Mr. Jerome D. Saltzman, Acting Director
Office of Strategic Planning and
International Programs
Office of Civilian Radioactive Waste
Management, RW-4
1000 Independence Ave, SW
U.S. Department of Energy
Washington, D.C. 20585

DEC 28 1993

Dear Mr. Saltzman:

SUBJECT: NUCLEAR REGULATORY COMMISSION INPUT TO AGENDA ITEMS OF THE OECD/NEA RADIOACTIVE WASTE MANAGEMENT COMMITTEE MEETING ON JANUARY 20-21, 1994

This letter is in response to your letter, dated December 1, 1993, requesting NRC review and input to Agenda Items #3, #10, and #11 for the Radioactive Waste Management Committee (RWMC) meeting on January 20-21, 1994, in Paris, France. Enclosed are the NRC staff comments to Agenda Item #3, a hand annotated mark-up of Agenda Item #10, and the revised NRC portion of Agenda Item #11.

The NRC staff will continue to support the U.S. Department of Energy (DOE) in the review of additional RWMC documents as they are received and disseminated by DOE for this meeting. If you have any questions concerning this subject, please contact Mr. Robert Carlson at (301) 504-2435, or Mr. John Buckley at (301) 504-2513.

Sincerely, Original signed by
Robert M. Bernero

060017

Robert M. Bernero, Director
Office of Nuclear Material Safety
and Safeguards

Enclosures: As stated

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LPDR	ACNW	PDR	CENTRAL FILE
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CPoland	BLynn		

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OFC	*HLPD	E	*HLPD	E	*HLPD	N	HLWM		*HLWM	N
NAME	RCarlson		RJohnson		WReamer		JLinehan		BJYoungblood	
DATE	12/21/93		12/21/93		12/21/93		12/ /93		12/21/93	

OFC	NMSS		NMSS							
NAME	GArlotto		RBernero							
DATE	12/22/93		12/28/93							

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NAME	GArlotto		RBernero							
DATE	12/ /93		12/ /93							

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AGENDA ITEM: 3 - APPROVAL OF THE SUMMARY RECORD OF THE 25TH RWMC MEETING

ACTION REQUESTED:

Approval of the Summary Record to the 25th RWMC Meeting.

U.S. RECOMMENDATIONS:

The U.S. approves the minutes of the 25th RWMC Meeting.

TALKING POINTS:

None.

BACKGROUND:

ENCLOSURE 1

NRC Mark-up (hand annotated) 12/17/93

12/28/93 Agenda Item #10

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RADIOACTIVE WASTE MANAGEMENT IN THE UNITED STATES

January 1994

Prepared for
Radioactive Waste Management Committee
of the
OECD Nuclear Energy Agency

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ENCLOSURE 2

PREFACE

This overview provides a brief description of the civilian radioactive waste management system in the United States. It includes a description of the policies, strategies, and requirements to ensure safe and environmentally acceptable disposal of nuclear waste.

Every effort has been made to present up-to-date information; however, the reader is advised to seek current information as the programs evolve.

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OVERVIEW OF RADIOACTIVE WASTE MANAGEMENT IN THE UNITED STATES

GENERAL STRATEGY

The policies, strategies and programs for managing civilian and Department of Energy (DOE) radioactive high, low, intermediate and Transuranic (TRU) wastes in the United States are described in this overview. Included is a description of the management of civilian wastes resulting from the production of electricity by nuclear power plants (commercial wastes) and non-reactor, non-fuel cycle wastes (i.e., academic, medical, industrial). Management of radioactive wastes from ~~Department of Energy~~ DOE activities, which include defense activities, are also discussed. Discussion of wastes from uranium mining, milling, conversion and enrichment, and fuel fabrication are not included.

NATIONAL POLICY

The primary objective of radioactive waste management in the United States is to protect: 1) the health and safety of the public and workers and 2) the quality of the environment. Management of radioactive wastes is considered the responsibility of the present generation and should not be left for future generations.

The U.S. Congress, recognizing that a national problem (HLW) exists due to the accumulation of commercial spent fuel and high-level wastes, and that an environmentally acceptable method of permanent disposal is needed, enacted the Nuclear Waste Policy Act of 1982 (NWPA) and in 1987 amended the Act through the Nuclear Waste Policy Amendments Act (NWPAA). The two Acts provide the current bases for the safe, timely, and effective storage, transport and disposal of spent nuclear fuel and ~~high level waste~~ HLW ~~waste~~.

In October 1992 Section 801 of the Energy Policy Act (EnPA) passed by Congress required the (EPA) Environmental Protection Agency to develop new standards for protection of the public from releases of radioactive materials at the proposed Yucca Mountain repository for spent fuel and ~~high level radioactive waste~~ HLW. Also, the (NRC) Nuclear Regulatory Commission was directed to amend its technical requirements and criteria to be consistent with new EPA standards. The EPA criteria are to be based on findings and recommendations by the National Academy of Sciences (NAS). A NAS panel has been holding meetings all during 1993 and is expected to make recommendations in 1994.

For HLW at the West Valley (New York) facility, the West Valley Demonstration Project Act of 1980 sets the general policy on activities to be conducted. The Act charged the Federal Government with demonstrating ~~high level waste~~ HLW solidification, decontamination, decommissioning, and transportation activities. This waste was of commercial origin. West Valley was a commercial nuclear fuel reprocessing facility from 1966 to 1972 which was transferred to federal responsibility in 1980.

The general policy for the disposal of commercial low-level waste (LLW) is provided in the Low-Level Radioactive Waste Policy Act of 1980 (LLWPA) and the 1985 amendment to the Act (hereafter called the LLRWPAA). The LLWPA and the LLRWPAA assigned to the individual states the responsibility for providing disposal capability for all commercial LLW generated within their borders with certain exceptions, Greater-than-Class C LLW. For this category of waste, disposal responsibility was assigned to the federal government. The Act

awkw. sentence

encourages states to form interstate agreements (Compacts) in order to share responsibility for disposal of LLW.

For DOE radioactive wastes, the general policy is established in the Atomic Energy Act of 1954, as amended. The DOE is responsible for management of wastes generated by its activities (which include ~~high-level~~, ~~low-level~~, HLW, LLW (TRU) and transuranic wastes). Through a combination of regulations codified in the Code of Federal Regulations (CFR) and a system of DOE Orders, DOE carries out its responsibilities under the Act. The primary DOE Order that provides for the safe and effective management of DOE generated radioactive waste is DOE Order 5820.2A, "Radioactive Waste Management."

Additionally, in 1979 Congress authorized (WIPP) under P.L. 96-164, the construction of the Waste Isolation Pilot Plant, the nation's first research and development facility to demonstrate the safe geologic disposal of defense transuranic wastes. In 1992, the WIPP Land Withdrawal Act, P.L. 102-579, permanently transferred public lands surrounding WIPP to the DOE, and mandated a new regulatory framework for the start and conduct of a Test Phase with transuranic waste, and the disposal and decommissioning phases of the WIPP Project. However ~~Although~~, a recent DOE decision changed the test phase to include only the use of simulated waste underground, until WIPP officials demonstrate the site meets EPA standards.

NATIONAL STRATEGIES

The major policies and strategies included in the aforementioned laws are as follows:

Department of Energy Order 5820.2A, "Radioactive Waste Management"

- Outlines the responsibilities of all Departmental elements concerning the safe and effective management of radioactive waste generated by DOE activities.
- Establishes the policies for management of all DOE-generated radioactive wastes.
- Provides guidelines for the management of DOE-generated radioactive waste, including principles for management, strategies, and planning documentation required for effective management.
- Establishes the minimum technical requirements for management of DOE-generated ~~high-level waste~~ (HLW), ~~transuranic~~ (TRU) ~~waste~~, ~~low-level waste~~ (LLW), waste from decontaminating and decommissioning (D&D) of DOE facilities, and uranium mill tailings.

Waste Isolation Pilot Plant Land Withdrawal Act 1992

- Establishes a new regulatory framework in which the ~~Environmental Protection~~ (EPA) must certify WIPP's compliance with the radioactive waste disposal regulations prior to establishing WIPP as a disposal site.
- Establishes several requirements that must be met by DOE and seven other Federal agencies for the start and conduct of a Test Phase with waste (limited to 0.5% by volume of design capacity), and the disposal and decommissioning phases of WIPP.
- Key prerequisites that must be met before the first Test Phase shipments can begin include:
  - EPA issuance of the final 40 CFR 191, Subpart B disposal regulations.

- DOE submission for EPA's formal review and approval of the DOE Test Phase Plan and Waste Retrieval Plan.
- EPA determination of WIPP's compliance with the terms and conditions of the "No Migration" determination issued by EPA under (RCRA) ← spell out
- Mine Safety and Health Administration concurrence of the adequacy of the DOE plan for assuring room stability in the underground test rooms.
- Occupational Safety and Health Administration (OSHA) certification of the DOE accident prevention and emergency response training programs.

- Key disposal phase prerequisites require DOE to:

  - Notify Congress of compliance with all applicable environmental laws and regulations.
  - Submit to Congress recommendations for the disposal of all TRU waste under DOE control, including a timetable for disposal of such waste.
  - Complete a survey identifying all TRU waste types at all sites from which waste are to be shipped to WIPP, and notice and opportunity for public comment, and provide results to EPA.
  - Submit to Congress decommissioning and post-decommissioning plans.
  - Wait 180 days after notifying Congress of compliance with all applicable environmental laws and regulations.
  - Acquire two existing oil/gas leases, unless EPA determines such acquisition is not required.

West Valley Demonstration Project Act of 1980

- Authorizes DOE to carry out a nuclear waste management project at the West Valley facility in New York.

- Provides for a demonstration that liquid waste from reprocessing of spent fuel can be managed safely.

- Requires DOE to:

  - solidify liquid HLW in a form suitable for transport and disposal.

    - develop waste containers suitable for permanent disposal. STET

    - transport the solidified HLW as soon as feasible to a federal repository for permanent disposal.

    - dispose of ~~low-level~~ LLW and ~~transuranic waste~~ TRU produced by the solidification of the HLW.

    - decontaminate and decommission the facilities and equipment used in the solidification and temporary storage of HLW at West Valley in accordance with NRC requirements.

Low-Level Radioactive Waste Policy Amendments Act of 1980

- Requires each State, either alone or in cooperation with other States (in arrangements referred to as compacts), to provide for the disposal of commercial ~~low-level radioactive waste~~ LLW generated within its borders.
- Allowed these compacts ratified by Congress to exclude waste generated outside their borders.

Low-Level Radioactive Waste Policy Amendments Act of 1985

- Establishes a schedule that individual State or compact regions must meet in providing the required disposal capability. Critical dates are: (1) each state shall ratify compact legislation or indicate its intent to develop its own LLW site by July 1, 1986; (2) identification of the host state responsible for a siting plan by January 1, 1988; and (3) submission of a license application by January 1, 1992.

- Establishes penalties in the form of surcharges and potential denials of access to existing disposal facilities for those States not meeting the schedule.

- Made Greater-than-Class C (GTCC) waste disposal a federal responsibility.

- Requires NRC to develop procedures and criteria to act upon petitions to exempt disposal of specific waste streams from regulation by the NRC.

- Specifies precisely which categories of LLW are a State responsibility, and establishes volume ceilings for individual nuclear reactors and for disposal sites.

Nuclear Waste Policy Act of (as amended) (1987)

- Establishes a federal program and responsibility for a geologic repository for permanent disposal of spent fuel and HLW.

- Provides for the permanent disposal of commercial spent fuel and HLW in a manner that ensures the protection of public health and safety, and the environment.

- Names the Yucca Mountain site in Nevada for detailed site characterization to determine its suitability as the first repository.

- Requires a report on the need for a second repository between 2007-2010.

- Provides for Nuclear Regulatory Commission (NRC) licensing of repositories for spent fuel and HLW.

- Provides for the appointment of a Nuclear Waste Negotiator to seek a volunteer host State, Indian Tribe, or local government for a repository or a Monitored Retrievable Storage (MRS) facility.

- Provides for benefits compensation to the host State, Indian Tribe, or local government in which a repository or MRS facility is located.

- Authorizes DOE to seek, negotiate, and enter into written consultation and cooperation agreements with the State of Nevada.

- Authorizes an MRS ~~(Monitored Retrievable Storage)~~ facility, but requires a number of conditions be met before construction can start.

- Establishes a system for safe transportation of waste to a repository or to other waste management facilities.

- Assigns responsibility for interim storage to the owner/generators of civilian spent fuel. Directs the federal government to expedite approval of new technologies to expand on-site storage. Provides for limited federal interim storage capacity.

- Provides the State of Nevada and interested parties full and open evaluation of the civilian radioactive waste management program.

- Provides for costs to be borne by the waste generators through the establishment of the Nuclear Waste Fund.

Energy Policy Act of 1992

- Directs ~~the U.S. Environmental Protection Agency~~ (EPA) to contract with NAS ~~the National Academy of Sciences~~ for a study to provide findings and recommendations on reasonable safety standards for disposal of ~~high-level radioactive wastes~~ HLW.

* See Insert 1

WASTE SOURCES AND TYPES

Radioactive wastes are broadly classified as follows:

Spent Nuclear Fuel (SNF). Irradiated nuclear fuel permanently withdrawn from a commercial nuclear power reactor that has not been reprocessed.

High-Level Waste (HLW). Irradiated reactor fuel, liquid wastes from the first step of reprocessing such fuel and solids made from these wastes (including solidified liquid).

Low-Level Waste (LLW). All the wastes which are not classified as spent nuclear fuel, HLW, ~~by product material transuranic waste~~ (TRU), or uranium or thorium mill tailings, as well as those wastes that the NRC, consistent with existing law, ~~is~~ has classified as ~~low level radioactive waste~~ LLW, ~~(By product material is radioactive material produced in nuclear reactors)~~.

In 10 CFR 61.55 ~~(Code of Federal Regulations)~~, ~~the~~ NRC has classified LLW into three categories (Class A, Class B, and Class C). These categories are based on the concentration limits of long-lived radionuclides and their shorter-lived precursors, and the concentration of shorter-lived radionuclides for which requirements on institutional controls, waste form, and disposal methods are effected. LLW exceeding the Class C concentration limits is termed GTCC ~~"Greater than Class C~~ waste." GTCC ~~low-level waste~~ LLW is not generally acceptable for near surface disposal.

Transuranic (TRU) Waste. Waste that is contaminated with alpha-emitting transuranium radionuclides with half-lives greater than 20 years and concentrations greater than 100 nanocuries per gram of waste. TRU Waste results from activities primarily associated with defense activities and research activities on nuclear fuel.

Mixed Waste. Waste that contains constituents that are radioactive and also constituents that are hazardous as defined in ~~the Resource Conservation and Recovery Act~~ (RCRA). All DOE HLW is considered mixed waste by DOE unless proven otherwise, and many DOE TRU and LLW waste streams are mixed waste streams because of the radioactivity and other hazardous components in the wastes.

Uranium Mill Tailings. The tailings or wastes produced by the extraction or concentration of uranium or thorium from any ore processed primarily for its uranium or thorium content.

WASTE INVENTORY

The current and projected inventories of commercial radioactive waste are shown in Table 1, and those for DOE wastes are shown in Table 2.

CONSIDERATIONS IN STRATEGIC PLANNING

The overall management of commercial radioactive waste in the United States includes the following activities:

- Development and implementation of regulations to ensure long-term protection to public health and safety and to ensure compliance with environmental standards.
- Establishment of a disposal system(s) for LLW from commercial and institutional sources through the collaboration of States, assistance and regulation by the federal government, and funding by industry.
- Demonstration and application of decontamination and decommissioning technologies for nuclear power reactors and other nuclear facilities.

The overall DOE radioactive waste management strategic plans include the following activities:

- Bring all DOE waste management facilities into full compliance with applicable laws, regulations, and agreements related to health, safety, and the environment.
- Reconfigure the DOE waste management facilities as the DOE production complex is reconfigured in order to achieve waste minimization and pollution prevention goals and to safely and efficiently manage the waste that is produced.
- Decontaminate and decommission the old DOE facilities as new facilities of the reconfigured DOE complex become operational.
- Safely dispose of all TRU Waste needing deep geologic disposal, safely dispose of all wastes generated by ~~Decontamination & Decommissioning~~ (D&D) of old DOE facilities and from cleanups of contaminated sites and facilities, and continue to develop better, safer, faster, cheaper methods of waste treatment to allow for better utilization of available disposal capacity.

TABLE 1. Current and Projected Cumulative Inventories of Commercial Radioactive Wastes[a]
(Units are 10^3 m^3 unless otherwise indicated)

Waste Source and Type	1991	2000	2010	2020	2030
HLW Glass Canister (West Valley)	1.729(c)	0.24		0.24	0.24
LWR Spent Fuel, MT of Heavy Metal					
No New Orders Case	23,681	42,400	61,000	77,200	87,700
Lower Reference Case[b]	23,681	42,300	61,200	81,600	103,200
LLW from Operations	1,423	1,722	2,055	2,321	2,508
LLW from D&D					
Classes ABC LLW	—	0.00	7.83	612.84	1292.85
Greater than Class C	—	0.00	0.00	0.22	0.45

This is incorrect; reactors are being decommissioned now. ?

(a) DOE/RW-0006, Rev.8. Integrated Data Base for 1992: Spent Fuel and Radioactive Waste Inventories, Projects, and Characteristics, Tables 0.4 and C.11, Department of Energy, Washington, D.C., 10/92.
(b) Includes all existing reactors (either completed or under construction) plus additional new reactors beyond the year 2005.
(c) Interim storage-West Valley

TABLE 2. Current and Projected Cumulative Inventories of DOE Radioactive Wastes (in 1000's of m3)

Waste Source and Type	1991	2000	2010	2020	2030
HLW in Storage	395	332	332	335	333
HLW Glass	0	1.6	3.3	6.8	13.4
TRU Wastes					
Buried	191	191	191	191	191
Stored	63	84	108	(b)	(b)
LLW	2,816	3,787	4,769	5,469	6,231
Environmental Restoration (ER) Activities					
TRU Waste	NA[b]	570	1100	1700	1700
LLW	NA[b]	920	18,000	29,000	29,000
By-product material	11,390	33,000	36,000	38,000	38,000
Mixed LLW	101.4	NA[b]	NA[b]	NA[b]	NA[b]

(a) DOE/RW-0006, Rev. 8
(b) Information not available.

IMPLEMENTING AGENCIES

Through the legislation described above, the storage and disposal of most commercially generated ~~Low-Level Waste~~ LLW is assigned to the States, and all other wastes, including ~~Low-Level Waste~~ LLW of noncommercial origin and all ~~Greater-Than-Class-C~~ GTCC Low Level Waste, are the responsibility of the Federal Government. The Federal Agencies which are assigned radioactive waste management responsibilities include the ~~Department of Energy~~ (DOE), which is generally responsible for storing and disposing radioactive waste; the ~~Nuclear Regulatory Commission~~ (NRC), which is responsible for regulating and licensing certain waste management facilities; and the ~~Environmental Protection Agency~~ (EPA) which is responsible for setting environmental protection standards.

~~The Department of Energy~~ DOE has the regulatory authority to implement its own regulations and to issue Orders that implement health, safety, and environmental protection policies regarding the radioactive waste generated at DOE facilities. The DOE is subject to regulatory oversight by the US EPA concerning the hazardous constituents of mixed wastes that are generated at DOE facilities.

Within DOE, the Office of Civilian Radioactive Waste Management (OCRWM) is responsible for implementation of the NWPA and its amendments. DOE's Office of Environmental Restoration and Waste Management is responsible for the development and demonstration of methods for ~~decontamination and decommissioning~~ D&D of commercial facilities and for the West Valley facility.

The Nuclear Waste Negotiator's Office is assigned the task of seeking a volunteer host site for a ~~monitored retrievable storage~~ (MRS) facility. DOE disburses grant money to eligible-prospective host communities for the MRS, who are interested in pursuing the siting process.

~~The Nuclear Regulatory Commission~~ (NRC) is responsible for setting technical standards and criteria, and for implementing overall offsite release standards set by ~~the Environmental Protection Agency~~ (EPA). This includes requirements for licensing and operating storage and disposal facilities, as well as the certification of transport casks. The NRC, and Agreement States (States to which NRC has relinquished certain regulatory responsibilities), also establish requirements and regulates LLW disposal along with Agreement States.

Disposal of defense-generated ~~transuranic~~ TRU wastes will be carried out by DOE, with oversight by EPA at WIPP. Disposal of commercially-generated ~~"Greater-Than-Class-C"~~ GTCC wastes, including ~~transuranics~~ TRU, is the responsibility of DOE, with licensing oversight by NRC.

The EPA ~~is responsible~~ has authority for developing generally applicable ~~environmental~~ standards ~~for the management and disposal of LLW. The EPA is also responsible for setting general standards for~~ for the protection of the environment from ~~offsite release~~ radiological impacts of radioactive ~~material after~~ waste disposal.

Both the Department of Transportation (DOT) and the NRC are responsible for regulating transportation of radioactive materials.

OVERALL SCHEDULE: Civilian High-Level Radioactive Waste Management Program

- 1987 - DOE is redirected to perform detailed site characterization only on the Yucca Mountain candidate site, Nevada.
- 1992 - Candidate ~~Monitored Retrievable Storage~~ (MRS) facility sites identified.
- 1998 - Start waste acceptance at MRS facility.
- 2001 - DOE recommends repository site to the President, if approved, DOE will then submit an application to the NRC for construction of the repository

NRC issues a construction authorization for the repository at the

- 2004 - Start repository construction (if Yucca Mountain ~~candidate~~ site) ~~is found suitable as a repository)~~

- 2010 - Earliest date to start emplacing wastes (if ~~Yucca Mountain candidate site is found suitable as a repository)~~).

NRC issues a license to receive and possess radioactive waste)

OVERALL SCHEDULE: Civilian Low-Level Radioactive Waste Program

The key milestones for the U.S. Civilian ~~Low-Level Waste Management~~ LLWM Program include:

- 1985 - Each State is required to provide for the disposal of commercial ~~low-level radioactive waste~~ LLW generated within its borders.
- 1986 - Each State shall ratify compact legislation or indicate intent to develop its own LLW site
- 1988 - Identification of host States for siting of new disposal facilities.
- 1992 - Submission of license applications for new disposal facilities.
- 1996 - Operation of a disposal facility by January 1.

TOTAL SYSTEM COSTS AND FUNDING

Spent Fuel and High-Level Wastes

The NWPA prescribes that (1) that owners and generators of spent fuel and HLW will pay the full costs of its disposal; and (2) a Nuclear Waste Fund was established to cover the cost of the civilian radioactive waste management program. This fund receives revenue from all those planning on using the repository.

An adjustable fee has been charged for the net electricity generated by commercial nuclear power plants beginning in April 1983, in addition to a one-time fee charged for spent fuel generated prior to April 1983. The on-going fee for electricity generated is currently set at 1 mill ($0.001) per kilowatt-hour (net). The total costs for disposing of commercial spent fuel and HLW are estimated to be approximately $25.6 billion (in 1988 dollars).

On April 5, 1985, a Presidential decision following a study made pursuant to Section 8 of the NWPA authorized DOE to proceed with plans and arrangements to dispose of DOE HLW in the civilian repository. OCRWM's cost for the disposal of the waste will be paid by the Department's annual appropriations from Congress.

During 1992, efforts to change the basic funding mechanism for OCRWM's ~~High-Level Waste~~ HLW Program continued. Currently, a 0.1 mil/KwHr tax on electric power use is generating about $600 million ~~dollars~~ annually, but Congress has allocated $300 million ~~dollars~~ or less to OCRWM, with the remainder offsetting other Federal Government spending. Efforts to establish an "off budget" revolving fund have been aimed at increasing program funding. Discussions relative to a revolving fund with Congress and the Office of Managment and Budget (OMB) are continuing.

Low-Level Wastes

The costs for management and disposal of LLW vary due to differences in disposal concepts, management practices, and characteristics of the wastes. Estimates for various assumptions are presented in the storage, transportation, and disposal sections of this report. Each generator of commercial LLW provides the funds for storage from its operating budget.

Disposal site operators levy fees on waste generators upon receipt of the wastes for disposal. Initial cost for developing LLW disposal facilities differ from State to State (or compact region). In the majority of States and compact regions, development costs are paid by waste generators, or through some type of assessment on tax fee imposed by the State of compact region.

INTERNATIONAL COOPERATION

The United States cooperates with foreign nations and international organizations to further the development of technology for the management and disposal of radioactive wastes. Presently DOE has bilateral agreements with the Commission of the European Communities and the following countries: Belgium, Canada, Federal Republic of Germany, France, Japan, Spain, Sweden, Switzerland, and the United Kingdom. DOE and NRC also cooperate with the Nuclear Energy Agency (NEA) of the Organization of Economic Cooperation and Development (OECD), and the International Atomic Energy Agency (IAEA), in projects, workshops, and meetings.

STORAGE SYSTEMS

NATIONAL POLICY

Spent Fuel and High-Level Wastes

As designated in the NWPA, commercial nuclear power plants are responsible for interim storage of spent fuel. Commercial power plants are encouraged to expedite the effective use of existing spent fuel storage facilities and to cooperate with DOE in the development and demonstration of technology to increase at-reactor storage (wet storage and/or dry storage).

The Amendments Act authorized a central ~~Monitored Retrievable Storage~~ (MRS) facility for storage of commercial spent fuel, subject to specific conditions linking MRS operation to the repository schedule, and established an independent MRS Review Commission to review the need for such a facility. In its report to the Congress of November 1, 1989, the Commission found that "cumulatively the advantages of an MRS would justify the building of an MRS if: (1) there were no linkages between the MRS and the repository; (2) the MRS could be constructed at an early date; and (3) the opening of the repository were delayed considerably beyond its presently scheduled date of operation." In a 1992 letter from the Secretary of Energy to Congress, the use of multiple purpose canisters (MPC) was proposed as a parallel plan to address the concern with identifying a voluntary MRS site and the DOE's commitment to accept SNF in 1998. The letter also called for investigating the use of Federal sites for hosting an MRS.

The Amendments Act prohibits the selection of an MRS site through a DOE-directed survey and evaluation process until a site is recommended by the President for development as a repository. However, the Amendments Act allows siting to proceed via the Nuclear Waste Negotiator, who may negotiate a proposed agreement with a volunteer host that offers a technically qualified site on reasonable terms. If negotiations are successful, the Negotiator will submit the proposed agreement to the Congress, along with an Environmental Assessment, for enactment into law. Under the Amendments Act, financial assistance for assessing the feasibility of siting an MRS facility is available to the potential host.

The NWPA requires that the MRS facility be licensed by the NRC. The DOE can construct and operate an MRS only after obtaining a license from the NRC, including a site on Federal land.

The DOE completed the MRS Conceptual Design report in 1992 which describes the configuration of the MRS facility for interim storage of commercial spent nuclear fuel. The proposed MRS facility will accept spent fuel from the reactors and store it under closely monitored conditions. Several proven concepts for handling and storing spent fuel were investigated by the MRS designers. Several of these facility designs have either been licensed by the NRC or are in the process of being licensed. The choice of concept or combination of concepts will depend on, among other considerations, safety, licensability, cost, and schedule considerations. Some of the storage technologies currently being considered include wet spent fuel pools, multiple element sealed metal canisters in concrete modules, modular vault dry storage, metal dual purpose transport/storage casks, and concrete casks. The stored spent fuel will be retrieved, loaded into large-capacity casks, and shipped to the geologic repository in dedicated trains.

Under the DOE's current plans, the MRS facility will store only commercial spent nuclear fuel. Spent fuel consolidation and pre-disposal packaging, previously envisioned to be performed at the MRS, would become optional functions that might be added later, if they were determined desirable.

All DOE-generated HLW is in storage at one of three DOE facilities: Hanford, Idaho National Engineering Laboratory, and Savannah River. This HLW is currently stored as a liquid or sludge in underground tanks. Conditioning and solidification (vitrification) will begin when facilities now under construction are completed. The Defense Waste Processing Facility at Savannah river is planned to begin operation with radioactive waste in 1994.

Historically, DOE-generated spent nuclear fuel was stored for a short time and then reprocessed to recover fissile materials. In April 1992, the Secretary of Energy decided to phase-out reprocessing for the purpose of recovery of highly enriched uranium and plutonium. DOE has estimated its spent fuel inventory at about 4600 tons. Most of this is at three sites (Hanford, Idaho National Engineering Laboratory, Savannah River) but small amounts are at a few other sites.

Commercial Greater-than-Class C Low-Level Wastes

Under the ~~Low-Level Radioactive Waste Policy Amendments Act~~ LLRWPA of 1985, the Federal Government (i.e. DOE) is responsible for disposing of GTCC LLW generated by licensees of the NRC. The strategy to fulfill DOE's responsibility under this Act is to provide for disposal of GTCC LLW, recognizing that acceptance and management of this waste before actual availability of disposal capacity are integral to a comprehensive management plan designed to protect public health and safety. The DOE is investigating sites and concepts for Federal interim storage of these wastes. At the present all commercial GTCC LLW is not being held by generators. A number of commercial generators have been producing GTCC LLW, and through contractual arrangements with the DOE and/or for health and safety reasons, the waste is being stored by DOE.

Low-Level Wastes

Generators of commercial LLW generally store the wastes onsite, for short time periods (e.g., a few weeks to a few months) until enough waste is available for a sufficient shipment to a disposal site; however, the failure to provide LLW disposal capacity is expected to increase storage needs. ~~However, with no new disposal facilities anticipated within the next several years, long-term storage is anticipated in the future.~~ In addition, because of the rapidly increasing costs of disposal, many commercial LLW generators reduce the volumes of their LLW before shipment, primarily by mechanical compaction and incineration.

Similar to commercial generators, DOE LLW generators store most of their LLW on-site for short periods of time until shipment to a DOE LLW disposal facility. However, some (not all) mixed LLW (i.e., LLW that also contains hazardous components) is being stored until appropriately designed mixed waste disposal facilities ~~is~~ are available.

Transuranic Wastes

All TRU wastes and mixed TRU wastes that are generated at DOE facilities are placed temporarily in storage, because no disposal capacity is yet available for this type of waste. TRU wastes have been stored at facilities for many years, so many modes of storage are present in the DOE complex of numerous facilities.

REQUIREMENTS

Spent Fuel and High-Level Wastes

In general, storage of the commercial spent fuel and HLW is the responsibility of the generator until the federal government takes title to such wastes (that process begins in 1998).

As many utilities begin running out of wet storage facilities, the option of dry on-site storage for older/colder fuel is being utilized. Each utility must submit a

license application for these storage facilities to the NRC under 10CFR72. These at-reactor dry storage facilities have been called: Independent Spent Fuel Storage Installations(ISFSI).

Storage of commercial spent fuel by the Federal Government in an MRS facility is to be regulated by the NRC and licensed under 10 CFR Part 72 (Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High-Level Radioactive Waste). Various safety features must be incorporated into the design of any storage facility for commercial spent fuel and HLW to protect the environment, the health and safety of the facility workers and the public. In addition to the standard industrial safety regulations, the facility must operate under the radiation protection standards established by the EPA and NRC. A Safety Analysis Report (SAR) and an Environmental Impact Statement (EIS) must be submitted with the application for a NRC license to construct and operate such a facility. On August 27, 1993, the NRC published a proposed rule change to 10 CFR 72:"Notification of Events at Independent Spent Fuel Storage Installations [ISFSI] and the Monitored Retrievable Storage Installation." The proposed rule will ensure that significant occurrences at ISFSIs and the MRS, such as failure of safety equipment, contamination events, personal injuries, and fires and explosions, are reported quickly to the NRC so that the NRC can protect the health and safety of the public.

Once the NRC license is granted, construction of the MRS facility will begin. From that point forward, throughout the construction, operation, and decommissioning of the MRS, monitoring and oversight by the NRC will continue.
All applicable federal, State, and local environmental, safety, and health laws and regulations will be strictly observed during construction, operation, and decommissioning of the MRS facility.

DOE Order 5820.2A establishes the principles and minimum criteria for safe storage of DOE-generated radioactive wastes. Radiation protection principles and technical criteria that will enable the waste to be safely stored, treated, and finally disposed are carried out by Department elements by following the Order.

Commercial Greater-than-Class C Low-Level Wastes

Regulatory requirements have not been issued by U.S. Government regulatory authorities regarding the duration of storage of these wastes prior to disposal. Storage of commercial wastes at the generator's site is regulated through a NRC license or agreement State license for the facility.

Low-Level Wastes

Storage of LLW at commercial generator sites is regulated by the NRC and/or the agreement State license for the operating facility. NRC's preference is that LLW be permanently disposed of as soon after it is generated as possible. ~~NRC is presently proposing to ammend its regulations, to establish license condition requirements for on-site storage of LLW, by licensees, after January 1, 1996~~. Commercial waste storage containers used for the transport and disposal of LLW, must meet DOT and NRC transportation requirements, and must fulfill NRC waste form criteria.

DESCRIPTION AND EXPERIENCE/STATUS

Spent Fuel and High-Level Wastes

Doing what?

The Nuclear Waste Negotiator had considerable success over the past several years. Twenty applications for phase 1 grants to learn more about the MRS and other waste management systems were submitted to the Negotiator's office and twelve were awarded. Four applicants have progressed to phase 2 awards, which can cover identifying potential sites, attending DOE meetings, benefits, impact analysis, and developing a proposed agreement with the negotiator on terms and conditions for hosting an MRS.

However, in 1993 the U.S. Congress enacted an amendment to the energy and water appropriations bill that limits the negotiators disbursement of phase 2B monies until he believes there is a "reasonable likelihood" that surrounding communities will support an MRS siting. While it is possible that phase 2B rules and guidelines may be modified and reimplemented to disburse monies appropriately to surrounding communities, the impact seems to have halted the MRS siting process.

On the other hand, considerable progress was made in 1993 for the parallel effort, use of ~~Multipurpose Canisters.~~ MPCs The new Secretary of Energy has indicated her support for this project and to date, the ~~Multipurpose Canister~~ MPC Implementation Program has produced a Conceptual Design Phase Report.

While the DOE continues toward accepting commercial spent nuclear fuel in 1998, utilities are independently beginning to utilize dry storage technologies to increase onsite storage capacity. Most commercial spent fuel has been and continues to be stored at reactor in onsite spent fuel pools composed of metal storage racks submerged in water pools. Most nuclear power plant spent fuel pools have installed high density metal storage racks in place of the original racks. The high density metal storage racks incorporate solid neutron absorbers for criticality control to allow for closer spacing of the spent fuel assemblies in the pool and thereby increase the total storage capacity of the pool. Some nuclear power plants have demonstrated limited in-pool (wet) consolidation of the rods from spent fuel assemblies. However, no widespread wet consolidation program is currently practiced in the U.S.

The spent fuel storage option currently being pursued in the U.S. by nuclear power plants which have reached the storage capacity limits of their spent fuel pools, is onsite dry storage. Several dry storage technologies have received approval from ~~the U.S. Nuclear Regulatory Commission~~ (NRC) for use in onsite dry storage, and spent fuel is currently in dry storage at seven nuclear power plants (Virginia Power: Surry; Public Service Co. of Colorado: Fort St. Vrain; CP&L: Robinson and Brunswick plants; Duke Power: Oconee; BG&E: Calvert Cliffs; Northern States Power: Prairie Island; Consumers Power: Palisades). The dry storage technologies which have been approved by the NRC include horizontal concrete module storage of sealed canisters, metal cask storage, and modular vault storage. Some nuclear utilities are utilizing trans-shipment to ship spent fuel from one reactor to another to temporarily alleviate storage problems. However, this practice is not widespread since many utilities do not operate a sufficient number of reactors to make this option feasible.

The horizontal concrete module storage technology is currently in use at two utilities in the U.S. For this technology, the spent fuel assemblies are loaded into a multi-assembly canister inside a shielded transfer cask in the spent fuel pool. The canister is dried, backfilled and sealed by welding, after which it is moved in the transfer cask to an onsite storage field where the concrete modules are located. The modules are located within the physical security boundary of the nuclear power plant. The sealed canisters are then transferred into the horizontal concrete storage modules by use of a hydraulic ram. After loading with the sealed canister, a metal door is welded in place over the opening to the concrete module. The Carolina Power and Light Company's H.B. Robinson site has loaded eight horizontal concrete modules which hold seven PWR spent fuel assemblies in a sealed canister in each module. The Duke Power Company is using the same horizontal concrete module dry storage technology at their Oconee site and has loaded 20 concrete modules which hold 24 PWR spent fuel assemblies in a sealed canister in each horizontal module. Other utilities are also planning to implement the horizontal concrete module for onsite dry storage. Most notably, the horizontal concrete module technology has also been licensed for use at Baltimore Gas and Electric's Calvert Cliffs site and the loading of 24 modules holding 24 PWR assemblies in each sealed canister began in 1993. A variant of the horizontal concrete module storage technology is one in which the sealed canisters to be stored within each module are licensed for both storage and transportation. This technology is currently being used by the Sacremento Municipal Utility District (SMUD) for use at their Rancho Seco site.

The concrete cask storage technology was first used in May 1993 at the Consumers Power Company's Palisades site. The concrete cask storage technology uses a sealed canister similar to that used in horizontal concrete module storage to hold spent fuel

assemblies. The loading process for the concrete cask storage technology is similar to that described for horizontal module storage, with the exception that the transfer cask is mated to the concrete cask, and the sealed canister is transferred to the concrete cask in a vertical, instead of horizontal, orientation. The loaded and sealed concrete cask is moved to an onsite storage area where it is placed in a vertical orientation on a reinforced concrete pad. Other utilities are also planning to implement the concrete cask storage technology for onsite dry storage.

The metal cask storage technology is currently in use at one utility in the U.S. For this technology, the spent fuel assemblies are loaded directly into the metal storage cask in the spent fuel pool. The metal storage cask is dried, backfilled, and sealed by bolting, after which it is moved to an onsite storage area where it is placed in a vertical orientation on a reinforced concrete pad. The Virginia Power Company has loaded and stored 17 metal storage casks at their Surry site. The metal casks at the Surry site are of three different designs; 15 of the metal storage casks hold 21 PWR assemblies each, one of the casks holds 24 PWR assemblies, and another cask holds 28 PWR assemblies. Other utilities are also planning to implement the metal cask technology for onsite dry storage.

The modular vault storage technology is currently in use at one utility in the U.S. This technology is currently being used in U.S. only for the storage of High-Temperature Gas Reactor (HTGR) spent fuel in the form of prismatic graphite blocks. For this technology, the HTGR spent fuel is loaded into sealed canisters which are transferred into a storage tube inside a large vault which is cooled by a natural convection cooling system. Public Service of Colorado has built, licensed, and completed loading of modular vault storage facility for HTGR spent fuel at Ft. St. Vrain site. The modular vault storage technology is adaptable for dry storage use with light water reactor (PWR and BWR) spent fuel.

To assist in the development of dry storage technology at all reactor sites and to help demonstrate recovery capability, the DOE is participating in a joint demonstration project with the Scramento Municipal Utility District at their Rancho Seco site to demonstrate the construction, testing, and use of a dry cask-to-cask transfer device to facilitate the dry transfer of spent fuel from at transfer cask to metal transportable storage casks outside of the spent fuel pool.

The DOE has also been developing technologies required for the dry consolidation of commercial spent nuclear fuel assemblies. At the repository or the MRS, dry consolidation would be used to reduce the number of repository waste packages (and thus their cost), to reduce the number of shipments from the MRS to the repository, and possibly to limit the radioactivity of the waste packages (combining older spent nuclear fuel with more recently discharged fuel). The development program has progressed to the point where equipment is being manufactured and non-radioactive demonstration of the equipment is planned for 1992. A follow-on demonstration of the equipment with actual spent fuel may occur depending on budget and expected economic benefits of the technology.

The liquid HLW, alkaline sludges and acid wastes, have been safely stored at the West Valley facility in large underground tanks since 1966.

DOE stores its spent fuel in pools for a short time in its reactor pools, followed by lag storage in the pools at the reprocessing plants. DOE-generated HLW is stored in liquid form in large underground storage tanks (up to one million gallons each) located at three DOE facilities; Hanford, Savannah River, and the Idaho National Engineering Lab, and in granular solid form in concrete vaults at Idaho. The HLW at Hanford and Savannah River is stored in the alkaline condition in mild steel tanks; at INEL, it is stored in the acid condition in stainless steel tanks.

Commercial Greater-than-Class C Low-Level Wastes

Commercial ~~Greater-Than-Class C~~ GTCC LLW is waste that is generated by NRC-and Agreement State-licensed generators and exceeds Class C limits defined in 10CFR 61. Data from existing literature, disposal records, and original research were used to estimate the characteristics and project volumes and activities of GTCC LLW.

GTCC LLW is categorized as Nuclear Utility wastes (57%), sealed sources (.2% , DOE-held GTCC LLW (33%), and all Other Categories (medical, research, etc.) (10%). Most of the estimated GTCC LLW projected to the year 2035 has not been generated. The existing waste, except for DOE-held GTCC LLW, is stored at the generator sites.

Low-Level Wastes

Commercial LLW has been stored and dispose~~r~~d of in a variety of facilities and containers since the mid-1950's. Listed below are descriptions of the typical structures and containers used.

This is misleading; none of these engineered structures, bunkers, etc has been used to any great extent for commercial LLW

- Large Engineered Structures: These are permanent buildings designed specifically for the extended storage of LLW. They may be reinforced concrete structures of steel frame buildings with metal siding and roofing. Overhead bridge cranes are used for handling of waste packages that require remote handling.
- Shielded Storage Modules or Bunkers: These are concrete structures with removable covers. Waste containers are emplaced or retrieved with an overhead crane.
- Shielded Storage Casks: These are all-weather concrete containers, usually cylindrical, that can be placed outdoors on pads and are designed to hold waste drums.
- Minimum Unshielded Facilities: These are simple fenced-in outdoor pads or storage sheds. These facilities are generally intended as holding areas for waste packages awaiting pick-up for transport to disposal or long-term storage.

Most commercial LLW storage containers are 55-gallon steel drums. Other types of containers include other types of steel containers, plastic drums, resin liners in cylindrical steel containers, and "dumpsters," which are large steel boxes.

DOE LLW is stored in containers and facilities similar to those used for commercial LLW storage. Mixed LLW is also stored at DOE facilities that have appropriate permits or are designed especially for storage of this type of waste.

Transuranic Wastes

DOE TRU waste generators store all of the TRU waste generated from DOE activities, either at the respective waste generating facility or at a designated DOE storage facility within the DOE complex. Among the storage methods that can be found at DOE facilities are: retrievably-buried TRU waste, below-ground bunkers, concrete caissons, above-grade concrete pads, and inside buildings. As discussed previously, all TRU wastes are in storage awaiting disposal capability for this type of waste. Therefore, storage of TRU wastes will continue in the DOE complex until disposal capability becomes available.

SCHEDULE

Spent Fuel and High-Level Wastes

In his November 1989 "Report to Congress on Reassessment of the Civilian Radioactive Waste Management Program," the Secretary of Energy announced an initiative to establish an MRS facility that will start accepting commercial spent nuclear fuel as early as 1998. Full MRS facility operational capacity is planned to be available in 2000. DOE plans to submit a license application to the NRC in 1995 in support of this schedule. This schedule has been confirmed in the DOE's Draft Mission Plan Amendment document (DOE-RW-0316P) issued in September 1991.

In another letter dated December 17, 1992, the Secretary proposed an alternative parallel plan based on the delay in identifying a volunteer host site for the MRS. This plan utilizes a multiple purpose canister and the use of Federal government sites. The new Secretary, Hazel O'Leary, supports the Multipurpose Canister effort and has indicated the Department of Energy's continued "moral obligation" to take title to commercial spent fuel beginning in 1998.

DOE spent fuel and HLW will continue to be stored until a disposal facility is operational. The HLW will continue to be stored as a liquid until the conditioning facilities are operational. The HLW vitrification facility at Savannah River is expected to become operational in 1994, and the facility at Hanford in 1999. The conditioning facility for converting the granular HLW at INEL to a final form for disposal will be operational about 2010. The current schedule calls for the HLW disposal facility to begin operations about the year 2015.

Commercial Greater-than-Class C Low-Level Wastes

The small amounts of commercial Greater-than-Class C LLW have been stored at the generating sites and some has been disposed of as LLW since the start of their generation in the late 1950's. Storage is expected to continue there until a decision on federal storage and/or disposal is made. Approximately 33% of the estimated volume of GTCC LLW is presently being held at DOE facilities.

Low-Level Wastes

Storage facilities for commercial LLW are usually constructed by the individual waste generators as needs develop.

As in the commercial industry, LLW and mixed LLW storage capacity is constructed at DOE facilities as needs develop.

Transuranic Wastes

TRU wastes generated by DOE facilities will continue to be stored until the TRU waste disposal facility is operational (WIPP). This facility should enter full operations sometime around 1998.

COSTS

Spent Fuel and High-Level Wastes

DOE's current estimate of life-cycle costs for the MRS facility for storage of commercial spent nuclear fuel, including development and evaluation, design, construction, operation, and decommissioning costs, is approximately $2.2 billion in 1988 dollars. This cost is for a basic MRS facility design (an MRS facility that receives and stores only spent fuel from reactors as intact bare assemblies before shipment to the repository) with limited waste acceptance starting in 1998 and reaching fully operational capability in 2000.

The MRS facility estimate does not include a cost of approximately $213 million ~~dollars~~ towards benefits payments to potential hosts for the MRS facility from siting through decommissioning. Further, the costs represent estimates based on previous designs for the MRS facility that were larger in scope than the concepts that are being currently studied.

DECOMMISSIONING CONSIDERATIONS

Spent Fuel and High-Level Wastes

The MRS facility for storage of commercial spent nuclear fuel will be decommissioned in accordance with NRC regulations at the end of operations. The site

will be restored as nearly as possible to its former condition, consistent with any terms negotiated by the host entity with the federal government.

Decommissioning of DOE facilities for storage of DOE spent nuclear fuel and HLW will be carried out to comply with applicable requirements of DOE, other appropriate federal agencies, and the respective host states, where applicable.

Commercial Greater-than-Class C Low-Level Wastes

Commercial ~~Greater than Class C~~ GTCC LLW storage facilities will be decommissioned when the respective operating facility is decommissioned. This will be done under NRC decommissioning criteria for the storage facility. DOE plans to provide general acceptance of GTCC LLW at a DOE facility for dedicated storage in the late 1990's. Permanent disposal of GTCC LLW will be provided as early as possible.

Low-Level Wastes

Decommissioning of commercial or federal LLW storage facilities will likely occur when the operating facility that generates the LLW is decommissioned. This will also be done under NRC decommissioning criteria for the commercial facilities, and under DOE criteria for the DOE facilities.

Transuranic Wastes

Decommissioning of DOE facilities for storage of DOE ~~transuranic~~ TRU wastes will be carried out to comply with applicable requirements of DOE, other appropriate federal agencies, and the respective host states, where applicable.

QUALITY ASSURANCE CONSIDERATIONS Need to expand upon QA in all areas below

Spent Fuel and High-Level Wastes

The general quality assurance (QA) criteria in the regulations for commercial nuclear power plants and fuel reprocessing plants apply to all commercial spent fuel storage facilities. The QA program takes into account the need for special controls, processes, test equipment, tools and skills to attain the required quality, and the need for verification of quality by inspection and tests. At DOE, a QA program that meets the requirements of the NRC (NRC 10 CFR Part 72, Subpart G) has been established for conducting MRS-related activities.

DOE operates all of their storage facilities in compliance with detailed DOE QA requirements, which include national consensus standards. DOE Order 5700.6C describes the QA requirements that all storage facilities comply with during operations.

Commercial Greater-than-Class C Low-Level Wastes

Commercial facilities are regulated by the NRC. The QA program is developed and monitored by the waste generator and NRC.

Low-Level Wastes

QA for commercial LLW storage facilities is regulated by the NRC and/or the agreement State. The QA program is developed and monitored by the waste generator and NRC.

Transuranic Wastes

DOE operates all of their storage facilities in compliance with detailed DOE QA requirements specified in DOE Orders, which include national consensus standards.

TRANSPORTATION SYSTEMS

NATIONAL POLICY

Through the Department of Transportation Act, 1966, the Hazardous Material Transportation Act, 1974, and the Hazardous Materials Transportation Uniform Safety Act, 1990, the Department of Transportation (DOT) has the authority over transportation of all hazardous materials. Radioactive material has been designated as hazardous material for transportation under these laws.

Overall regulation of transportation of radioactive materials in the civilian sector is the responsibility of the NRC and ~~the Department of Transportation~~ (DOT). The responsibilities of each agency with regard to the transportation of radioactive material were identified in a 1979 Memorandum of Understanding between the two agencies. Their requirements are consistent with the international transportation standards promulgated by the International Atomic Energy Agency (IAEA) as of 1985. Economic regulation of rail and motor carriers is the responsibility of the federal Interstate Commerce Commission (ICC). With the reduced federal regulation of the transportation industry in recent years, the impact of the ICC on carriers has been greatly reduced.

Transportation of most commercially generated radioactive wastes is the responsibility of the waste generator (except as discussed in subsequent subsections) using commercial carriers. Commercial radioactive wastes are transported by truck and conventional rail.

Spent Fuel and High-Level Wastes

Transportation of commercial spent fuel *between* nuclear power plants, or to licensed commercial interim storage facilities, is the responsibility of the owner/licensee of the spent fuel. This transportation is normally carried out under contract with commercial carriers or radioactive waste service vendors. Transportation is by truck or rail, using exclusive-use shipments in Type B transport packagings that meet the design and certification criteria of the NRC. Spent fuel and solidified HLW that is transported by truck must follow preferred highway routes as specified by the DOT, since they contain a Highway Route-Controlled Quantity of radioactive material (i.e., radioactivity quantities that are large enough to require control of the shipment routes according to federal requirements).

DOE is expected to begin spent fuel acceptance from commercial reactors beginning in 1998. Current plans call for this fuel to be transported to an interim storage facility (MRS). DOE/OCRWM's office of Storage and Transportation is responsible for developing the spent fuel and HLW transportation system including cask development and systems for spent fuel acceptance. Initial OCRWM cask development efforts are focused on from-Reactor Cask Systems. Additionally, the new Secretary of Energy supports the ongoing, parallel ~~Multipurpose Canister~~ MPC development effort.

Commercial Greater-than-Class C Low-Level Wastes

The transportation of commercial ~~Greater-than-Class C~~ GTCC LLW has not occurred to any great extent, except for a few unusual situations. For the few shipments of commercial ~~Greater-than-Class C~~ GTCC wastes that have taken place, some were the responsibility of the waste generator and some were the responsibility of DOE. The transportation of ~~Greater-than-Class C~~ GTCC commercial waste has been the responsibility of the waste generator. Transportation is typically carried out under contract with commercial carriers, or radioactive waste service contractors, in full compliance with NRC and DOT regulations.

~~Greater-than-Class C~~ GTCC wastes can be transported in Type A or Type B transport packages, depending on the radioactive content and waste form. Waste is transported by truck or rail, using exclusive-use shipments for the vehicles.

The DOE will be responsible for the transportation of ~~Greater than Class C~~ GTCC waste from commercial generators, which will be disposed of at a federal disposal site. These exclusive-use shipments will be transported in Type A or Type B transport packaging by truck or rail.

Low-Level Wastes

? packages

Transportation of commercial LLW is the responsibility of the commercial waste generator and the waste hauler. These wastes are usually transported by truck in exclusive-use vehicle shipments under contract with commercial carriers or radioactive wastes service contractors using equipment that meets regulations of NRC and DOT. ~~Type A or Type B~~ transport packagings ~~are generally used~~ for LLW depend~~ing~~ on the content and form of the waste. Some small generators use the services of a "broker" who consolidates waste packages from a number of generators.

Each shipment to a commercial LLW disposal site must be accompanied by a waste manifest that meets the requirements of NRC LLW disposal regulations.

Transuranic Wastes

Transportation of ~~transuranic waste (TRU)~~ TRU waste is destined for ~~the Waste Isolation Pilot Plant~~ WIPP from the nation's defense facilities if the WIPP is determined to be a suitable disposal facility. The DOE will be responsible for the transportation of TRU waste from DOE generator sites. TRU wastes will initially be transported via truck by a dedicated commercial carrier using equipment that meets regulations of NRC and DOT. The TRUPACT-II, a NRC certified type B transport package will be used exclusively during the Test Phase to transport TRU waste to or from WIPP.

REQUIREMENTS

The general requirements of a transportation system are to safely transport the wastes from the source of generation to the disposal facility within the United States. In some cases, such as may occur with commercial spent fuel, an additional transport step to an interim storage facility may be required before shipment to the final disposal facility. The packaging and transportation of radioactive materials is regulated by the DOT (49 CFR 100-199) and NRC under 10 CFR Part 71 and other applicable requirements in Parts 20, 21, 30, 40, 61, 70, and 73.

The EPA sets standards for protecting the public and environment from the potential hazards of radioactive material. The EPA also plays a role in the coordinating federal response to emergencies involving radioactive materials.

Spent Fuel and High-Level Wastes

Spent fuel from commercial nuclear power plants will be transported from reactor sites to either an MRS facility or a geologic repository. Transport distance to the repository will average about 3000 km if the Yucca Mountain site in Nevada becomes the repository for spent fuel and HLW. In some cases, spent fuel may be first transported between the originating nuclear power plant and another power plant or to a commercial storage facility by the waste generator before transport to a federal storage or disposal facility. Spent fuel shipments from reactors will be by truck or rail/barge. Spent fuel shipments from an MRS facility are planned to be by rail.

The NRC is responsible for regulating the design, fabrication, and maintenance of transportation casks for spent fuel and high-level wastes (DOT retains this responsibility for shipments of all other hazardous materials(49 CFR 173)). The NRC also has the responsibility for regulating the safeguarding of spent fuel and HLW shipments while in transit (10 CFR 73).

~~Department of Transportation~~ DOT regulations apply to shipment preparation (packaging), labeling, and routing of hazardouz materials. ~~Department of Transportation~~ DOT has the authority to review state, tribal, and local transportation

regulations and resolve conflicts between these and federal transportation regulations.

Low-Level Wastes

As of January 1993, LLW is currently being transported from the waste generating sites to one of two shallow-land burial sites for commercial wastes. LLW may also be transported from the waste generating site to a commercial waste processing facility for volume reduction and/or consolidation prior to being shipped for disposal.

DOE LLW is transported to DOE disposal sites for generators not having their own disposal capability. Transport is in accordance with applicable NRC, DOT, and host State regulations.

Transuranic Wastes

Section 16 of the WIPP Land Withdrawal Act (P.L. 96-164) sets forth a number of requirements related to the transportation of ~~transuranic~~ TRU waste to or from WIPP, including accident prevention and emergency preparedness requirements. No ~~transuranic~~ TRU waste may be shipped to or from WIPP except in packages whose design has been certified by the NRC and which have been determined by the NRC to satisfy its quality assurance requirements. Additionally, prior to shipping ~~transuranic~~ TRU waste to or from WIPP, DOE must provide advance notification to States and Indian Tribes through whose jurisdiction DOE plans to transport ~~transuranic~~ TRU waste to or from WIPP.

DESCRIPTION AND EXPERIENCE

Spent Fuel and High-Level Wastes

Around 9,000 spent fuel assemblies were shipped from commercial nuclear power stations to other sites in the United States between 1964 and 1989. These assemblies were shipped in 2,576 separate shipments and represent 1,861 metric tons of uranium (MTU).

Currently, DOE is developing procedures, institutional relationships (between the federal government and local government agencies), and transportation equipment for shipping commercial spent fuel and HLW to an MRS facility and to a repository.

Currently, OCRWM is sponsoring the development of two types off SNF shipping casks: legal-weight truck (LWT) cask and a rail/barge cask. The legal-weight truck has 2 versions: one with a deign capacity of 4 PWR assemblies and one with a design capacity of 9 BWR assemblies. The rail/barge cask has a design capacity of 21 PWRs or 52 PWRs. The design of special casks for transporting the reprocessed vitrified HLW to the deep geologic repository is underway. Additionally, the ~~multipurpose canister~~ MPC effort is proceeding concurrently with the design of transport only casks.

Currently available casks were designed to carry commercial spent fuel that has not been cooled as long as the fuel that will be transported by DOE. DOE is designing SNF casks that will take advantage of this longer cooling and as a result will carry a greater payload per cask. This greater payload will allow for a substantial reduction in both the risk and cost of the transportation system.

The use of ~~multiple purpose canisters~~ MPC (storage, transportation and disposal) would greatly alter DOE's cask development program.

Low-Level Wastes

Can this be updated to reflect 1994?

Commercial LLW have been transported to commercial shallow-land disposal facilities since 1962. In calendar year 1991 a total of 38,600 m^3 of LLW was shipped to the three existing commercial LLW shallow-land disposal facilities. The total volume of commercial LLW transported to LLW disposal facilities through 1991 was 1,423,000 m^3.

In calendar year 1991, a total of 53,500 m3 of DOE LLW was transported to DOE shallow-land disposal facilities. The total volume of DOE LLW transported to DOE LLW disposal facilities through 1991 was 2,816,000 m3.

SCHEDULE

Spent Fuel and High-Level Wastes

- 1988 - Contracts awarded for legal-weight truck and rail/barge casks for from-reactor shipments of commercial spent fuel
- 1995 - Certification of legal-weight truck and rail/barge transport casks for from-reactor shipments of commercial spent fuel
- 1996 - Fabrication of prototypes completed
- 1998 - First shipments of commercial spent fuel from reactors to a Monitored Retrievable Storage (MRS) facility ?
- 2005 - Certification of rail spent fuel transport casks for commercial spent fuel from the MRS facility
- 2010 - First shipments of commercial spent fuel to geologic repository

Low-Level Wastes

- 1962 -First shipments of ~~low level wastes~~ LLW started to a commercial waste burial facility
- ~~reference to~~ There are currently six LLW sites or seven? (see pg. 29)
- ~~1993/July 1994 deadline~~

Transuranic Wastes

- First shipment of TRU waste to WIPP is scheduled to occur ?

COSTS

Spent Fuel and High-Level Wastes

The estimated costs for transporting spent fuel from commercial nuclear power plants, defense HLW from defense sites, and waste from the MRS facility to the repository are listed below. Costs are in millions of 1988 U.S. dollars, and are total life-cycle costs for transporting 86,800 MTU equivalent of spent fuel and 8,875 MTU equivalent of DOE HLW.

	Millions
Total development costs for transportation system	$ 90
Total transportation costs for commercial spent fuel	2,45
Total transportation costs for defense HLW	35
Decommissioning costs (decon, costs approx. = salvage value)	
Total transportation & development costs, spent fuel & HLW	3,70

Low-Level Wastes

Transportation costs for commercial LLW depend on negotiated contracts with the carriers and are highly variable. In addition, costs are dependent on the part of the country, whether or not shielded casks are needed and numerous other factors. These same factors affect DOE transportation costs.

DECOMMISSIONING CONSIDERATIONS

Next page

Decommissioning of transportation equipment is typically carried out by decontamination to allow subsequent unrestricted use of the equipment or materials that comprise the equipment. The decontaminated materials are then salvaged for re-use. Items such as transportation casks may be converted to other uses such as onsite LLW storage containers. Fixed transportation maintenance and operating facilities are typically decommissioned in a similar manner.

QUALITY ASSURANCE CONSIDERATIONS

~~Quality assurance~~ (QA) requirements for transportation of commercial wastes are established by the NRC and DOT. QA/QC requirements are applicable to all aspects of the transportation system. Each organization that transports a "Greater-than-Type A quantity" of radioactive wastes is required to have an NRC-approved QA program. The QA programs and activities must be audited periodically, and records must be kept for the duration period of the regulatory requirements. Organizations that transport less than a "Type A quantity" of radioactive waste do not need a regulatory-approved QA program, but must control their activities using a modified program as described in NRC and DOT regulations.

SAFETY CONSIDERATIONS

Regulations for commercial transport are generally consistent with the 1985 revised IAEA Transportation Safety Standards. To obtain certification of transport packages by the regulatory authorities, safety may be demonstrated by approved destructive testing or by approved methods of analysis, or by a combination of testing and analysis. Each transportation packaging design is normally recertified by the regulatory authority every five years. Other specific safety requirements are identified below.

Pre-notification of expected arrival time of commercial waste-hauling vehicles at a State border may be required for safety inspections or other purposes if the shipment contains a sufficient amount of radioactivity.

Spent Fuel and High-Level Wastes

Currently, truck shipments require communication with the dispatcher every two hours. Rail shipments are followed through the standard train tracking system. Future shipments will have the capability for continual vehicle contact with base stations using satellite communication systems.

Low-Level Wastes

Some truck shipments of commercial LLW contain sufficient concentrations of radioactive materials to require control of the highway routing for safety purposes.

Is this statement verifiable?

DISPOSAL SYSTEMS

NATIONAL POLICY

Spent Fuel and High-Level Wastes

Under the authority of the NWPA, the DOE has HLW sought to identify a suitable site for geologic disposal of spent fuel and ~~high-level wastes~~. In 1987, three sites (including Yucca Mountain in the State of Nevada) were selected from among nine sites under consideration as potentially acceptable and were recommended as suitable for characterization. Shortly thereafter, Congress amended the NWPA and directed the DOE to characterize only the Yucca Mountain candidate site. If this site is found to be suitable, the Secretary of Energy will submit a report to the President recommending Yucca Mountain for development as a repository. This report must be accompanied by a comprehensive statement of the basis for the recommendation and must include an environmental impact statement. If the President approves, the recommendation will go to the Congress.

After Congress receives the recommendation from the President, the State of Nevada may submit a notice of disapproval to the Congress to prevent selection of the site as a repository. Congress must pass a joint resolution of repository-siting approval in order to overturn the State's notice. If no notice is submitted, or if it is overturned then the site designation will become effective. The State may choose to enter into a benefits agreement with the DOE at any time during site characterization but, in doing so, will forfeit its right to submit the notice of disapproval. Currently, the State of Nevada has declined to enter into any benefits negotiations.

If the Yucca Mountain HLW site designation becomes effective as a repository for spent fuel and ~~high level wastes~~, the DOE must submit a license application to the NRC seeking authorization to construct the repository. If NRC authorization is received, construction may then begin.

The DOE-generated HLW will be disposed of in the same geologic repository as commercial spent fuel and HLW. Also, any DOE spent fuel to be disposed of meeting the waste acceptance criteria of the repository will be disposed with the commercial spent fuel. Other DOE spent fuel that does not meet the waste acceptance criteria will most likely be disposed of in the repository after receiving appropriate treatment.

Low-Level Wastes

The LLRWPAA (1985 Act) requires that each State, either through a compact with one or more other States or individually, provides for safe management and disposal of LLW generated within its borders, according to a defined timetable or incur penalties. Nuclear power plants are required under the Act to meet certain waste volume limits during a seven-year transition period provided for the opening of new disposal sites.

It is the policy of the DOE to manage LLW it generates and to dispose of it at DOE facilities. It is also the policy of DOE to safely manage the mixed LLW (i.e., LLW that also contains hazardous components) it generates. However, mixed waste disposal facilities and capability are not available within the DOE complex to date. Facilities for disposal of DOE mixed LLW are in the planning phases.

Commercial Greater-Than-Class C Low-Level Wastes

Under the ~~Low-Level Radioactive Waste Policy Amendments Act of 1985~~ LLRWPAA, DOE is responsible for disposing of GTCC LLW in a facility licensed by NRC. The small amount of these wastes have radioactivity levels that are generally too high for disposal in near-surface facilities. These wastes, for which DOE is responsible for ultimate disposal, must be disposed of in a deep geologic repository, or other NRC licensed facility. The site and concept for disposal of these wastes is being studied.

Transuranic Wastes

The ~~Waste Isolation Pilot Plant~~ (WIPP) facility has been constructed by DOE for the disposal of DOE transuranic wastes. The WIPP, a deep geologic repository in a bedded salt formation, is entering a "Test Phase" that will determine its suitability to provide safe disposal of the TRU wastes. DOE's revised test plan (1993) has all onsite testing using only simulated ~~transuranic~~ TRU waste; and many of the previously scheduled insitu tests will be done in the laboratory.

Testing will include:

- Bin Tests, which will provide information on gas generation to reduce model uncertainties. Bin tests will be conducted in the WIPP underground test rooms using a phase approach (dry, humid, and inundated. These tests will involve a minimum of 95 55 gallon drum equivalents of waste over a 5-to-7 year period

- Source Term Tests, which will measure concentrations of radionuclides and hazardous constituents in brine. These tests will be conducted at Los Alamos National Laboratory and will involve about 20 55 gallon drum equivalents of waste.

- Alcove Tests, which will collect data on volatile organic compounds and other gases in order to reduce uncertainties from headspace sampling. These tests will be conducted in the WIPP underground in rooms that simulate a real repository environment. Alcove tests will involved a minimum of 1,000 55 gallon drum equivalents of waste.

The designation of WIPP as a permanent disposal facility is dependent upon demonstrated compliance with long-term disposal regulations and EPA certification of such compliance.

REQUIREMENTS

The EPA sets the general standards for the protection of the environment, which includes regulations for disposal of radioactive and other hazardous materials. The NRC is responsible for specific regulations relating to radiation protection and radioactive materials. The NRC radiation protection regulations, which have been amended to be consistent with those of the International Commission on Radiation Protection, are given in 10 CFR Part 20, "Standards for Protection Against Radiation." These regulations establish the general requirements for radiation protection, including general amounts and concentrations of radionuclides that may be released to the environment or disposed of in the ground.

Spent Fuel and High-Level Wastes

The EPA issued environmental standards (40 CFR Part 191) for the management and disposal of spent nuclear fuel, HLW, and TRU wastes in 1985. The regulation was challenged in court and, as a result, the rule was remanded in 1987. Subpart A, which establishes radiation dose standards for repository operations, was reinstated that same year. As directed in the ~~Energy Policy Act of 1992~~, EPA has contracted with ~~the National Academy of Sciences~~ NAS to provide recommendations by the end of 1994 on part of the regulation that establishes the standards to be met following repository closure. The EPA then has until December 31, 1995 to promulgate new standards.

The NRC regulations (10 CFR Part 60) provide the specific requirements that must be addressed in a license application for a repository for commercial spent fuel and ~~high level wastes~~ HLW. In addition to implementing the standards set by the EPA, the regulations require the demonstration of a "multiple barrier" system that provides: 1) a minimum period of 300 to 1,000 years of containment within the waste packages; 2) a maximum fractional release rate of one part in 100,000 per year following the containment period; and 3) a minimum pre-waste-emplacement groundwater travel time

from the underground facility to the accessible environment of 1,000 years. Also, as directed in the ~~Energy Policy Act of 1992~~, the NRC has one year after the EPA promulgation to modify 10 CFR 60 to be consistent with the EPA standards.

* See Insert 2

~~A recent proposed amendment to 10 CFR 60 clarifies the requirements for analysis of "potentially adverse conditions." Currently, DOE must demonstrate each ~~potentially adverse condition~~ has been "adequately investigated." Instead, under the amendment the DOE could show one of three things: 1) the ~~adverse condition~~ does not compromise the ability of the repository to meet waste isolation objectives, 2) the ~~adverse condition~~ was studied in context with other site and design characteristics, or 3) that the ~~potentially adverse condition~~ in combination with other characteristics of site and design, will meet the performance objectives relating to waste isolation.~~

DOE siting guidelines (10 CFR Part 960) identify the factors to be considered in evaluating sites on the basis of the regulatory preclosure and postclosure requirements. It establishes the technical and environmental requirements that a candidate site must meet, and specifies the site evaluation process to be followed by the DOE.

Because DOE-generated HLW and spent fuel will be disposed in the same repository as commercial waste streams of this type, the DOE will be following the same requirements as the commercial sector for the disposal of its comparable wastes.

Low-Level Wastes

The regulations governing the disposal of commercial LLW are found in NRC's regulation 10 CFR 61, "Licensing Requirements for Land Disposal of Radioactive Waste." Specific technical requirements are given for near-surface (up to approximately 30 meters deep) disposal. NRC amended 10CFR61 (1993) to clarify that its regulations ~~extend~~ apply to above ground facilities. The amendment does not provide design guidance for above ground LLW disposal. NRC will develop above ground design criteria on a case by case basis. All facilities, above ground and below ground, will have to meet ~~10CFR61~~ performance objectives in Subpart C of 10 CFR Part 61.

EPA is in the process of developing environmental protection standards for ~~low-level radioactive wastes~~ LLW.

Title 10 CFR Part 61 establishes, among other things, (1) performance objectives for disposal facilities during operations and after closure (including inadvertent intrusion), (2) requirements for institutional controls after closure, (3) technical requirements for near-surface disposal sites and facilities, and (4) definitions of the upper radionuclide limits for the three classes of LLW. Class A wastes are of low concentrations, or decay to low concentrations within 100 years. Thus, no special waste form stability requirements are necessary. Instead, a 100-year institutional control period is ~~assumed to be effective~~ required for ~~ensuring~~ to ensure safe disposal. Classes B&C wastes remain sufficiently hazardous beyond 100 years so that institutional controls cannot be relied on. Special emphasis is placed on ~~waste form~~ structural stability of the waste form or disposal units to ensure safe disposal. Class C wastes also require use of ~~an intruder~~ an engineered barrier ~~because of high existing radiation levels~~ to preclude inadvertent intrusion of individuals into the buried waste.

DOE Order 5820.2A provides the criteria that govern the disposal of DOE LLW at DOE disposal facilities. The Order contains many of the same basic principles in health and environmental protection as the NRC regulations that apply to commercial LLW disposal. Disposal of DOE mixed wastes will comply with the DOE Order and also with appropriate EPA or State requirements for the disposal of hazardous waste.

Commercial Greater-Than-Class C Low-Level Wastes

~~Greater-Than-Class C~~ GTCC ~~low-level wastes~~ LLW may need to be disposed of in a deep geologic repository, or other specially authorized facility that is licensed by NRC. The site and concept for disposal of these wastes is being studied. ~~Greater-than-Class C~~ GTCC wastes are generally not acceptable for disposal in commercial disposal facilities. In the past, however, specific exemptions, issued by the site regulating

authority, have authorized the disposal of some of this material in commercial ~~low-level waste~~ LLW burial grounds.

Transuranic Wastes

DOE Order 5820.2A delineates the requirements that the Department will comply with for disposal of TRU wastes in the WIPP facility. These criteria will be augmented by compliance with the same EPA environmental standard that is imposed on the HLW geologic repository, 40 CFR 191. EPA requirements for the disposal of hazardous wastes are also being complied with, because much of the TRU wastes that require disposal are mixed with hazardous constituents.

SITE SELECTION/CHARACTERIZATION

Spent Fuel and High-Level Wastes

The NWPA, as amended, requires that DOE characterize Yucca Mountain, Nevada, to determine its suitability as a repository. The DOE prepared a Site Characterization Plan (SCP) for Yucca Mountain as required by the NWPA as amended, and released a consultation draft of the SCP in January 1988 for comment by the NRC and the State of Nevada. After revision, the final SCP was issued in December 1988 to the NRC, the State of Nevada, local governments, and the general public for comment. Significant changes made in the SCP as a result of these comments are reported in the semiannual progress reports.

The SCP is a comprehensive document that describes and presents the rationale for more than 100 technical studies comprising approximately 300 activities. More detailed descriptions are provided in separate study plans. The studies outlined in the SCP involve surface-based testing, and underground testing in the exploratory studies facility (ESF), laboratory studies and computer modeling. Results from the studies will be used to conduct quantitative evaluations and performance assessments to evaluate site suitability and satisfy licensing requirements, as well as to refine the repository and waste package designs.

Underground tests will be performed in ~~an exploratory studies facility~~ the (ESF) that will be constructed to provide access to the potential host rock for characterization of it and surrounding rock units. ~~An ESF alternative study to evaluate alternative ESF configurations and construction methods was completed.~~ The ESF ~~will be~~ design is a U-shaped facility with a north entrance ramp, a main cross tunnel, and a south exit ramp. Site preparation for the ESF began November 25,1992 and the starter tunnel excavation began in April 1993. ~~The contract to design and manufacture the tunnel boring machine (TBM) was awarded in May, 1993, and DOE expects to begin tunneling with the TBM in the Spring of 1994.~~ Excavation will be by a tunnel boring machine (TBM). The TBM will be delivered to the site in Spring 1994, and excavation with the TBM is expected to begin in Aug. 1994.

Early site suitability evaluation is also a critical part of the site characterization process. The DOE is presently focusing on those features or conditions that might indicate that the candidate site would not be suitable as a repository. If no disqualifying conditions are discovered during the initial evaluation process, additional suitability evaluations will be performed at appropriate intervals throughout the duration of site characterization. In January 1992, an early partial site suitability evaluation relative to the DOE siting guidelines was completed by an interdisciplinary team of 17 experts. The study concluded that 14 of the 18 possible disqualification conditions are not present at the Yucca Mountain site, and that additional information is needed before the Yucca Mountain site could be evaluated for the remaining possible disqualification conditions. The evaluation team also found that nine of the 24 qualification features in the siting guidelines are present. Further information is required to evaluate the site relative to the remaining 15 qualifying conditions.

Delete (may not be applicable any longer)

DOE began limited surface-based site characterization studies at Yucca Mountain in July 1991. The final permit (water) from the State of Nevada for site characterization work was received in March 1992. ~~and DOE is now preparing for full scale characterization. In U.S. Fiscal Year (FY) 1992, 20 boreholes and 26~~ Since then, DOE has begun full-scale, surface-based site characterization with various drilling, trenching, mapping and sampling activities.

and a second large-diameter dry-drilled hole was begun.

~~exploratory trenches were completed at Yucca Mountain.~~ Dry drilling of UZ-16 (523 meters) was completed during fiscal year 1993. Shallow neutron drill holes continue to aid the understanding of the unsaturated zone hydrology at Yucca Mountain. Trenching across suspected fault zones will aid in the understanding of the age and degree of fault movement.

Low-Level Wastes

Selection of a commercial LLW disposal site is the responsibility of States and compact regions. Selection of a site is done through a screening process which requires characterization of available land and comparison of the potential sites with the NRC criteria in 10 CFR 61. Currently, ~~most~~ sites are either in the characterization or licensing phase in California, ~~Illinois~~, Nebraska, North Carolina and Texas. California's Ward Valley site completed the characterization and licensing phase in 1993 and is awaiting Federal to State land transfer. ~~After a long, tedious, and expensive characterization effort, the Martinsville, Illinois site was denied a license~~.

Careful site selection and characterization is performed by the DOE for disposal facilities for DOE LLW and mixed LLW. These sites are purposely selected from candidate sites on DOE facility land, because it is the policy of the DOE to dispose of its own LLW streams.

Transuranic Wastes

The site of the WIPP facility was carefully selected for disposal of DOE TRU ~~transuranic~~ wastes because of the unique characteristics of the salt rock formation in which the facility is constructed. Prior to placement of any waste in the facility, many years of characterization and testing have taken place, and the facility is being prepared to undergo a test phase..... EPA/DOE UPDATE NEEDED HERE

UNDERGROUND TESTING

Spent Fuel and High-Level Wastes

The Yucca Mountain site was recognized in the late 1970's as a possible site for an underground repository. As a result, the Nevada Nuclear Waste Storage Investigations program was initiated in 1977. Underground testing was performed in both tuff and granite. Experiments were conducted to obtain data on radionuclide migration and rock mechanics in tuff. In the early 1980's, 11 canisters of spent fuel were placed in a granite test facility 1400 ft below the surface within the Climax granite stock (the test program called "Spent Fuel Test - Climax") to evaluate granite as a medium for deep geologic disposal and as a general demonstration of geologic disposal of spent fuel and HLW. In 1980 through 1988, G-tunnel (on the Nevada Test Site) was the site of active underground testing and equipment prototyping. A key part of this work was the set of ~~excellerated~~ accelerated heater experiments, which were the first such tests done in an unsaturated tuff environment (UCRL-ID-106159).

During detailed site characterization at the Yucca Mountain site, the ~~an Exploratory Studies Facility~~ (ESF) will be constructed for in-situ testing. A long term heater test is scheduled to take place to increase confidence in the understanding of coupled processes (thermal-hydrologic-mechanical-chemical), which will be important during the licensing process. Prior to the underground heater test, DOE will be conducting a prototype heater test in surface rock at Fran Ridge, located approximately 1 km east of Yucca Mountain.

Low-Level Wastes

Extensive R&D has been done to develop an understanding of the characteristics of existing disposal sites for commercial LLW and of potential improvements at these sites. ~~No plans currently exist for construction and use of a research facility to characterize a potential new site; although the NRC has a research facility in Beltsville, Maryland where it is testing the use of capillary engineered barriers underground.~~ Each State that hosts a LLW disposal site is responsible for developing its own plans for site characterization, and to carry out site characterization activities in preparing an application for the selected site.

Transuranic Wastes

The WIPP facility is being prepared to undergo a five-year test phase which will involve underground tests of the facility's performance with actual TRU wastes emplaced (in a retrievable manner, if retrieval becomes necessary) in the facility. The purpose of this test phase is to demonstrate the safe disposal of the TRU wastes in WIPP and allow it to be opened for disposal of all DOE-generated TRU waste needing environmentally safe disposal.

DISPOSAL CONCEPTS - DISPOSAL FACILITY DESCRIPTION

Spent Fuel and High-Level Wastes

The Yucca Mountain candidate site is located in southern Nevada, approximately 100 miles northwest of Las Vegas. The region is arid with sparse vegetation and few people. If the site is suitable, the repository will be constructed in densely welded ash-flow tuff about 1000 ft below the ground surface. Because the water table is very deep at the candidate site, it will be possible to construct the repository in the unsaturated zone, approximately 600 to 1300 ft above the water table.

The repository for spent fuel and HLW will resemble a mine with both surface and underground facilities. Based on current design concepts, the surface facilities will receive, handle and package the wastes and transfer the wastes down to the underground disposal galleries. The surface facilities would be connected to the underground area of the repository through two ramps and one possible shaft. The wastes would be transferred down the ramp and along horizontal passageways (drifts) to waste-emplacement panels consisting of a number of disposal rooms. In the reference conceptual design, vertical holes would be bored into the floor of these rooms and the waste containers would be inserted into them. Other methods, such as horizontal in-borehole emplacement, and in-drift emplacement are possible alternative approaches that are still being considered. Underground development and waste emplacement will proceed simultaneously with sufficient separation between the development and emplacement operations to ensure that construction workers are isolated from the waste-handling activities.

Low-Level Wastes

does this include Enrichment?

A total of seven shallow-land disposal facilities for commercial LLW wastes have been sited, developed and operated; of these, four are no longer operational. Near-surface disposal in excavated trenches is presently in general use at the past and currently-operating sites for commercial Class A LLW. Classes B and C LLW are disposed of in similar but separate trenches. ~~or in isolated parts of the same trenches~~. Class C LLW are disposed of with a minimum of 5 m cover ~~and are typically backfilled, in part, with concrete~~ to provide additional intruder protection. or with an engineered (e.g., concrete barrier)

Several alternative disposal concepts are currently being considered by the States and compacts for new commercial disposal facilities using engineering methods such as below-ground vaults and earth-mounded concrete bunkers. It is expected that future disposal facilities will likely incorporate engineered barriers to a greater extent than do currently operating facilities.

The DOE has six facilities for the disposal of its LLW. The facilities are located at Savannah River, Oak Ridge, the Nevada Test Site, the Los Alamos National Laboratory, the Idaho National Engineering Laboratory, and Hanford. There are several disposal designs used at these facilities for the disposal of LLW that include: shallow land burial trenches, below ground vaults, tumuli, above-ground vaults, and deep shaft disposal. DOE is currently developing plans for mixed LLW treatment in response to Federal Facilities Compliance Act of 1992. This will impact the types and locations of DOE mixed LLW disposal.

Commercial Greater-Than-Class C Low-Level Wastes

Next Page

The disposal concept and the site for disposal of ~~Greater-than-Class C~~ GTCC LLW have not been determined. However, regulations require that disposal be in a deep geologic formation or other suitable special type of facility.

Transuranic Wastes

The WIPP deep geologic facility for disposal of DOE-generated ~~transuranic~~ TRU wastes is designed and constructed very similarly to the proposed design of the HLW repository. WIPP resembles a mine with above-ground and below-ground facilities. The underground facilities are constructed in a salt formation a little more than 2000 feet below the surface in New Mexico. A separate area of the facility has been used to conduct the tests and experiments to demonstrate the technology, while the actual disposal area remains undisturbed awaiting real TRU wastes for disposal.

DISPOSAL CONCEPTS - WASTE RECEIPT AND HANDLING

Spent Fuel and High-Level Wastes

In the reference conceptual design, commercial spent fuel and HLW will be received at the surface facility in interim storage racks in a hot cell. Subsequently the spent fuel and HLW will be encapsulated in disposal containers and transferred underground to be emplaced in disposal rooms. The repository design will provide the capability for retrieval at any time for up to 50 years after the start of waste package emplacement. If ~~multiple purpose canisters~~ MPCs, suitable for disposal, are chosen for the Civilian Radioactive Waste Program as a whole, then the functions for this type of above ground facility will be modified.

Low-Level Wastes

For current disposal of commercial LLW, the waste packages are usually unloaded from the transport vehicle onto an onsite trailer or platform by fork lift and crane. Temporary shielding may be used to handle wastes with high radiation levels. Waste packages with high radiation levels are usually placed near the bottom and center of the trench to allow the shielding from surrounding packages. Partially-filled trenches are typically backfilled periodically to minimize exposure of the waste packages to the elements, and to minimize possible exposures to disposal facility personnel.

DISPOSAL CONCEPTS - WASTE PACKAGE

Spent Fuel and High-Level Wastes

If a repository is developed at the Yucca Mountain candidate site, the principal engineered barrier will be the waste package which will be designed to meet various functional and regulatory requirements. For the postclosure period, these requirements include providing substantially complete containment for the waste for at least 300 to 1000 years and thereafter controlling the rate of release from the engineered-barrier system to a small fraction of the inventory present at 1000 years after closure of the repository.

The current advanced conceptual design for both waste types will utilize a multi-barrier design approach. Several materials are being considered including corrosion resistant and corrosion tolerant types. The primary list is as follows: low carbon/iron-based alloys, Cast iron/mild steel, iron-silicon base alloy, Ti12, Hastelloy C4, and Inconnel 825. The secondary list being considered is as follows: Stainless Steel 316L and Cu-alloy (Cupronickel 70-30). Again, the use of ~~multi-purpose containers~~ MPCs would alter current conceptual designs. Several proposed options for waste packages that are being evaluated provide substantially complete containment of radionuclides for a very long time period (perhaps thousands of years).

The HLW form is monolithic borosilicate glass cast into a stainless steel canister 3.00 meters tall and 0.60 meters outside diameter, with 1 centimeter thick walls. The bottom is dished, the top is flared to accept a cap, and the seams are

welded. the filling nozzle is sealed with a plug by pressure and electrical resistance welding. Nominally, each canister will be at least 80% full and contain about 2 metric tons of borosilicate glass having about 100,000 curies of activity (mostly strontium-90 and cesium-137).

Low-Level Wastes

Commercial LLW packages disposed of in near-surface disposal facilities cannot be made of cardboard or fiberboard (NRC 10 CFR 61.56). The most common LLW package is the 55-gallon steel drum (208-liters, with wall thickness ca. 0.12 cm) that is painted, galvanized, or plastic-coated. Recently, 55-gallon drums comprised about 75% of all the LLW packages, but accounted for less than 20% of the waste volumes that are disposed. Other sizes of steel drums are also used, ranging from 5 gallons to 80 gallons. In addition, cylindrical containers made of plastic, fiberglass-plastic, and reinforced concrete are used, particularly for Classes B and C wastes ranging in size from 30 gallons to about 500 gallons.

DOE packages its LLW in many of the same containers that are used by the commercial disposal facilities. 55-gallon and 30-gallon steel drums are common containers used for disposal of LLW, and a rectangular metal box of approximate dimensions of 4 feet x 4 feet x 7 feet is also used quite regularly for disposal of DOE LLW. Mixed LLW will likely be packaged in similar containers for disposal when capability for its disposal becomes available.

Transuranic Wastes

DOE has packaged its TRU wastes in many of the standard containers known throughout the radioactive waste industry. 55-gallon drums and standard metallic waste boxes with approximate dimensions of 4 feet x 4 feet x 7 feet are used most commonly for packaging of TRU wastes. Other containers are used for odd shaped wastes or for wastes with extremely high surface radiation levels.

DISPOSAL CONCEPTS - BUFFER AND BACKFILL

Spent Fuel and High-Level Wastes

Under the reference design concept, no buffer material will be used around the waste packages (with either spent fuel or HLW) at the Yucca Mountain site because the waste package is designed to be surrounded by an air gap. Alternatives to this reference design concept are being evaluated. If drift emplacement is selected, the drifts may be backfilled prior to permanent closure. The permanent closure of the repository would require the sealing of all shafts, ramps, boreholes, and other underground openings to reduce, to the extent practicable, the potential for creating preferential pathways for groundwater or radionuclide migration.

Low-Level Wastes

No buffer materials are used around packages for commercial LLW in the ~~three~~ two currently operating commercial ~~low-level waste~~ LLW disposal facilities. Backfill is typically the soil material that was excavated to make the disposal trenches. NRC is currently evaluating the use of backfill as a capillary barrier to minimize water infiltration. In some cases for Class C wastes, cement backfill is used around the waste package to enhance intruder protection. For DOE ~~low-level wastes,~~ LLW buffer materials are also typically not used.

DISPOSAL CONCEPTS - TEMPERATURE AND PRESSURE

Spent Fuel and High-Level Wastes

DOE is currently examining the effects of thermal loading on the waste package and repository environment, both near- and far-field. The engineered-barrier system is being designed to meet the performance objectives of the NRC's regulations. The

appropriate thermal loading will be determined by the DOE considering licensing and safety implications, restrictions on operations, rock stability, and long term corrosion effects of water on the waste packages. Thermal tests are planned for the ESF (drift scale), surface based (large block test), and the laboratory (small block tests). For the far-field (i.e., regional-scale), the temperature increases will be tentatively limited to temperatures of about 5°C in the aquifer and 0.5°C in the earth surface. Further evaluation is underway to determine if these tentative limits are appropriate.

Low-Level Wastes

LLW commercial disposal facilities have no temperature requirements. Class A LLW have no specific structural requirements except they must withstand the forces of normal operations. Commercial Classes B and C LLW are required to maintain gross physical properties and identity for 300 years, and are required to maintain structural integrity under expected disposal conditions such as weight of overburden. High-integrity containers (~~Hick~~) for Classes B and C LLW must meet the waste form stability requirements. HICs

DISPOSAL CONCEPTS - DECOMMISSIONING

Spent Fuel and High-Level Wastes

After the repository has been filled and the caretaker and performance-confirmation program (about 25 years) has been completed, the DOE plans to submit to the NRC an application for a license amendment to close the repository. After NRC approval, the DOE will seal the repository and decommission the surface facilities. Repository shafts will be sealed; surface facilities will be decontaminated and dismantled; the mined rock that is not used in backfilling will be stabilized or moved off the site; the surface area will be returned to its original natural condition to the extent feasible; and permanent markers will be erected.

Low-Level Wastes

The operator or D&D holder of the license for a commercial LLW disposal facility must ~~dismantle/decontaminate~~ surface facilities to the extent defined in the site closure plan provided in the original license application. The disposal facility operator must show by measurements and modeling that the closed facility will meet regulatory requirements without active controls. Permanent markers must show locations of all burial trenches. A passive site surveillance system must be installed that requires minimum maintenance. The disposal facility is turned over to the State or federal landowner for custodial care for a minimum 100-year institutional-control period.

DOE imposes similar requirements on the commercial sector as defined in DOE Order 5820.2A.

DISPOSAL CONCEPTS - POSTCLOSURE

Spent Fuel and High-Level Wastes

The regulation 10 CFR 60 requires that a description of the program for monitoring of the repository during the postclosure period be included in the license amendment for permanent closure. However, the performance confirmation of the repository will be carried out during the potential retrieval period (through the period of caretaking and performance confirmation, about 25 years after emplacement has stopped). Because this performance confirmation program is expected to provide final assessment of repository performance, additional monitoring subsequent to postclosure is not expected to be necessary.

Low-Level Wastes Next Page

For commercial LLW disposal facilities, post-closure activities by the State custodian for the duration of institutional control will involve periodic visits, inspections, maintenance (if any), and environmental monitoring of the performance of the site. The period of institutional control will be determined by the NRC or the agreement State, but may not be relied upon for more than 100 years in evaluating the license application.

The principles and requirements in the DOE Order 5820.2A are relative to post-closure of DOE LLW disposal facilities are similar to the requirements that apply to the commercial disposal facilities. For the DOE facilities, the federal government will continue to be the custodian in charge of care of the closed facilities.

SCHEDULE

Spent Fuel and High-Level Wastes

- 1988 - Site Characterization Plan was issued for the Yucca Mountain site for evaluation as a repository
- 1991 - Start comprehensive surface-based testing at Yucca Mountain
- 1992 - Start site preparation for the ESF
- 1993 - Start portal construction of the ESF
- 1994 - Start ramp/drift construction of the ESF with the TBM
- 1996 - Begin in-situ testing in the ESF
- 2001 - If site is suitable, submit license application to NRC
- 2004 - Receive construction authorization from NRC for repository and start construction
- 2010 - Start (Phase I operations) at repository

Has this date been delayed to 2013?

What are these operations?

Low-Level Wastes

~~Two~~ Three sites are currently operating for disposal of commercial LLW, and the plans for additional sites vary from state to state. The ~~Low Level Radioactive Waste Policy Amendments Act of 1985~~ LLRWPAA establishes a schedule that each State must meet for commercial LLW or face penalties. See the Overview Section, under the "Overall Schedule" subsection, given earlier for specific dates.

~~Six~~ Seven DOE disposal sites are currently operating, with no new sites currently planned.

COSTS

Spent Fuel and High-Level Wastes

The following are the estimated total life-cycle costs to site, develop, construct operate, and decommission the repository based on the schedule presented in the previous section. The costs are for a single repository system based on the no-new-orders and end-of-reactor-life spent-fuel projection and intact disposal.

Estimated Repository Costs
(in Millions of 1988 Dollars)

Next page

Development & Evaluation	$ 6,700
Engineering & Construction	1,200
Operation	7,100
Decommissioning	500
TOTAL	$15,500

Low-Level Wastes

Costs for commercial LLW disposal vary due to differences in disposal facility concepts, capacities, management practices, State fees and surcharges, number and size of waste packages, and the characteristics of the radioactive wastes received.

The following cost estimates were made (which includes pre-operating, operating, closure, and post-operating costs) for each general type of commercial LLW disposal facility in a study comparing alternative disposal systems for 8,800,000 ft^3 of commercial LLW over a 30-year period.

Estimated Commercial LLW Disposal Facility Costs
(in millions of 1986 Dollars)

Near-Surface Burial	406
Intermediate-Depth Disposal	421
Below-Ground Vault	617
Above-Ground Vault	790
Modular Concrete Canisters	630
Earth-Mounded Concrete Bunker	893

RADIATION PROTECTION

During the operational period, releases of radioactive materials to the general environment from a repository for commercial LLW disposal facilities must not result in an annual dose to any member of the public in excess of 25 mrems to the whole body, 75 mrems to the thyroid, and 25 mrems to any other critical organ. Occupational doses at repositories are limited to values indicated in NRC regulations 10 CFR 20, revised in 1991. Occupational doses are limited to a total effective dose equivalent of 5 rem/yr (0.05 Sv). However, the principle of ALARA (As Low as Reasonably Achievable) must also be applied, and occupational doses significantly below this value are anticipated.

The allowable releases from a DOE LLW disposal facility, specified in DOE Order 5820.2A, are similar to the criteria that are applicable to commercial facilities. However, the performance objectives that are in the Order for DOE LLW disposal facilities utilize a newer dose assessment methodology than the NRC requirements for commercial LLW disposal facilities, so there are slight differences. The Order allows an annual dose to any member of the public to be 25 mrem/yr effective dose equivalent (EDE), and also specifies a maximum dose to the inadvertent intruder of 100 mrem/yr EDE, or 500 mrem from an acute exposure.

QUALITY ASSURANCE CONSIDERATIONS

Spent Fuel and High-Level Wastes

The NRC's regulation 10 CFR 60 mandates that the general ~~Quality Assurance~~ QA criteria in NRC's regulation 10 CFR 50, Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Facilities," shall be applied to disposal of commercial spent fuel and HLW. An extensive program AS APPLICABLE, has been developed by DOE to

HLW

assure quality in the total commercial system for managing spent fuel and ~~high-level wastes~~.

A major goal in the commercial waste management activities is to sustain a high level of quality, both technically and administratively, in all activities. This concept is referred to as "Managing for Quality," and QA is an important aspect of this broad concept. QA includes elements of management planning and control, verification, and overview. QA elements are systematically and selectively applied in a formal and auditable QA program that is designed to: (1) validate the program compliance with regulatory and other programmatic requirements and standards; and 2) validate that the program has demonstrated the technical appropriateness, adequacy, and completeness.

Low-Level Wastes

A stringent QA plan, approved by the regulatory agencies, must be in effect for all commercial disposal facility siting, verification, evaluation, design and construction, operations, and decommissioning.

DOE operates all of their disposal facilities in strict compliance with detailed QA requirements specified in DOE Order 5700.6C. DOE Order 5820.2A references DOE Order 5700 as the applicable QA requirements.

SAFETY CONSIDERATIONS

Spent Fuel and High-Level Wastes

Analytical techniques developed for and successfully used in the radiological assessment and licensing of other nuclear facilities are being used for estimating public and occupational radiation doses from waste disposal facilities. For long-term safety, performance assessment includes estimation of the potential release of radionuclides to ensure that release levels and resulting environmental impacts are below the NRC criteria and EPA standards. All commercial spent fuel and HLW storage, transportation, and disposal facilities and activities are monitored by the NRC.

Commercial Greater-than-Class C Low-Level Wastes

Stringent industrial and radiological safety requirements are dictated by the federal, DOE, or State agencies responsible for regulating the various aspects of commercial ~~Greater-than-Class-C wastes.~~ GTCC

Low-Level Wastes

All commercial LLW disposal activities are monitored by regulatory personnel from the NRC or the agreement State, and by other regulatory and enforcement organizations to ensure that facility activities conform to applicable industrial (OSHA) and radiological safety regulations (10CFR Part 20).

DOE LLW disposal activities are monitored by DOE in accordance with the environmental monitoring requirements of DOE Order 5820.2A.

REFERENCES

1. 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," amended through January 1991.

2. 10 CFR Part 72, "Independent Spent Fuel Storage Facility Licenses," amended through January 1991.

3. 10 CFR 50 Appendix B, "Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Facilities," July 1985.

4. 10 CFR Part 20, "Standards for Protection Against Radiation," amended in May, 1991.

5. 10 CFR 71, "Packaging and Transportation of Radioactive Material," amended through January 1991.

6. 10 CFR 72, "Licensing Requirements for Independent Storage of Spent Fuel and High Level Radioactive Waste," 1991.

7. 40 CFR Part 191, "Environmental Radiation Protection Standards for the Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes," August 1985.

8. 10 CFR Part 60, "Disposal of High-Level Wastes in Geologic Repositories," amended through January 1991.

9. 10 CFR Part 960, "Nuclear Waste Policy Act General Guidelines for the Recommendations of Sites for the Nuclear Waste Repositories," December 1984.

10. Prototype Engineered Barrier System Field test (PEBSFT) Final Report (A.L. Ramirez Ed.)1991."

AGENDA ITEM #10

RADIOACTIVE WASTE MANAGEMENT IN THE UNITED STATES

Insert 1 - Page 5, 2nd paragraph (add the following)

- Directs EPA to develop standards specifically for Yucca Mountain based on and consistent with the findings and recommendations of NAS
- Directs NRC to amend its rules as necessary to be consistent with the EPA standards.
- Directs DOE to provide post-closure oversight of Yucca Mountain to prevent breaching of the repository or radiation exposures above allowable limits.
- Directs DOE to prepare (in consultation with NRC and EPA) a study of current waste management programs and plans to determine the adequacy for any additional wastes that might be generated by new nuclear power plants.

AGENDA ITEM #10

RADIOACTIVE WASTE MANAGEMENT IN THE UNITED STATES

Insert 2 - Page 26, 2nd paragraph (replace with following)

A recently proposed amendment to 10 CFR Part 60 clarifies the requirements for the investigation and evaluation of potentially adverse conditions (PACs) and their relationship to post-closure performance objectives. Currently, DOE must show that a PAC has been "adequately investigated" and "adequately evaluated." The proposed rule clarifies this language by requiring DOE show that the presence of a PAC does not compromise the ability of the repository to meet the performance objectives related to isolation of the waste. The proposed rule also clarifies that the effect of a particular condition is not to be studied in isolation, but in the context of other characteristics of the site and design.

U.S. NUCLEAR REGULATORY COMMISSION

Regulatory Development Activities

During this fiscal year, the NRC continued to take steps to ensure that the regulations governing high-level waste (HLW) disposal (10 CFR Part 60) were clear and complete. In particular, a July 1993 proposed amendment to 10 CFR Part 60, clarifies the requirements for investigation and evaluation of certain potentially adverse conditions which are listed in the regulation and their relationship to post-closure performance objectives. Currently, to show that a particular potentially adverse condition would not compromise the repository, DOE must demonstrate that it has been "adequately investigated" and that the effect of the condition has been "adequately evaluated." The proposed rule clarifies this language. It would require that DOE show that the presence of the potentially adverse conditions does not compromise the ability of the repository to meet the performance objectives related to isolation of the waste. Another uncertainty addressed by the proposed rule is the relationship of particular potentially adverse conditions to the ability of the site to isolate waste after permanent closure. The proposed change would clearly indicate that the effect of a particular condition is not to be studied individually, but in the context of other characteristics of the site and design.

The Energy Policy Act (EnPA) of 1992 requires the National Academy of Science (NAS) to conduct a study and make a finding and recommendation on reasonable standards. The NAS is expected to complete the activity by December 31, 1994. Within one year after the NAS recommendation is made, the Environmental Protection Agency (EPA) must promulgate new standards consistent with the NAS recommendations. The NRC staff is interacting with NAS as NAS conducts its study. The EnPA also requires that within one year of the promulgation of the EPA standards, NRC must amend its regulation to be consistent with those of EPA.

Interim Surface Storage

During 1993, the NRC permitted at reactor dry fuel storage at several new reactor sites. Northern States Power was authorized, pending Minnesota State Legislature approval for use of up to 48 Transnuclear TN-40 dry storage casks. Both Carolina Power and Light's H.B. Robinson Unit 2 independent spent fuel storage installation (ISFSI) and the Duke Power's Oconee Nuclear Station were exempted from certain instrumentation requirements that limited on-site dry storage capability.

In addition, in August 1993, the NRC published a proposed rule change to 10 CFR 72: "Notification of Events at Independent Spent Fuel Storage Installations and the Monitored Retrievable Storage Installation." The proposed rule will ensure that significant occurrences at ISFSIs and the MRS, such as failure of safety equipment, contamination events, personal injuries, and fires and explosions, are reported quickly to the NRC so that the NRC can protect the health and safety of the public.

Regulatory Guidance Activities

During this reporting period, the NRC staff issued a draft Staff Technical Position (STP) that addresses those situations in which faults of regulatory concern exist or are assumed to exist at the location of systems, structures, and components important to safety or important to waste isolation. Specifically, this STP, entitled "Consideration of Fault Displacement Hazards in Geologic Repository Design," recognizes the acceptability of designing the geologic repository to take into account the attendant effects (e.g., displacement) of faults of regulatory concern and expresses the staff's views on what is needed, from DOE, if DOE chooses to locate structures, systems, and components important to safety or important to waste isolation in areas that contain faults with Quaternary-age displacement. The intent of this STP is to encourage DOE to seek early resolution of fault-related design and performance issues, at the staff level, before submitting a license application to construct and operate a geologic repository. STPs provide guidance to DOE for selected topics, in the form of criteria for methods acceptable to the NRC staff for demonstrating compliance with 10 CFR Part 60.

Technical Assessment Capability for Repository Licensing Reviews

The NRC staff continued with the preparation of the draft License Application Review Plan (LARP) during this reporting period. The LARP, designated NUREG-1323, will provide guidance to the NRC staff who will review DOE's license application to construct and operate a geologic repository. The LARP is intended to ensure the quality and uniformity of the staff reviews and establishes the appropriate review priorities, and presents a well-defined base from which to evaluate proposed changes in the scope and requirements of the staff reviews. Because of the exploratory and evolving nature of the geologic repository program, as well as the need for flexibility under these conditions, the staff is preparing the draft LARP early and in an iterative manner. Accomplishments during this reporting period relative to LARP development included identification of the applicable 10 CFR Part 60 regulatory requirements defining the individual 97 review plans comprising the LARP, preparation of the Review Strategy Section for 93 individual review plans, and completion of all remaining sections of two individual review plans (i.e., review procedures/acceptance criteria, implementation, and staff evaluation findings).

To enhance the staff's ability to review a potential DOE license application, as part of the LARP, the staff expanded and improved its capability to independently conduct total-system performance assessments (TSPAs). Such assessments will be used by DOE to show compliance with 10 CFR Part 60, which includes by reference the EPA radiation protection standard -- 40 CFR Part 191. For its part, the staff will use its technical assessment capability to review DOE's performance assessments and other aspects of the DOE HLW program. The staff is documenting the results of the demonstration of the second phase of this capability in NUREG-1323. These improvements include preparation of an executive module to control and operate the computational modules comprising the total-system performance assessment computer code, the use of a much more mechanistic and detailed source term model and computer code, more

refined modeling of flow and transport in both saturated and unsaturated media including the addition of gas flow (e.g., ^{14}C) to the transport analysis, the inclusion of seismic and magmatic disruptive scenarios, and the addition of a dose assessment capability to the TSPA. Many of the improvements to the staff's analysis were based, in part, on the preliminary recommendations made as a result of the insights gained from the first phase of the effort undertaken in 1991.

Yucca Mountain Site Characterization Analysis

Activities at Yucca Mountain increased substantially this year, following the receipt of appropriate permits from the State of Nevada. In April 1993, excavation of the north portal tunnel/ramp of the Exploratory Studies Facility (ESF) began at Exile Hill, east of Yucca Mountain. Construction of the first 200 feet (approximately), completed in September 1993, will serve as a launching chamber for a tunnel boring machine (TBM) to be delivered to the site in April 1994. DOE will use the TBM to excavate the subsurface facilities (ramps, drifts, and tunnels). DOE plans to begin excavation of the north portal tunnel with the TBM in August 1994. DOE also began numerous borehole, trenching, mapping, and sampling activities at the site, as well as continuing similar on-going activities. NRC staff participated in several site visits to observe ESF excavation activities, trenching, and drilling, and to examine data gathered from trenching and drilling activities.

During this year, the NRC staff also reviewed a DOE report on the status of volcanism studies for site characterization. The staff met with DOE to discuss its review in June 1993, and later provided comments to DOE in a letter of August 1993.

In December 1992, DOE submitted two progress reports (Numbers 6 and 7) on the scientific investigation program for the Yucca Mountain site (known as Site Characterization Plan Progress Reports). Such reports, mandated at six-month intervals by the NWPA and 10 CFR Part 60, are to address progress, results, and changes in DOE's site characterization program, including site investigations, repository and waste package designs, and performance assessments. Following its review of these progress reports, in May 1993, NRC transmitted comments to DOE regarding the contents of these reports and future reports.

In September 1993, DOE submitted Progress Report Number 8. This report is currently under review by the staff.

DOE's Site Characterization Plan consists of 104 individual studies, each of which are written as a separate study plan. The NRC staff reviews each of these study plans against the level of detail agreement and conducts a review to determine if activities proposed in the study plan will have any adverse impacts on the site's ability to isolate waste or the ability to gather data from other proposed and necessary tests to be conducted at the site. If such adverse impacts were identified, the staff would recommend DOE not start work in that area until the concern, called an "objection," was resolved. If warranted, the staff also conducts a technical review of study plans which may

result in written comments and questions that are considered to be open items to be addressed by DOE prior to submittal of the LA.

To date, the staff has received approximately 56 study plans and has provided DOE with reviews of 50 of those submitted. The staff identified no reasons to object to start-up of activities related to any reviewed study plan, but conveyed comments and questions to DOE related to 10 of the study plans reviewed.

As a result of its review of DOE's Site Characterization Plan, the NRC staff, in its Site Characterization Analysis (SCA), dated August 1989, identified concerns, including two objections, related to DOE's planned studies for site characterization. Objection 2, related to DOE's quality assurance (QA) program, was lifted in March of 1992. On November 2, 1992, the NRC staff notified DOE that SCA Objection 1, related to the adequacy of DOE's exploratory studies facility design control process and ESF design, was lifted. The lifting of these two objections was considered to be a major milestone as it enabled DOE to begin data collection activities under NRC accepted QA programs and to begin work on the ESF north portal.

During fiscal year 1993, the NRC and DOE have revised agreements important to conducting pre-licensing activities and interactions. The first of these, the "Procedural Agreement Between the Nuclear Regulatory Commission and the U.S. Department of Energy Identifying Guiding Principles for Interface During Geologic Site Investigation and Site Characterization" (Procedural Agreement), and the "Agreement Between the U.S. Department of Energy Office of Civilian Radioactive Waste Management and the Nuclear Regulatory Commission Division of High-Level Waste Management During Site Characterization Programs and Prior to the Submittal of an Application for Authorization to Construct a Repository" (Project-Specific Agreement) outline the revised procedures for staff consultation and exchange of information which NRC, DOE, and DOE's designated contractors will observe in connection with the site characterization phase of the HLW program. Changes to these agreements included additions to or revisions of guidelines for conducting interactions, preparing interactions reports, maintaining and distributing site characterization data, communications between points of contact, acquisition of samples during site characterization activities by NRC contractors, and NRC on-site representative responsibilities and authority.

In February 1993, the NRC and DOE, at DOE's request, revised the agreement defining the level of detail to be found in site characterization study plans submitted by DOE. The new agreement makes the requirements for content of study plans written by DOE scientists better fit the need of the study and eliminates unneeded requirements. The State of Nevada and local governments also participated in the revisions to the agreement. In conjunction with the revised level of detail agreement, the staff completed a revision to its Study Plan Review Plan that will expedite study plan reviews and increase review efficiency.

Interaction with Affected Governmental Units and Indian Tribes

The State of Nevada and local representatives continued to participate in the technical exchanges and meetings between NRC and DOE. State, local, and Tribal representatives also continued to receive notification of upcoming NRC/DOE HLW meetings, as well as NRC advisory Committee on Nuclear Waste meetings. In addition, each party continues to receive all correspondence and NRC publicly available reports relative to the HLW program.

Quality Assurance Activities

The NRC staff continued its reviews of DOE's and DOE contractors' quality assurance (QA) plans and procedures (document reviews), evaluation of DOE effectiveness in auditing its program to identify and correct problems in program implementation, and evaluations of DOE contractor effectiveness in implementing QA programs. Work in this area for fiscal year 1993 included review of revisions to QA plans accepted in previous years. DOE is in the process of revising its QA manual in the form of a topical report, which will be referenced by all participants. To conduct its evaluation of DOE effectiveness in auditing, and DOE contractor effectiveness in QA program implementation, the NRC staff conducted observations of DOE audits. The DOE audits were conducted at all major DOE contractor organizations participating in the site characterization program for the Yucca Mountain Project. Formal NRC staff reports were issued for all of the audit observations, and DOE will be required to respond to those reports, where improvements are needed.

In August 1993, the NRC staff identified to DOE concerns in design control and the design process for the ESF starter tunnel. DOE has developed a plan to resolve the NRC concerns and DOE-identified problems, and is presently implementing a recovery program.

Center for Nuclear Waste Regulatory Analyses

The Center for Nuclear Waste Regulatory Analyses (CNWRA), an NRC-sponsored federally funded research and development center, completed its sixth year of operation in October 1993. The level of technical assistance and research support that the CNWRA provided to the NRC continued, pursuant to its fundamental mission of providing sustained special expertise in a broad range of engineering and scientific disciplines to support the NRC HLW program, under the Nuclear Waste Policy Act (NWPA) of 1982, as amended. The CNWRA provided an extensive range of support to both the Office of Nuclear Material Safety and Safeguards and the Office of Nuclear Regulatory Research. CNWRA staff are located at the Southwest Research Institute campus in San Antonio, Texas, and at the Washington Technical Support Office in Arlington, Virginia.

A primary focus of the CNWRA and NRC staffs continued to be development and implementation of a computer-assisted "systems engineering approach," called the Systematic Regulatory Analysis (SRA). SRA is used to identify and reduce uncertainties in the program, to select strategies and methods for determining compliance with NRC regulatory requirements, and to define issues related to

licensing a HLW geologic repository. This approach is being taken by the NRC to assure that all of its HLW activities under the NWPA are planned, integrated, implemented, documented, and managed as thoroughly and effectively as possible. To support this process and the technical assessment capabilities described above, CNWRA completed a design for a comprehensive high-performance computer system that provides for an advanced computer network to be obtained by the NRC over a three-year period beginning with fiscal year 1992.

As DOE investigative activities at the proposed repository site increased, the CNWRA's technical expertise was utilized to support NRC staff in: review of study plans and design reports; NRC/DOE prelicensing technical exchange meetings; QA observation audits; technical support to NRC rulemaking and regulatory guidance development programs; the development of analysis methods (e.g., computer codes); and research. In depth support was provided to the Iterative Performance Assessment (IPA) program, which is aimed at developing NRC and CNWRA staff capabilities to evaluate DOE compliance with repository performance objectives related to containment and isolation of the wastes from the biosphere. Activities under the research program included: studies on the thermodynamic and ion exchange properties of sorbing minerals; laboratory and field studies of geochemical natural analogs of a repository located in an unsaturated geologic medium; evaluations of the adequacy of current techniques for modeling sorption of radioactive species; laboratory and calculational investigations of two-phase flow under ambient and thermally driven conditions in heterogeneous fractured porous media; field and laboratory investigations of rock mechanical and hydrogeological responses to repeated seismic events; evaluation and modification of seismic rock mechanics and coupled thermo-hydro-mechanical computer codes; laboratory investigation of the degradation of nickel and copper-based alloy container materials; evaluation of techniques for identifying and incorporating scenarios in performance assessment calculations; investigation of the probability and consequences of volcanic and tectonic disruptive events; and assessment of the regional hydrologic characteristics of the proposed repository site.