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Evolution of the Civilian Radioactive Waste Management Program

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APPENDIX A

Evolution of the Civilian Radioactive Waste Management Program

Appendix A describes the genesis of this Nation's efforts to resolve the radioactive waste management problem, the development of an international consensus on geologic disposal, the key provisions of and revisions to the Nuclear Waste Policy Act of 1982, and the oversight and system components of the Civilian Radioactive Waste Management Program.

DEVELOPMENT OF RADIOACTIVE WASTE MANAGEMENT POLICY

United States' Efforts Begin

The strategy of geologic disposal for the long-term isolation of spent nuclear fuel and high-level radioactive waste dates back several decades: In the mid-1950s, the National Academy of Sciences considered the disposal of defense-related high-level radioactive waste. In 1957, the Academy concluded that radioactive wastes could be disposed of safely in a variety of geologic media within the United States. The Academy noted, however, the technical and institutional uncertainties involved in implementing a geologic repository strategy, and assumed that significant research would be necessary and substantial costs incurred before a final conclusion could be reached on the feasibility, reliability, and safety of geologic disposal. At the same time, the nationwide screening for suitable repository sites began and continued through the early 1980s.

International Consensus on Geologic Disposal

In parallel with the evolution of the United States' policy, geologic disposal also emerged as the international community's consensus strategy for managing the permanent disposal of highly radioactive wastes.

In 1985, the Nuclear Energy Agency of the Organization of Economic Cooperation and Development, an international organization

of 23 countries (including the United States) cooperating in the development of peaceful uses of nuclear energy, reported a high degree of confidence worldwide that disposal systems in deep geologic structures can be designed and operated safely to assure long-term isolation of spent nuclear fuel or high-level radioactive waste. In 1995, the Nuclear Energy Agency reaffirmed the international consensus in its report *The Environmental and Ethical Basis of Geologic Disposal: A Collective Opinion of the Radioactive Waste Management committee of the OECD*. The Agency asserted that:

"... our responsibilities to future generations are better discharged by a strategy of final disposal than by reliance on stores which require surveillance, bequeath long-term responsibilities of care, and may in due course be neglected by future societies whose structural stability should not be presumed."

**Nuclear Waste Policy Act of 1982**

In 1982, Congress passed the Nuclear Waste Policy Act, which established the Office of Civilian Radioactive Waste Management within the Department of Energy. The Act adopted geologic disposal as the National's long-term strategy for the safe isolation of radioactive waste and confirmed the Federal Government's responsibility for managing and disposing of commercial spent nuclear fuel. The Act directed the Department to identify three potential sites for the first repository and to conduct a multi-year evaluation, known as site characterization, of each of the three sites. This provision was later amended to terminate site characterization at all sites except the Yucca Mountain site in Nevada.

Following site characterization, the Secretary of Energy may decide to recommend a site for development as a repository. If the President accepts the Secretary's recommendation, the Act directs the President to submit a recommendation of the site to Congress. The site designation becomes effective 60 days after the President's recommendation, unless in the interim a notice of disapproval is submitted by the governor and legislature of the state in which the site is located, or by the governing body of an Indian tribe on whose reservation the site is located. If such a notice is submitted, the site would be disapproved unless within 90 days of the submittal Congress passes a resolution of siting approval. If the President recommends a site and it is not disapproved, the Act directs the Department to submit an application to the Nuclear Regulatory Commission for a license authorizing repository construction. If the application is approved and construction proceeds, the Act requires the Department to apply to the Commission for additional licensing authority to begin accepting waste into the repository, and ultimately to close the facility permanently when waste emplacement is completed.
The Act limits the quantity of waste to be stored in the first repository to 70,000 metric tons of heavy metal until a second repository is in operation. The Act provides for the disposal of defense-related high-level radioactive waste, contingent upon a Presidential determination that such waste could be disposed of in a geologic repository along with commercial waste. In 1985, the President found no basis to conclude that a defense-only repository was required, and therefore, under provisions of the Act, the Department is to proceed with plans and actions to dispose of defense waste with commercial spent nuclear fuel in a single repository.

The Act directs that activities associated with the management and disposal of civilian spent fuel conducted under the Act be funded through a fee on the commercial generation of nuclear power. The fee was set initially at 1.0 mil per kilowatt-hour, to be deposited into the Nuclear Waste Fund. The Secretary of Energy is directed to review the fee amount annually to determine its adequacy to meet Federal Government costs of managing civilian spent fuel, and to propose adjustments as needed to ensure full cost recovery. Costs associated with the disposal of high-level radioactive waste from defense activities are to be paid by the Federal Government.

The Act authorized the Secretary to enter into contracts with utilities for the acceptance and disposal of spent nuclear fuel. These contracts, which came to be known as the Standard for Disposal of Spent Nuclear Fuel and/or High-Level Radioactive Waste (10 CFR Part 961), were promulgated through rulemaking and provide that the Department will:

* take title to the spent nuclear fuel as expeditiously as practicable following commencement of operation of a repository, and
* in return for the payment of fees, beginning not later than January 31, 1998, dispose of such spent nuclear fuel.²

The Act directed the Department of Energy to study the need for and feasibility of a monitored retrievable storage facility for the purpose of storing nuclear waste on an interim basis prior to disposing of it permanently in an underground repository and to submit to Congress a site-specific proposal for such a facility. It also required the Federal Government to transport spent nuclear fuel to a Federal storage facility, utilizing private industry to the fullest extent possible.

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² In May 1995, the Department published a finding that it has no legal obligation under the Act or the Standard Contract to begin disposal of spent nuclear fuel by January 31, 1998 in the absence of a repository or interim storage facility constructed under the Nuclear Waste Policy Act, as amended.
of storing nuclear waste on an interim basis prior to disposing of it permanently in an underground repository and to submit to Congress a site-specific proposal for such a facility. It also required the Federal Government to transport spent nuclear fuel to a Federal storage facility, utilizing private industry to the fullest extent possible.

The Act defines certain units of government as "affected" because of their jurisdiction over the site of a proposed geologic repository or monitored retrievable storage facility, and permits the Secretary of Energy to designate additional units of local government as "affected" because of their proximity to such sites. It requires the Department to provide financial assistance to support participation of parties with "affected" status.

The Department was directed to issue general guidelines for the recommendation of sites for repositories, which were finalized in December 1984 as General Guidelines for the Recommendation of Sites for the Nuclear Waste Repositories (10 CFR Part 960), and to characterize multiple sites for possible development of a geologic repository. The Department selected nine sites to study as candidates for the first repository. In May 1986, the Secretary nominated five sites as suitable for the first repository, and recommended three of the sites to the President for approval for site characterization. The President approved three sites: Yucca Mountain, Nevada, Deaf Smith County, Texas; and the Hanford Site, Washington. The Department also began the process of identifying sites for a second repository.

Nuclear Waste Policy Amendments Act of 1987

Motivated in part by concern about program costs, Congress reassessed the need to characterize three potential repository sites. Through passage of the Nuclear Waste Policy Amendments Act of 1987, Congress redirected the Department to focus its site characterization activities only at Yucca Mountain, Nevada, and report on the need for a second repository on or after January 1, 2007 but no later than January 1, 2010.

The Department's proposal to locate a monitored retrievable storage facility at a site at Clinch River in Oak Ridge, Tennessee, with two alternative sites in Tennessee, was nullified in the Amendments Act. Congress directed that the need for a monitored retrievable storage facility be examined by a commission before the Department could proceed and restricted the Department's ability to site and develop such a facility by prohibiting:

- selection of a monitored retrievable storage facility site until the Secretary of Energy recommends for Presidential approval a site for development as a repository;
- selection of a site within the State of Nevada; and
commencing facility construction until the Nuclear Regulatory Commission issues a license for the construction until the Nuclear Regulatory Commission issues a license for the construction of repository.

The Amendments Act established the Office of the Nuclear Waste Negotiator to seek a volunteer host site for repository or monitored retrievable storage facility and also expanded external oversight of the Department of Energy by establishing the Nuclear Waste Technical Review Board, authorizing on-site oversight representatives of host jurisdictions, and providing for increased local government participation.

Finally, the Amendments Act required that packages for transport by certified by the Nuclear Regulatory Commission, and that the Department provide technical assistance and funds to States to train transportation public safety officials.

EXTERNAL OVERSIGHT AND REGULATION

Recognizing the far-reaching implications of national radioactive waste management policy, Congress mandated that oversight and regulation of the Department's civilian radioactive waste management activities he provided by a number of external organizations.

The Nuclear Regulatory Commission was made responsible for overseeing the safety of the Civilian Radioactive Waste Management System through its process of licensing waste management facilities and certifying other system components, such as waste containers. The Nuclear Waste Technical Review Board was directed to evaluate the technical scientific validity of program activities.

Additionally, the National Academy of Sciences has provided analysis and recommendations regarding waste management system issues at various times, sometimes at specific Congressional direction. For example, the Energy Policy Act of 1992 directed the Environmental Protection Agency to contract with the Academy for a study to provide recommendations on standards for protection of the public from the radioactive waste that might be disposed of in a geologic repository at the Yucca Mountain Site. A special Academy committee complete its report, and the Environmental Protection Agency is currently developing revised regulations in light of the committee's recommendations.

The Nuclear Waste Policy Act also gave specific rights to the State of Nevada and affected units of local government to oversee the development of the system. Since its inception, the Program has also solicited external expertise and opinion through its own initiatives, and has sought the involvement of a broad range of stakeholders, including State and local officials, nuclear utilities and their regulators, environmen-
tal groups, labor unions, and the general public to contribute to its decision-making process.

CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM

As directed by the Nuclear Waste Policy Act, as amended, the Department of Energy's Civilian Radioactive Waste Management Program initiated the development of a waste management system consisting of three components: a geologic repository for permanent disposal of spent nuclear fuel and high-level radioactive waste; a monitored retrievable storage facility for temporary waste storage (if Congress approves the Department's proposal for the construction of such a facility or facilities); and a system for transporting the waste from commercial reactor sites to the temporary and permanent facilities. Figure 12 illustrates the waste management system as contemplated in the Act.

Geologic Repository

The strategic endpoint of the Civilian Radioactive Waste Management System is the emplacement of spent nuclear fuel and high-level radioactive waste in special packages in a deep geologic repository to isolate the waste for at least tens of thousands of years. The waste isolation performance of the repository will rely on multiple barriers, both natural and engineered. The natural barrier will be the rock formations of the repository site. The principal engineered barrier will be the waste package, which consists of the waste form, a disposal container, and any supplemental barriers such as backfill surrounding the waste package. Waste emplacement activities at the repository will incorporate multiple back-up safety systems and equipment to protect workers and the public.

Monitored Retrievable Storage Facility

Congress directed that a proposal be developed for the construction of one or more facilities for the monitored retrievable storage of spent fuel. As originally conceived, a monitored retrievable storage facility as to be deployed to provide back-up storage only if development of a geologic repository were significantly delayed. The facility would duplicate the spent fuel receiving and consolidating functions of the repository, and would be phased out of operation when the repository was in operation and had significantly reduced the backlog of spent fuel at the reactors. The facility would include a building with equipment for spent nuclear fuel reception, inspection, disassembly, and consolidation into storage packages; a large storage yard; and the necessary support facilities.
CIVILIAN RADIOACTIVE WASTE MANAGEMENT SYSTEM AS ORIGINALLY ENVISIONED

SNF = Spent Nuclear Fuel
HLW = High-Level Waste

FIGURE 12
After a subsequent reassessment of the monitored retrievable storage concept, the Department concluded that the facility should be deployed as an integral part of the waste management system, with expanded capabilities, rather than serve as a back-up to be constructed only in case of repository development delays.

The Department's current strategy for implementing a near-term interim storage program, if and when interim storage authorization is enacted, is for a less-complex facility to be developed and licensed in two phases. The first phase of the facility would be limited to the receipt and storage of spent nuclear fuel in sealed canisters or casks, and could thus be brought into operation relatively quickly. The second phase of the facility, which would require more time to develop, would include the capability to receive uncanistered spent fuel assemblies and transfer them to sealed canisters for on-site storage. Phased development would facilitate timely implementation of the interim storage facility.

TRANSPORTATION SUB-SYSTEM

The Civilian Radioactive Waste Management System also includes the development of a transportation sub-system to provide waste acceptance at reactor sites and shipment to an interim storage facility or directly to a repository. Under precious plans, development of the transportation sub-system had been placed to support waste receipt at a geologic repository. Those plans had included development through Federal contracts of special casks for truck, rail, and barge shipment of waste.

Under the sub-system now envisioned, multiple contracts would be awarded to competing contractors to arrange waste shipments; acquire, maintain, and inspect equipment; plan and schedule operations; and train personnel. Transportation routes would be identified following the selection of interim storage and repository sites, and the technical assistance and funds would be provided to States for training public safety officials of local governments and Indian tribes through whose jurisdiction waste will be shipped.

Shipments will be made by truck, rail, or barge, or a combination of these modes. From an interim storage facility, the spent nuclear fuel will be transported on dedicated trains to the repository. In vitrified form, defense-related high-level radioactive waste is planned to be shipped by rail directly from storage sites to be repository. The planned schedule, activities, and products have been redirected under the revised Program Plan in Appendix C.
APPENDIX C

Site-Specific Waste Acceptance, Storage and Transportation Strategy

INTRODUCTION

Section 2.2 of the Program Plan, Revision 1, describes activities to acquire the capability for waste acceptance, storage, and transportation, which will be conducted prior to interim storage facility site designation under the Program's revised strategy. This appendix describes the waste acceptance, interim storage, and transportation activities currently planned to begin once a facility site is designated.

PLANNING ASSUMPTIONS

Plans for activities following interim storage facility designation are based on the following assumptions:

- The $85 million reserved in the Energy and Water Development Appropriations Act of 1996 will be requested by the Administration and will be made available in Fiscal Year 1998 appropriations for non-site specific activities.
- Legislation designating an interim storage site will be enacted approximately six months after the 1998 completion of the Yucca Mountain viability assessment.
- Site-specific work on a Federal interim storage facility will be initiated with Fiscal year 1999 funding.
- Design, licensing, and construction will take approximately three and one-half years following designation of a site for interim storage, assuming the necessary funding is provided to develop a topical safety analysis report and conduct related design and analysis work.
- Interim storage facility legislation will be enacted which:
  - authorizes implementation in two phases to facilitate the earliest possible acceptance of waste;
  - requires separate environmental reports for each phase of construction;
  - allows construction of an interim storage facility to begin as soon as the license application is submitted; and
  - directs the Nuclear Regulatory Commission to develop an
Environmental Impact Statement for the interim storage facility, based on an environmental report submitted with the license application.

- The interim storage facility will be designed, licensed, constructed, and brought into operation using the best commercial, and in accordance with the Nuclear Regulatory Commission regulation Licensing Requirements for the Independent Storage of Spent Nuclear Fuel and High Level Radioactive Waste (10 CFR Part 72) and other application regulations.

- An interim storage facility environmental report and license application will be submitted to the Nuclear Regulatory Commission in 2000.

- The Federal interim storage facility will begin receiving spent fuel deliveries from the waste acceptance, storage and transportation contractors in 2002.

**KEY PLANNING ELEMENTS WASTE ACCEPTANCE, STORAGE, AND TRANSPORTATION**

*Competitive procurement for waste acceptance, storage, and transportation services.*

The program is contemplating carrying out its waste acceptance, storage, and transportation functions using a market-driven approach that relies on competitive contracts with the private sector for implementation. Under this initiative, contractors will perform their functions consistent with the *Standard Contract (Article IV.B)* by accepting spent fuel at Purchasers' sites on behalf of the Department and delivering it to Department facility. Contractors would be compensated based on performance of these services and would accept financial risk. Contractors will be encouraged to use innovative approaches to improve efficiency, to solve problems, to overcome obstacles to performance, and to lower costs.

*Multiple Awards:* It is envisioned that this will be the first of several similar future procurements covering waste acceptance, storage modules, and transportation services and equipment to be provided over several decades. For the purpose of establishing and sustaining viable competition, the Department is contemplating awarding multiple fixed-price type contracts. One approach under consideration is to divide the country into regions. (For example, the four Nuclear Regulatory Commission regions might be used.) Under this approach, one contractor would provide waste acceptance and transportation services to all Purchasers in a given
region for the duration of the contract period. Selected contractors would be responsible to provide waste acceptance and transportation services to all Purchasers with allocations in the Department's Acceptance Priority Ranking and Annual Capacity Report within their respective service regions. To preserve competition and encourage industrial capability within the market place, no single offerer would be awarded more than a portion of the work.

**Scope of Services:** Contractors will be responsible to accept spent fuel on behalf of the Department as identified in the Acceptance Priority Ranking and the Annual Capacity Report at Purchasers' facilities and deliver it to a Federal facility (either a repository or an interim storage facility). Contractors would be responsible to provide all transportation casks and equipment suitable for use at Purchasers' sites, accept spent fuel for shipment as an agent of the Department, and deliver the spent fuel delivered to the facility storage systems to the Department facility. Initially, spent fuel delivered to the facility would be canistered before arrival at the facility. At some point in the service period, the facility license may be amended to allow handling of uncanistered spent fuel, and the contractor may be required to transition to delivery of uncanistered spent fuel.

Transportation and storage would be carried out using commercially available equipment in compliance with applicable Nuclear Regulatory Commission and Department of Transportation regulations, Department of Energy acceptance criteria, and standard commercial practices. Contractors would provide service in accordance with the Acceptance Priority Ranking and Annual Capacity Report; however, contractors might, with Purchaser agreement and notification to the Department, alter the order of acceptance to achieve efficiency of operation or to lower costs. Contractors would also be responsible for any intermodal transport required, including heavy haul, whether from the Purchasers' sites or the Federal receiving facility.

**Schedule:** Schedule specifics would be addressed in the solicitation. For planning purposes, it is expected that a Federal facility could be in operation to receive spent nuclear fuel within three and one-half years of Congressional direction and contractors could be expected to begin developing service arrangements with Purchasers two to three years before spent nuclear fuel shipment.

**Technical assistance and funding**

Approximately three years before the start of waste acceptance and transportation operations, the Program would begin providing
technical assistance and funding for training public safely officials in emergency response and safe transport procedures, as required under Section 180(c) of the Nuclear Waste Policy Act, as amended. Section 2.2.2 provides an expanded discussion of this requirement.

INTERIM STORAGE

The development of an interim storage facility would include environmental design, licensing, and construction activities. Development of the facility would be accelerated by licensing and constructing the facility in two phases.

- Phase I operations would be limited to the acceptance of spent nuclear fuel in canisters suitable for transportation and storage. Operations in this phase would not require the construction of spent fuel-handling facilities, which would be deferred to Phase II.
- Phase II operations would include acceptance of uncanistered spent nuclear fuel that would be transferred from transportation casks to storage casks for storage on site at the interim storage facility.

Following the designation of a site, the Program would perform a detailed site investigation and develop an environmental report to be submitted to the Nuclear Regulatory Commission as a part of the Phase I license application. The environmental report would provide the basis for an Environmental Impact Statement to be prepared by the Commission. Site-specific activities, including site-specific facility design and preparation of the Phase I license application, would begin following the enactment of legislation designating a site. These activities would draw on the non-site specific work conducted under the first stage of the strategy before site designation. The Program would also develop and issue request(s) for proposals for facility construction and operation.

Following submission of the license application, the Program would complete final procurement and construction design and award a contract or contracts for constructing and operating Phase I of the facility. Upon issuance of an Environmental Impact Statement, a Record of Decision on the Environmental Impact Statement, and an interim storage facility operating license by the Nuclear Regulatory Commission, the Phase I facility would begin accepting canistered spent fuel. Spent fuel acceptance and interim storage facility operations are expected to commence approximately four years after a site is designated.

Phase II development would proceed concurrently with Phase I development and operations, and would follow the same general process,
but would take about two years longer due to the requirements of designing, licensing, and constructing a facility to handle uncanistered spent nuclear fuel. Under the assumed timetable, the Phase I license application would be submitted to the Nuclear Regulatory Commission an estimated six months before the Phase I license is granted. Transportation and receipt of uncanistered spent nuclear fuel would commence when the Nuclear Regulatory Commission issues the Phase II license. Figures 13 and 14 present a preliminary concept of Phase I and Phase II interim storage facilities.

**MILESTONES**

The following waste acceptance, storage, and transportation milestones are contingent on Congressional interim storage authorization, funding, and facility site designation.

**Fiscal Year 1999**

- Begin investigations at the interim storage facility site
- Initiate site-specific interim storage facility design
- Begin interim storage facility Phase I license application
- Award multiple contracts for waste acceptance, storage modules, and transportation services and equipment; authorize contractors to initiate the waste acceptance, storage, and transportation planning phase of the contract

**Fiscal Year 2000**

- Begin providing technical assistance and funding to States for emergency preparedness and safe transport training under Section 180(c) of the Nuclear Waste Policy Act
- Submit Pressurized Water Reactor Principal Isotope (Full) Burnup Credit Topical Report to the Nuclear Regulatory Commission
- Complete interim storage facility Phase I Environmental Report
- Submit interim storage facility Phase I license application to the Nuclear Regulatory Commission
- Issue request(s) for proposals for Phase I interim storage facility construction and operation
- Authorize contractor procurement of waste acceptance, storage modules, and transportation services and equipment
A temporary storage facility would have the capability to receive canistered spent nuclear fuel from transport casks or to store casks for interim storage. The site would consist of a concrete pad with appropriate security and environmental control. Temporary facilities would be provided for administrative activities.
A Phase II interim storage facility would include transfer facilities for handling uncanistered spent fuel. Phase II of the interim storage facility would incorporate modular construction and be in individual concrete pads, handling any waste generated from the facility. In Phase II, emergency facilities would also be included in this permanent facility.
Fiscal Year 2001

- Award contract(s) and initiate interim storage facility Phase I construction and preparations for operations
- Begin interim storage facility Phase II license application

Fiscal Year 2002

- Submit interim storage facility Phase II license application to the Nuclear Regulatory Commission
- Issue request for proposals for interim storage facility Phase II construction
- Receive interim storage facility Phase I operating license
- Authorize contractors to proceed with the operations phase of the waste acceptance, storage modules, and transportation services and equipment contracts
- Commence interim storage facility operations and begin receiving canistered spent nuclear fuel at interim storage facility

Fiscal Year 2003

- Award contract(s) and begin construction of interim storage facility Phase II