950s a committee of the National Academy of Sciences recommended salt as a repository medium because it was believed to be dry and because it has good heat-retention characteristics. Moreover, because the rate of dissolution (the process whereby a space in or between rocks is formed by water dissolving part of the rock) associated with salt was considered small, salt beds were viewed as resistant to penetration by water. Consequently, some members of the scientific community believed that salt offered a dry repository environment. Others members of this community, however, were not convinced of the presence of such a dry environment.

DOE detected brine at WIPP in late 1983, and in 1984 it began a brine sampling program to investigate the origin, extent, and composition of brine seepage. It was not until 1986, however, that controversy began to emerge about the potential problems that brine could create.

Appendix I
Events Surrounding Brine Seepage and DOE's
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Discovery of Brine Seepage

A borehole drilled in the floor of the repository in late 1983 contained about 2 liters of brine the following day. Since then, DOE has encountered brine seeping into other excavations and shafts. DOE believes that if present technology is used, the shaft leaks are not a significant problem because they are small and can be corrected by refilling or grouting the concrete shaft liners.

In June 1984 EEG requested DOE to provide it with information on its brine seepage observations. On the basis of this information, EEG officials stated that salt rock at WIPP contains more brine than DOE had anticipated.

DOE's Position on Brine Seepage Challenged

Dr. John D. Bredehoeft, a hydrologist with the U.S. Geological Survey and a member of the Academy's WIPP Panel, initially pointed out the possibility that WIPP might become saturated with brine within a few hundred years after closure. At a February 1986 meeting of the panel, Dr. Bredehoeft questioned the concept of salt as a dry environment. He added that the salt at WIPP is apparently saturated with brine and appears dry only because ventilation during mining operations keeps mined surfaces free of moisture. Using permeability data from the Salado formation, he calculated that repository excavations would provide enough brine to saturate the repository rooms in a few hundred years.

Subsequently, the Scientists Review Panel analyzed brine seepage and related data and presented the preliminary results of its investigation at a December 8, 1987, hearing before the Subcommittee on Energy and the Environment, House Committee on Interior and Insular Affairs. The panel contended that the disposal rooms in the WIPP repository will probably be saturated with brine shortly after sections of the repository have been filled with waste and sealed. In a January 1988 report, the Scientists Review Panel concluded that the repository will become wet, rather than stay dry, as DOE has contended, after it has been closed.¹ The panel postulated that a liquid mixture of brine and nuclear waste could form. Further, the liquid would be under pressure caused by the slow creep of the surrounding rock and the generation of gases from bacterial decomposition of organic matter in waste drums. Eventually, according to the panel, the liquid could reach the accessible environment either through fractures in plugs and seals of underground excavations, shafts,

¹Evaluation of the Waste Isolation Pilot Plant (WIPP) as a Water-Saturated Nuclear Waste Repository, Scientists Review Panel on WIPP (Jan. 1988).

and boreholes, or through unintentional human intrusion. Under the latter scenario, the panel of scientists postulated that someone might inadvertently drill a hole into the repository a few hundred years from now and release the radioactive liquid.

The Scientists Review Panel contended that the formation of pressurized liquid waste and possible intrusion would prevent WIPP from complying with standards for disposal of TRU waste prescribed by EPA in 1985. The panel expressed concern about what may happen in WIPP after it has been filled with waste and its openings have been plugged and sealed. Consequently, the panel recommended, among other things, that DOE defer all mine construction, excavation, and nuclear waste storage operations until (1) disposal methods have been demonstrated that would isolate waste within a wet repository and (2) an effective program for reducing or permanently containing liquid waste in the repository is available and tested.

EEG also concluded that observations of brine from WIPP repository excavations indicate the salt at the repository horizon is saturated with brine and the repository will begin to fill with brine once ventilation of the facility stops removing moisture.

Academy Reviewed Potential for Brine Accumulation at WIPP

As a result of the Scientists Review Panel's testimony and report, in February 1988 New Mexico's congressional delegation asked DOE to request the Academy's WIPP Panel to express an opinion on how effectively existing data resolve conflicting viewpoints on the amount of potential brine seepage and accumulation at WIPP. In response to DOE's subsequent request, the panel reviewed program documents and existing data on the brine seepage issue, and convened a meeting on February 18-19, 1988, in Albuquerque, New Mexico. At that meeting, scientists from DOE's Sandia National Laboratories (a technical consulting contractor to DOE on the WIPP project), EEG, and the Scientists Review Panel presented their views.

Representatives of Sandia said they project brine accumulation at the WIPP facility in small enough volume (11,000 gallons per storage room in 100 years) that the brine will be absorbed by backfill material.² Therefore, they concluded, brine will not interfere with the movement of salt around waste containers.

²DOE intends to fill the spaces between waste drums, and between stacks of drums and storage room walls and ceilings, with a material such as crushed salt rock.

Members of the Scientists Review Panel stated that there has not been enough research to establish WIPP will be an unsaturated repository and that evidence in Dr. Bredehoeft's report indicated the repository would become saturated. EEG did not advocate rejecting the repository site or stopping repository excavation work and experiments with TRU waste in WIPP. It expressed the opinion that engineering solutions are available to address the potential brine seepage problem. In outlining its position, however, EEG stated that uncertainty regarding the quantity of brine seepage and accumulation, including the effects of gas-generation on closure of repository storage rooms, was sufficient to warrant serious study before DOE places large numbers of waste drums in WIPP. EEG recommended, among other things, that DOE (1) publish preliminary analyses on the facility's compliance with EPA's disposal standards; (2) obtain empirical data on brine seepage; and (3) evaluate the effects of gas-generation on room closure, consolidation of waste, and brine seepage.

On March 3, 1988, the Academy's WIPP Panel reported to the Secretary of Energy on the potential brine accumulation problem at WIPP. The panel concluded that the formation of an abundant mobile fluid in the repository area is unlikely, but not impossible. The panel added that the necessary assumption of a sequence of improbable events coupled with the drilling of exploratory holes that strike disposal rooms does not make the results postulated by the Scientists Review Panel credible.

The Academy's WIPP Panel concluded that contaminated brine escaping through a drill hole from a pressurized cavity would cause a temporary spurt of radioactive liquid. Transport of waste in drilling fluid might lead to longer lasting flow, but these events would result in only brief surface contact between a few individuals and slightly radioactive liquid. Release of radioactive liquid to an aquifer could be more dangerous because the fluid would be disseminated over a wider area and ingestion could lead to significant exposure. It noted, however, that the water in the aquifer above WIPP is not suitable for drinking.

The brine seepage issue did not, the Academy's WIPP Panel said, warrant stopping WIPP research activities; however, the panel did not know exactly what research activities were planned by DOE. Therefore, the panel recommended that DOE assign a high priority to developing a comprehensive, systematic experimental program to reduce technical uncertainties (such as permeability of salt and generation of gases) and to support a conservative assessment of WIPP's performance as required by EPA's disposal standards. The panel pointed out that in the absence of

detailed descriptions of DOE's intended experiments, independent scientific groups have no basis for meaningful judgments about DOE's ability to reduce technical uncertainties. The panel also commented, however, that some of the WIPP experiments will require the use of drums containing radioactive waste. Because of continued uncertainty about achieving compliance with EPA's standards, the panel agreed with EEG that no more drums than needed for well-described and necessary experiments should be placed underground until the experimental work has substantially reduced key technical uncertainties.

Finally, the Academy's WIPP Panel recommended that DOE (1) design its experiments to lessen uncertainties, not to "verify" preconceived ideas about their probable results; (2) develop models to describe the behavior of the complex fluids that might form as brine enters the repository excavations and gas is generated from the wastes; and (3) immediately begin to investigate technical solutions in the event experiments show brine seepage is a serious problem. The panel suggested several possible solutions, such as using getters to selectively absorb and hold certain radionuclides, to reduce or control the amounts of gas generated from the waste and, as an extreme measure, processing the waste into dense, chemically stable forms before emplacing it in the repository.

DOE's 1988 Draft Experimental Plan Criticized

DOE issued a press release on March 22, 1988, stating that it would respond to each recommendation of the Academy's WIPP Panel in an aggressive and positive manner. It also said that it would prepare and present to the panel a comprehensive 5-year experimental and operations test plan for WIPP. This plan would provide for acceleration of experimental and modeling investigations in order to reduce uncertainties regarding the permeability of the salt and, consequently, the gas-generation and brine seepage rates that are expected to occur after the repository has been filled and closed. Also, DOE said it would evaluate the need for a test plan for remote-handled TRU waste. Shortly thereafter, DOE provided the Academy's WIPP Panel and EEG with part of its draft plan, called the "panel one monitoring plan." The draft plan stated that monitoring is one of the important elements in determining (1) compliance with EPA's waste disposal standards, (2) the amount of gas generated from TRU waste, and (3) the amount of brine seepage, before DOE makes a decision to proceed with permanent disposal operations at WIPP.

DOE's draft plan stated that it is necessary to perform full-scale underground tests to provide data needed to supplement understanding of the repository environment and improve confidence in the understanding of

waste/facility interactions, which was previously limited to data from laboratory-scale and simulated tests. The underground environment, the draft plan stated, will ensure that the effects of factors such as temperature and moisture on the generation of gases by the various TRU waste materials are properly addressed. It would also provide data on the interactions—of chemicals, microbes, and radioactive materials—that may occur in the various physical arrangements within the waste forms.

According to DOE, the thousands of drums of TRU waste that would be stored in WIPP will contain a wide variety of physical, chemical, and radioactive forms. Therefore, to develop representative data for assessing the repository's performance, including the potential effects of brine seepage and gas-generation, DOE needs to conduct experiments using enough waste drums—four storage rooms with a total capacity of about 25,000 drums—to comprise a representative sample of the larger universe of waste drums. According to the plan, the data obtained would represent the initial conditions existing during the first few years of the repository. Simulating these conditions aboveground, DOE maintained, would require large and expensive tests and would not provide the same quality of data. Also, breach of waste containers due to corrosion or repository room closure over a long period of time may start a new set of gas-generation processes that DOE would analyze by means of laboratory experiments and computer simulations.

Academy Panel Informally Comments on Draft Plan

In April 1988 the Academy's WIPP Panel informally reviewed DOE's draft panel one experimental plan and advised DOE that the plan did not respond to earlier recommendations the Academy's WIPP Panel had made. As a result, in June 1988—about 1 week before the panel held a general meeting—DOE provided the panel with a revision of plan and a draft of the overall 5-year experimental and operations test plan. Because the panel had only 1 week to review the plans, and because DOE had not publicly released them, the panel did not formally comment on the plans. At the panel's June 28-29, 1988, meeting, however, individual panel members commented on the draft plans. According to one panel member, comments and concerns raised by the panel members indicated that the arguments contained in the plans for emplacing TRU waste in WIPP did not substantiate DOE's need to conduct experiments with such waste.

EEG Comments on Draft Experimental Plan

In commenting on the draft experimental plan, EEG stated that although DOE contends WIPP is a research and development facility, DOE has not issued a final plan for research that supports the need to store TRU waste in WIPP for such research. Moreover, EEG expressed its concern that DOE would emplace a large amount of waste underground during the 5-year demonstration period without simultaneously putting backfill material around and over the waste drums. According to EEG, this would eventually require DOE to shuffle the drums within the repository to permit backfill operations in preparation for permanent disposal of the wastes.

Also, EEG stated that DOE's proposal to monitor the effects of temperature and humidity on gas-generation and on the interaction among gases produced in different drums would not be realized. It pointed out that the waste would be isolated in the drums, inside a liner and two layers of heavy plastic (for the purpose of ease of retrieval). In EEG's view, moisture would not have sufficient time to penetrate those protective layers, nor would gases from different drums have time to interact with one another, during the 5-year experimental period.

Finally, in the view of EEG, DOE may decide to reprocess (compact, cement, or convert to glass) the contents of the drums—one of the Academy's WIPP Panel's suggested solutions to a serious brine seepage problem—to ensure that WIPP will comply with EPA waste disposal standards. In this case, EEG said, DOE would have to bring the drums to the surface for reprocessing before final disposal in WIPP. Therefore, EEG said, the wisest course for DOE to follow is to refrain from putting a large quantity of waste in the repository until after it has demonstrated compliance with EPA's disposal standards and made decisions on reprocessing, engineering solutions to the brine problem, and using a backfill material.

Scientists Review Panel Comments on DOE's Draft Plan

The Scientists Review Panel was not asked by DOE to review the draft experimental and operational test plan but obtained a copy of the plan, including the panel one experimental plan, from a source other than DOE. In a May 1988 evaluation of the experimental plan, the panel of scientists expressed concern about DOE's contention that the temperature and humidity in WIPP storage rooms would be similar to disposal conditions. The panel contended that because DOE did not propose using either backfill or brine in the storage-room test, and because of the short period planned for observation of the stored waste, little information would be obtained about the interaction of TRU waste and brine. The panel also said that experiments discussed in DOE's draft plans would

Appendix I
Events Surrounding Brine Seepage and DOE's
Intentions to Emplace TRU Waste at WIPP

not provide data needed to predict WIPP's compliance with EPA's repository standards. According to the panel of scientists, the data that are required for determining compliance can be obtained from other experiments that do not use radioactive waste. More importantly, it said, it is concerned that the planned experiments are a means for DOE to open WIPP and commit TRU waste to permanent disposal without compliance with EPA's disposal standards.

In commenting on DOE's proposed WIPP experiments, the panel said that DOE's principal argument for underground experiments on gas-generation appears to be that surface experiments would require construction of an expensive facility with a controlled environment. Such experiments, the panel said, could be scaled down to use laboratory facilities that might already exist. More importantly, it added, because the amount of brine expected is unknown, surface experiments could simulate a range of possibilities and be immediately applicable once the brine seepage problem is clarified. Also, the panel said that the cost of aboveground experiments could be small in comparison to the cost of transporting, handling, and storing waste underground; rehandling or repackaging the waste for final disposal; and possibly removing and transporting the waste to another location if DOE eventually determines that WIPP is unsuitable for permanent TRU waste disposal.

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