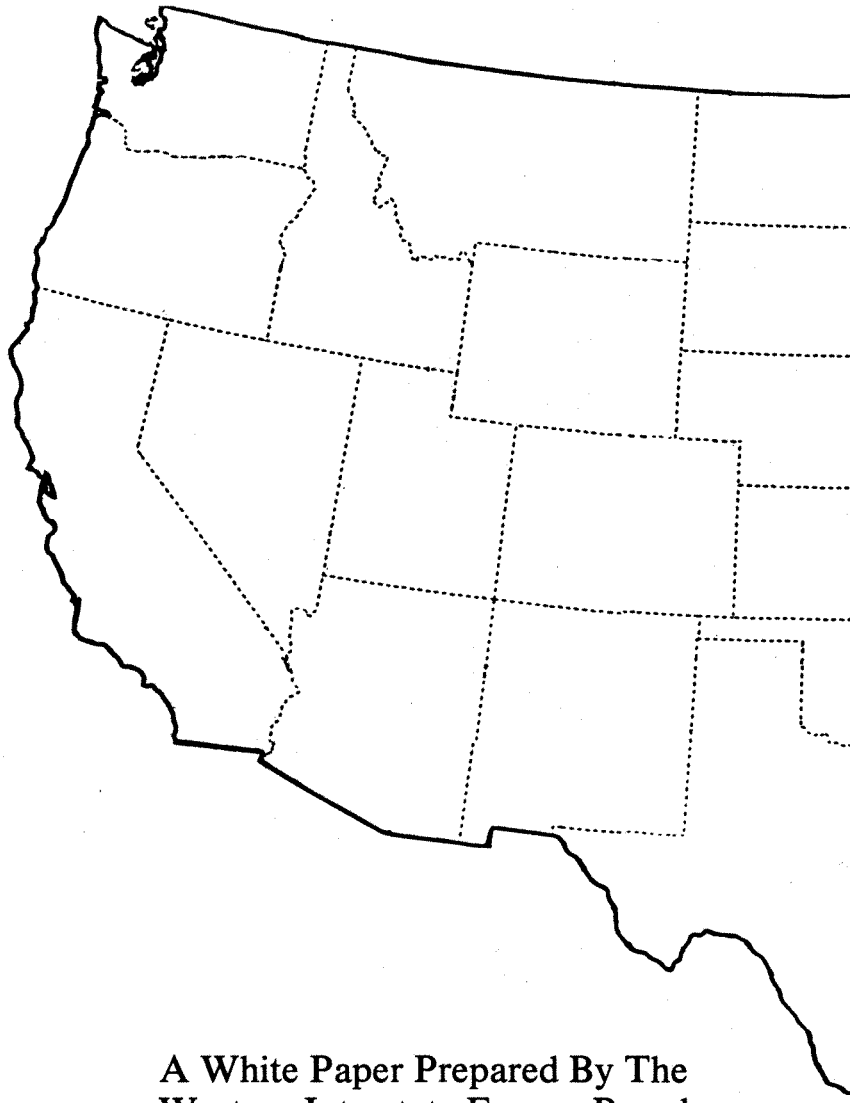
SPENT NUCLEAR FUEL AND HIGH LEVEL RADIOACTIVE WASTE TRANSPORTATION



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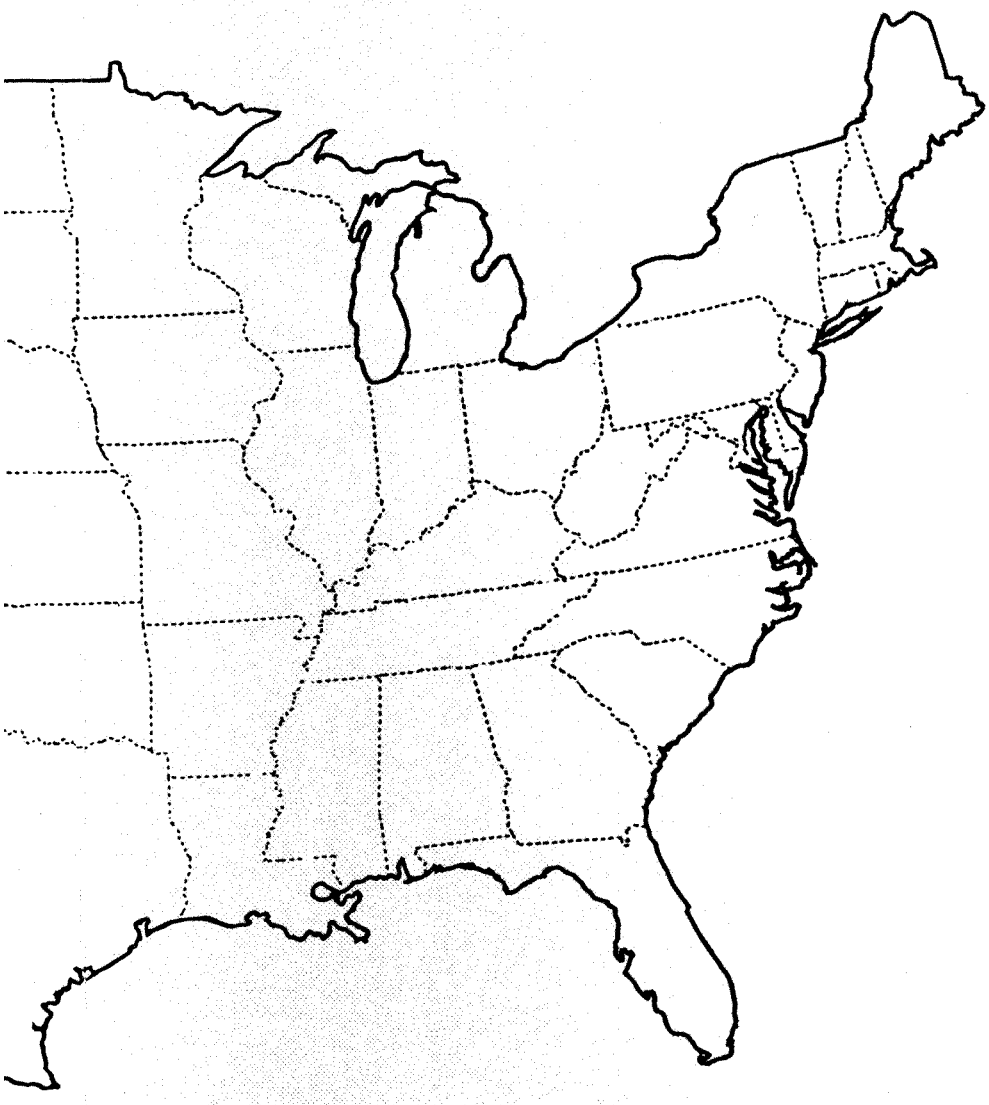
Western Interstate Energy Board



SPENT NUCLEAR FUEL AND HIGH LEVEL RADIOACTIVE WASTE TRANSPORTATION

White Paper

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This White Paper draws on an extensive data base contained in the 550+ page report **Spent Nuclear Fuel and High-Level Radioactive Waste Transportation Primer,** prepared by the Western Interstate Energy Board. Further information on the Primer is provided on pages A-1 to A-3 of this White Paper.

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INTRODUCTION

The High-Level Radioactive Waste Committee of the Western Interstate Energy Board has been involved in a year-long cooperative project with the U.S. Department of Energy (DOE) to develop an information base on the transportation of spent nuclear fuel and high-level radioactive waste (HLW) so that western states can be constructive and informed participants in the repository program under the Nuclear Waste Policy Act (NWPA). The project, which has been conducted under contract with the Department of Energy, also involves making recommendations regarding transportation of spent fuel and HLW. The Board is an association of sixteen western states dedicated to fostering cooperative efforts among member states and the federal government in the energy field to enhance the economy of the West and to contribute to the well-being of the region's people.

The historical safety record of transportation of HLW and spent fuel is excellent; no release of these radioactive materials has ever occurred during transportation. Projected shipments under the NWPA will, however, greatly exceed current shipments in the United States. For example, over the past five years, 119 metric tons of civilian spent fuel have been shipped in this country, while shipments to the first and second repository are each expected to peak at 3,000 metric tons per year.

The Committee believes that the successful development and operation of a national HLW/spent fuel transportation system can best be accomplished through an open process based on the common sense approach of taking all reasonable measures to minimize public risk and performing whatever actions are reasonably required to promote public acceptance.

Therefore, the Committee recommends that the Department of Energy further the goals of the NWPA by developing a Comprehensive Transportation Plan which adopts a systematic, comprehensive, and integrated approach to resolving all spent fuel and HLW transportation issues in a timely manner. The suggested scope of such a plan is discussed in this White Paper. Many of the suggested elements of such a plan are similar to those being developed by the Department of Energy for inclusion in the Department's Transportation Institutional Plan.

WHAT ARE SPENT FUEL AND HIGH-LEVEL WASTE?

Spent fuel and high-level radioactive waste (HLW) are two types of radioactive wastes that will be shipped to the repository under the NWPA. (Frequently, the term "high-level waste" is used to refer collectively to spent fuel and high-level waste.) Spent fuel is produced by commercial nuclear power plants. HLW is produced primarily by national defense activities.

Types of Radioactive Waste

Waste To Be Deposited In NWPA Repositories

Spent Fuel
- Irradiated fuel discharged from a nuclear power reactor
- Highly radioactive and very hot
- Small pellets sealed into metal fuel rods
- Produced by commercial utility power reactors

High-Level Waste
- Residues from reprocessing spent fuel
- Highly radioactive
- Calcined solids and liquid or sludge which would be solidified prior to transportation
- Produced primarily by defense activities

Other Types of Radioactive Waste

Transuranic Wastes
- Materials contaminated with elements heavier than uranium
- Moderately radioactive; slow decay
- Used nuclear equipment, filters, clean-up waste
- Produced primarily by defense activities

Low-Level Wastes
- Radioactive wastes not included in the above categories
- Typically, small amounts of radiation in a large volume of waste
- Includes contaminated rags, laboratory equipment, resins, etc.
- Produced by commercial, industrial and medical uses and by defense activities

Tailings
- By-products of uranium mining and milling
- Low concentrations of natural radioactivity
- Large volumes of rock and soil
- Produced by commercial mining operations

Nuclear reactors are fueled by highly enriched uranium oxide formed into small ceramic pellets and typically sealed in 12-foot long metal fuel rods. After several years, the fissile uranium and transuranic elements have been mostly depleted and radioactive fission products have built up within the rods, limiting their usefulness as fuel sources. When the spent fuel rods are removed from the

reactor, they are much more radioactive than the fresh fuel rods or the uranium ore from which they were made. Figure 1, which shows the toxicity of uranium ore, spent fuel, and high-level waste, is on a logarithmic scale - each interval represents a 10-fold increase. Thus, spent fuel recently removed from a reactor is seen to be more than 1,000 times as toxic as uranium ore. Notice that the toxicity of the spent fuel declines over time after it has been removed from the reactor. This is because radioactive fission products decay by emitting radiation and eventually lose most of their radioactive properties as they become more stable.

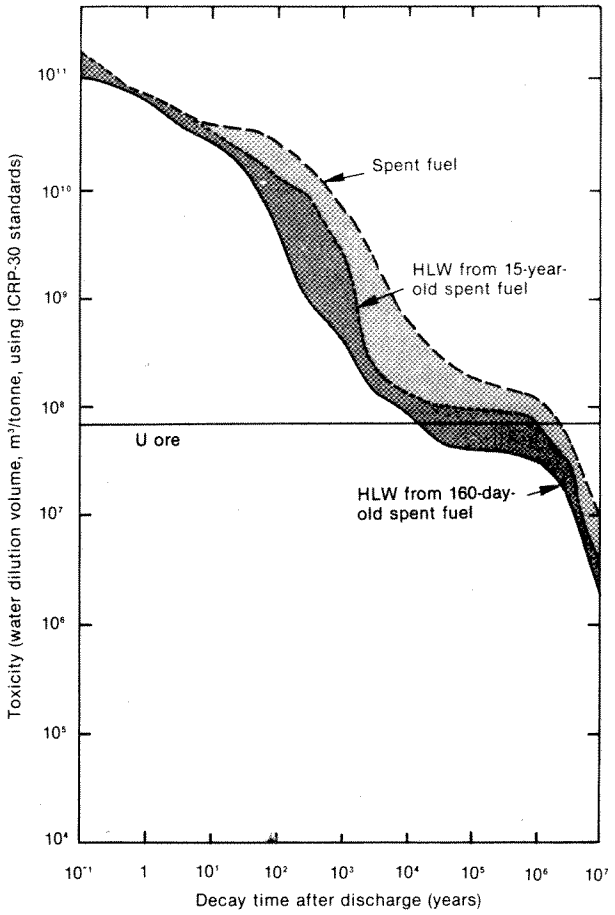


Fig. 1 — Toxicity of Spent Fuel, High-Level Waste, and its Parent Uranium Ore

SOURCE: **Managing the Nation's Commercial High-Level Radioactive Waste,** March 1985; U.S. Congress, Office of Technology Assessment, OTA-0-171.

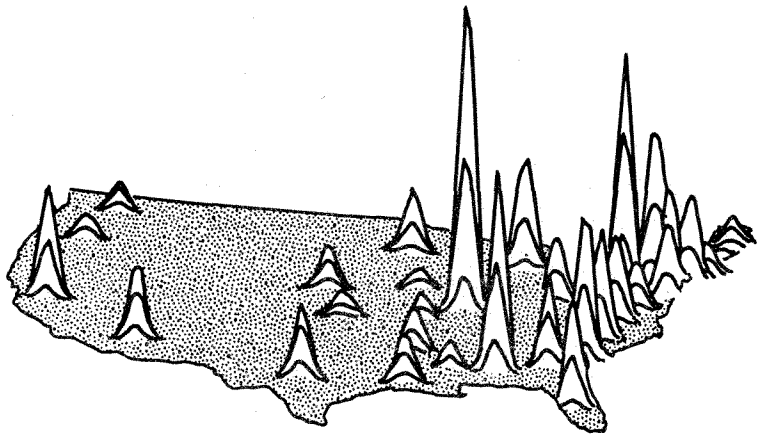
Spent fuel can be reprocessed to separate the reusable uranium and plutonium from the radioactive residues. These separated residues, which are almost as radioactive as the spent fuel, are known as high-level waste. Currently, for economic reasons, fuel from commercial power reactors is not being reprocessed.

DOE provides the Department of Defense with nuclear products from its own production reactors for national defense activities. The spent fuel from reactors used to produce plutonium for weapons and to power nuclear submarines for the Navy has been routinely reprocessed for many years. Thus, these defense activities have generated and continue to generate significant amounts of HLW.

WHERE IS THE WASTE LOCATED?

Most of the existing inventory of commercial spent fuel is being stored onsite at the nuclear power reactors. As shown in figure 2, most of the commercial spent fuel is located in the midwest and eastern parts of the United States.

Fig. 2 — Projected Distribution of Spent Fuel to be Shipped to First Repository

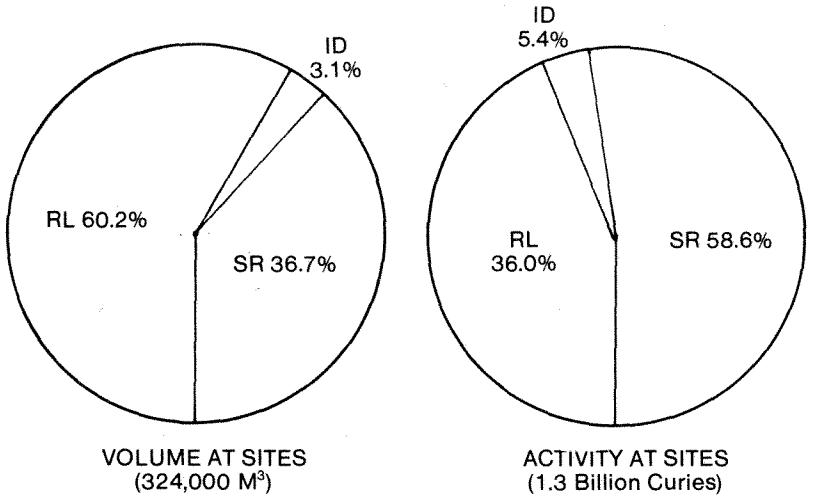


Weighted Distribution of First 70,000 MT of Spent Fuel

SOURCE: **Screening and Identification of Sites for a Proposed Monitored Retrievable Storage Facility,** April, 1985, DOE/RW-0023.

Defense spent fuel and HLW have accumulated at the Idaho National Engineering Laboratory, the Hanford Site in Washington and the Savannah River Plant in South Carolina. As a result of the President's decision in April 1985 approving the commingling of defense and civilian waste, much of this material will be shipped to a repository under the NWPA. Figure 3 indicates the volume and radioactivity of defense wastes which have accumulated through 1983.

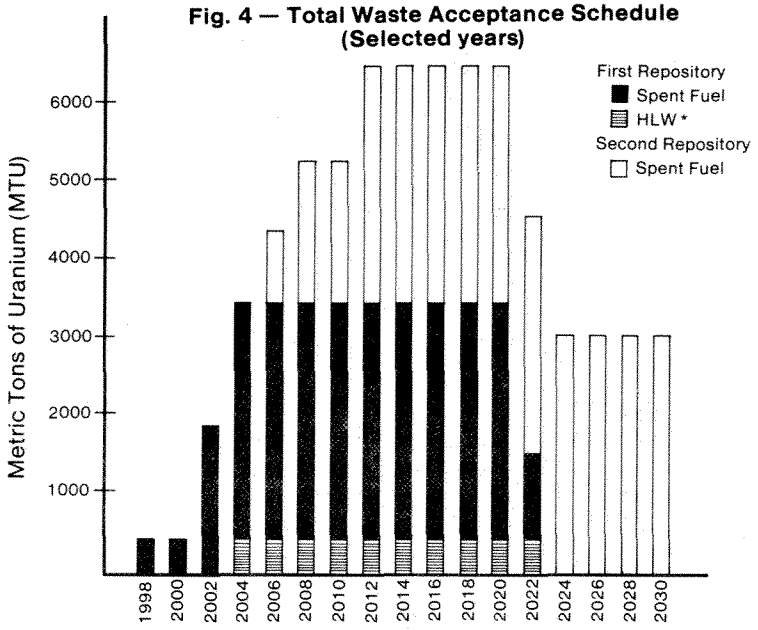
Fig. 3 — DOE Defense High-Level Waste Inventory 12/31/83



SOURCE: **Spent Fuel and Radioactive Waste Inventories, Projections and Characteristics,** September, 1984, DOE/RW-0006.

DOE's waste acceptance schedules for commercial and defense spent fuel and HLW to the first and second repositories are summarized in the following graph.

Fig. 4 — Total Waste Acceptance Schedule (Selected years)



* Approximate schedule for defense HLW and commercial HLW from the West Valley Demonstration Project. Spent fuel and HLW are not strictly comparable, but have been normalized on a Curie-Equivalent Basis.

SOURCE: Data Supplied by the **Mission Plan for the Civilian Radioactive Waste Management Program**, June 1984, DOE/RW-0005.

WHERE IS THE WASTE GOING?

The Nuclear Waste Policy Act (NWPA), which became law on January 7, 1983, sets forth for the first time a comprehensive statutory framework for the siting, construction and operation of geologic repositories for the disposal of HLW and spent fuel. The law affirms the basic elements of a federal government waste program which had been taking shape for more than a decade, but which suffered numerous false starts because of a lack of specific statutory direction. The NWPA supplies such direction.

The NWPA requires DOE to nominate sites for a first and second repository and prepare environmental assessments for these sites. For each repository, three sites will be chosen by the President, based on DOE's recommendations, for more in-depth site characterization. Following characterization, DOE is to recommend, and the President is to select, a site for the repository and submit a license application to the NRC for construction of the repository. The following chart outlines the siting schedule established by the Act and the status of each required action.

Nuclear Waste Policy Act

Action	Statutory Deadlines	Status
Siting Guidelines		
DOE proposed guidelines	7/7/83	Completed
Approved by NRC		Completed
NRC Technical Guidelines	1/1/84	Completed
EPA Standards for Offsite Releases	1/8/84	Expected Summer 85
Mission Plan		
Draft Plan	4/6/84	Completed
Final Plan to Congress	6/6/84	Completed
Nomination of Sites		
Preparation of environmental assessments (1st repository)	Prior to nomination	Drafts issued 12/84 Final EAs Expected 11/85
DOE Secretary nominates 5 sites (1st repository)	Prior to DOE recommendation of 3 sites for characterization	
Site Characterization		
DOE Secretary recommends 3 sites for characterization	1/1/85 (1st repository) 7/1/89 (2nd repository	delayed
President selects 3 sites for characterization	3/1/85 (1st repository) 9/1/89 (2nd repository)	
Secretary recommends site	3/31/87 (1st repository) 3/31/90 (2nd repository)	
NRC decision on construction authorization	1/1/89 or 3 years after receipt of application (1st repository) 1/1/92 or 3 years after receipt of application (2nd repository)	
Acceptance of waste	1/31/98 (per contracts with utilities)	

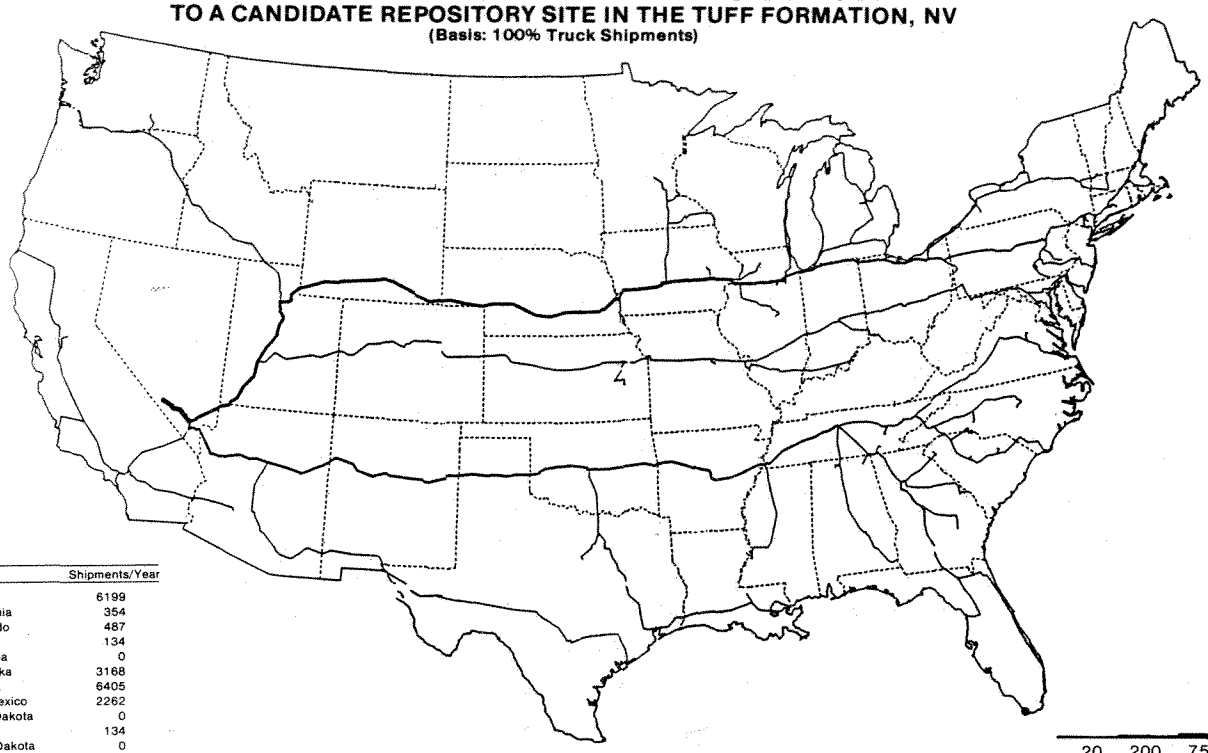
The NWPA establishes a 1.0 mill per kilowatt-hour fee, to be deposited in the Nuclear Waste Fund, on electricity generated by civilian nuclear power reactors. The Fund is to be used for the costs associated with any repository, monitored retrievable storage facility, or test and evaluation facility constructed under the Act, including the costs of transportation to such facility. The federal government is to pay a proportionate share of disposal costs associated with defense waste placed in a repository.

As part of the process for selecting the first repository, DOE is evaluating nine candidate sites in the states of Washington, Nevada, Utah, Texas, Mississippi, and Louisiana. The first repository is planned to begin operations in 1998. DOE has tentatively identified the three sites for recommendation to the President (in Washington, Nevada, and Texas) from which the final site is to be chosen following site characterization. DOE is currently conducting area screening in the north-central, northeastern, and southeastern regions of the country to identify suitable candidates for the second repository.

If one of the tentatively identified western sites (Washington or Nevada) is chosen for the first repository, a significant amount of waste will be transported through the western states. The following maps illustrate possible highway and rail routes for shipments to a repository in Washington or Nevada. The inserts show the predicted number of shipments through each of the western states for the transportation mode and repository location depicted in the map. Numbers are based on current cask capacities; fewer shipments would be required if future casks have larger capacities. The shipment numbers are not cumulative because each shipment is counted in each state through which it will travel. Rail shipments refer to numbers of cars shipped; fewer shipments would be required if several carloads were shipped on a single train.

POSSIBLE ROUTES FOR SHIPMENTS OF SPENT FUEL TO A CANDIDATE REPOSITORY SITE IN THE TUFF FORMATION, NV

(Basis: 100% Truck Shipments)



State	Shipments/Year
Arizona	6199
California	354
Colorado	487
Idaho	134
Montana	0
Nebraska	3168
Nevada	6405
New Mexico	2262
North Dakota	0
Oregon	134
South Dakota	0
Utah	3790
Washington	134
Wyoming	3168

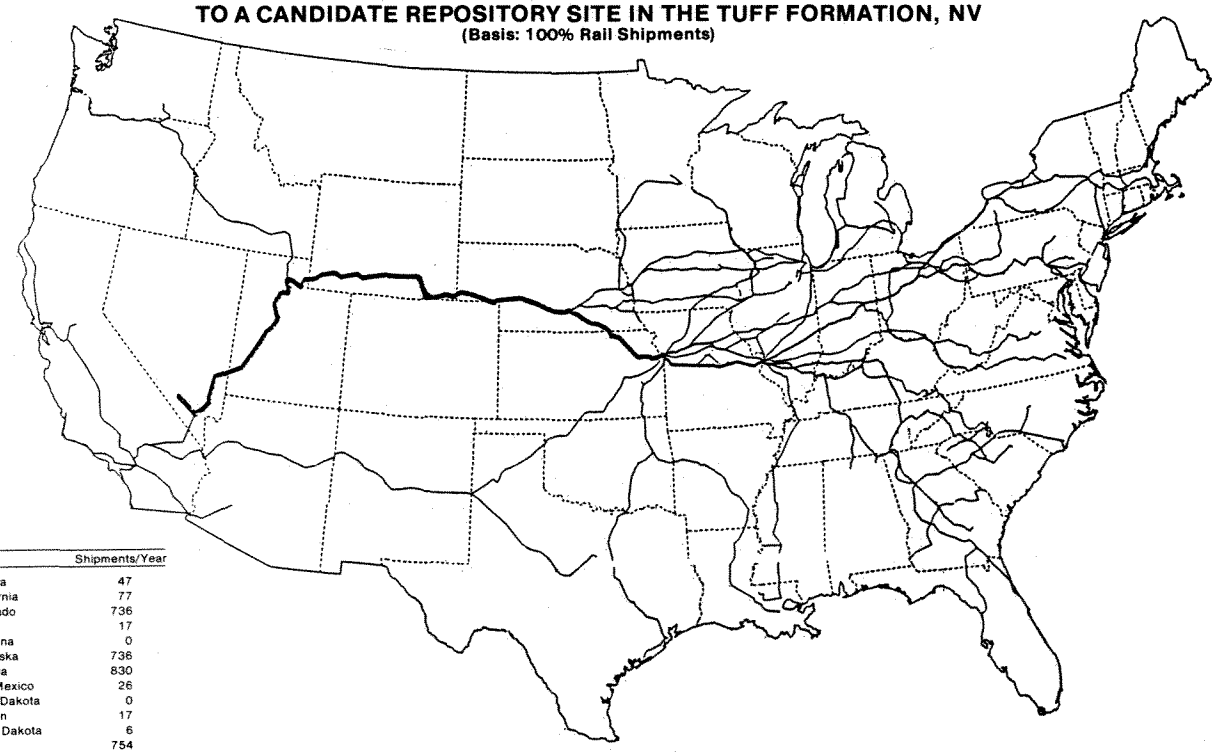
The following maps were prepared by Geographic Data Systems for the Department of Energy / Office of Civilian Radioactive Waste Management

20 200 750

Annual Shipments

POSSIBLE ROUTES FOR SHIPMENTS OF SPENT FUEL TO A CANDIDATE REPOSITORY SITE IN THE TUFF FORMATION, NV

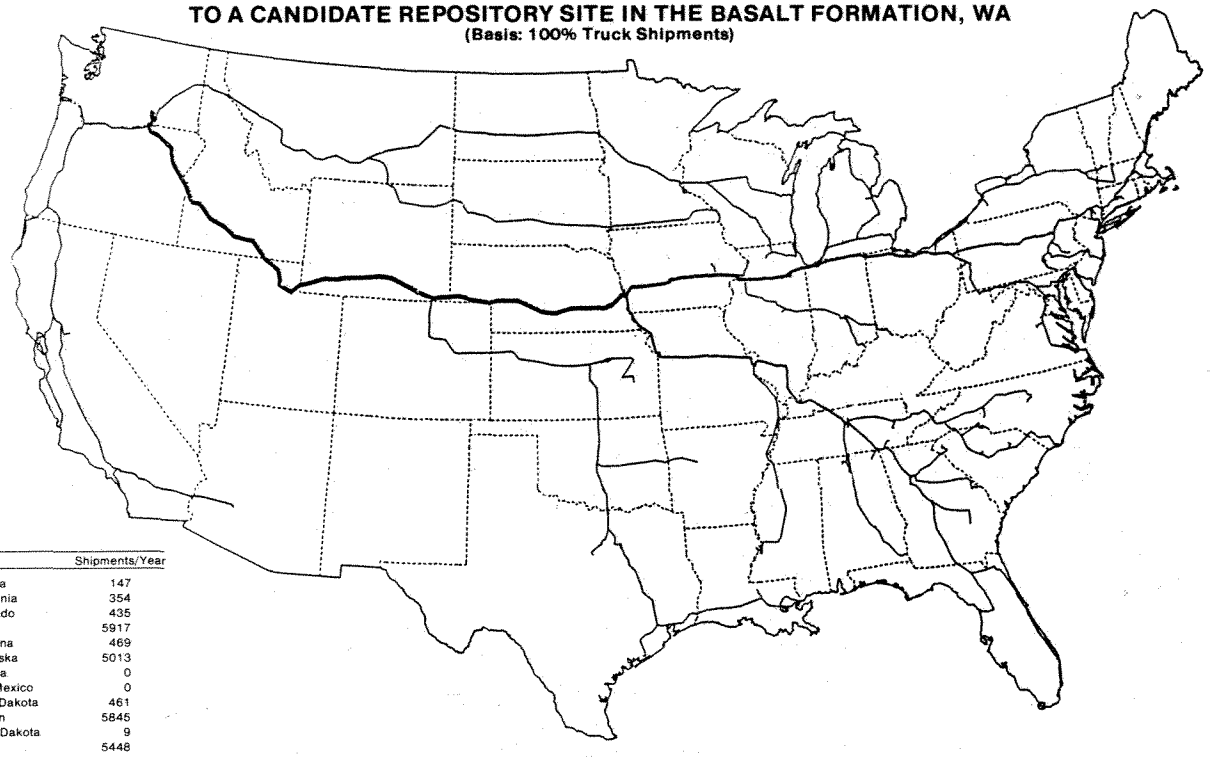
(Basis: 100% Rail Shipments)



State	Shipments/Year
Arizona	47
California	77
Colorado	736
Idaho	17
Montana	0
Nebraska	736
Nevada	830
New Mexico	26
North Dakota	0
Oregon	17
South Dakota	6
Utah	754
Washington	11
Wyoming	736

POSSIBLE ROUTES FOR SHIPMENTS OF SPENT FUEL TO A CANDIDATE REPOSITORY SITE IN THE BASALT FORMATION, WA

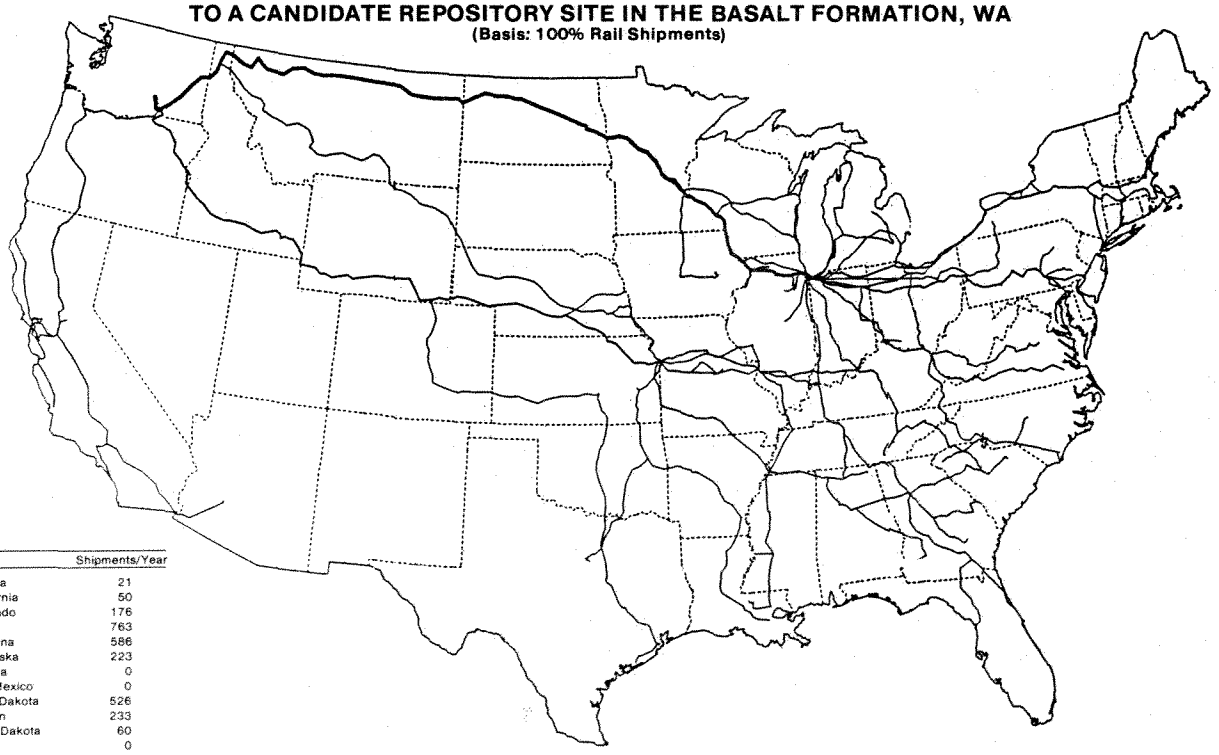
(Basis: 100% Truck Shipments)



State	Shipments/Year
Arizona	147
California	354
Colorado	435
Idaho	5917
Montana	469
Nebraska	5013
Nevada	0
New Mexico	0
North Dakota	461
Oregon	5845
South Dakota	9
Utah	5448
Washington	6405
Wyoming	5456

POSSIBLE ROUTES FOR SHIPMENTS OF SPENT FUEL TO A CANDIDATE REPOSITORY SITE IN THE BASALT FORMATION, WA

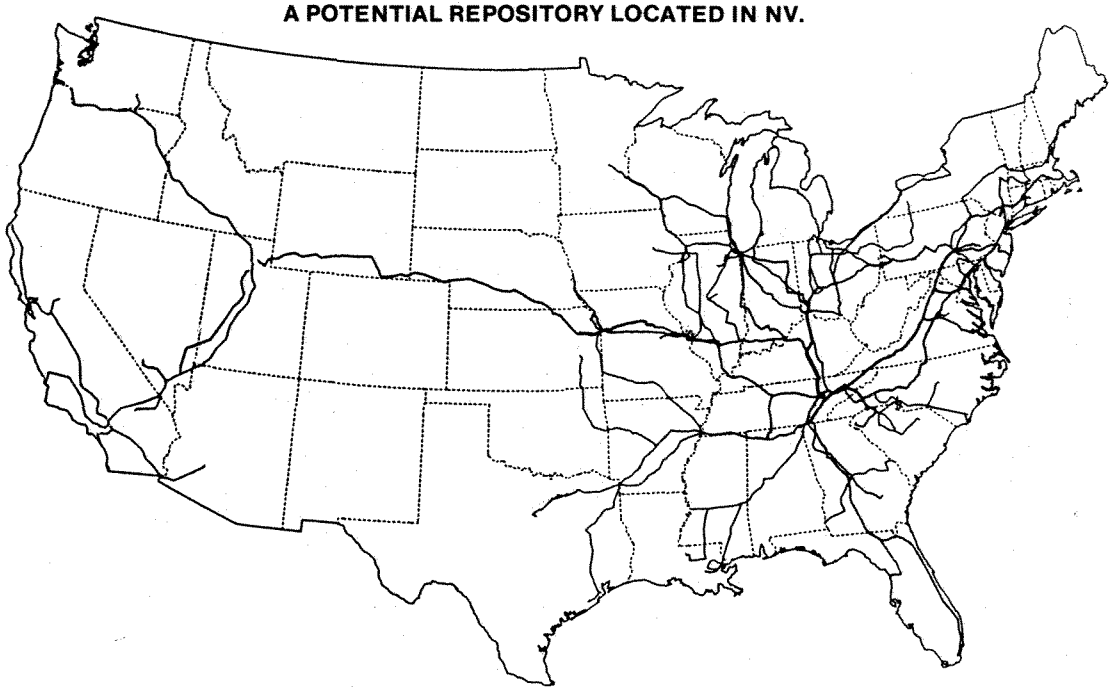
(Basis: 100% Rail Shipments)



State	Shipments/Year
Arizona	21
California	50
Colorado	176
Idaho	763
Montana	586
Nebraska	223
Nevada	0
New Mexico	0
North Dakota	526
Oregon	233
South Dakota	60
Utah	0
Washington	830
Wyoming	237

DOE is required under the NWPA to investigate the concept of a monitored retrievable storage (MRS) facility. Such a facility, as currently envisioned by DOE, would be located in Tennessee where it would serve as a receiving, packaging and handling facility for spent fuel shipments from utilities in the eastern half of the United States. The MRS could repackage the spent fuel and consolidate many smaller shipments for ultimate shipment to the repository, possibly by truck convoy or unit train, thus decreasing the total number of shipments to the repository. The following map shows one possible set of highway and rail routes from eastern reactors to an MRS facility in Tennessee, rail transport from the MRS to the candidate repository site in Nevada and highway and rail routes from western reactors directly to the repository.

POSSIBLE COMBINATION OF RAIL AND TRUCK ROUTES TO A POTENTIAL MRS FACILITY LOCATED IN TN AND A POTENTIAL REPOSITORY LOCATED IN NV.



Based on maps provided by the Department of Energy

Since enactment of the NWPA, the Department of Energy has generated a series of documents affecting transportation decisions under the Act. Following is a description of the most significant documents.

DOE Transportation Documents

Required by NWPA

Siting Guidelines (10 CFR 960)

The Guidelines are required by the NWPA to guide DOE efforts to select sites for the first and second round repositories. The Guidelines, which include transportation considerations, were approved by the NRC in June 1984 and are currently the subject of litigation by several states and environmental groups.

Mission Plan

The Act requires DOE to prepare a Mission Plan "which shall provide an informational basis sufficient to permit informed decisions" under the NWPA. A draft Mission Plan was issued in April 1984; a plan was issued in June 1985. The plan is expected to be subject to regular review and revision as the repository program progresses.

Environmental Assessments

Environmental Assessments of sites being considered for characterization are required to be prepared under the NWPA. DOE issued draft EAs on the nine potential first round sites in December 1984. Final EAs are expected in November 1985 after which the President will select the three sites to be characterized. The draft EAs delineate how the transportation factors were evaluated in selecting the three sites to be characterized.

Other Transportation Documents

Transportation Discussion Papers

Beginning in September 1984, DOE decided to develop a series of Transportation Discussion Papers to outline the Department's views on a number of issues. First drafts of papers on routing, prenotification, liability, emergency response, overweight trucks, inspection and enforcement/highway, inspection and enforcement/rail, safeguards, and safety assurances in cask development and testing have been prepared. The Board's HLW Committee has recommended expansion of those papers and development of several additional papers. DOE is currently working to expand the papers.

Transportation Business Plan

In December 1984, DOE released an interim *Transportation Business Plan: Strategies Options Document.* The document outlines the plans and business strategies for developing and operating the transportation system (e.g. cask engineering, procurement, maintenance, etc.) needed to move spent fuel and HLW under the Act.

Transportation Institutional Plan

This plan for DOE interaction with various groups on transportation issues is being prepared by the Department; a draft plan is expected in the Fall of 1985. The plan will include expanded discussion papers on individual transportation issues.

HOW ARE WASTE SHIPMENTS REGULATED?

Numerous federal agencies will be involved in the transportation of spent fuel and high-level waste to the repository. However, the major roles, as shown in the following box, will be played by DOE as the shipper, and by the Nuclear Regulatory Commission (NRC), the Department of Transportation (DOT), and the Interstate Commerce Commission (ICC), as regulatory agencies, and by the Federal Emergency Management Agency (FEMA).

Federal Responsibilities for Commercial Spent Fuel/HLW Transportation

DOE
- Take title to the spent fuel at the reactor
- Provide casks for waste transport
- Make all shipping arrangements
- Collect disposal fees from the waste owners and generators
- Regulate DOE's transportation contractors
- Assist state and local governments in responding to transportation emergencies
- Sponsor emergency response training

NRC
- Establish shipping cask requirements
- License casks
- Establish lifting and tie-down standards for packages
- Establish safeguard requirements to prevent sabotage of shipments
- Approve shipment routes for spent fuel
- Require advance notification to states of shipments

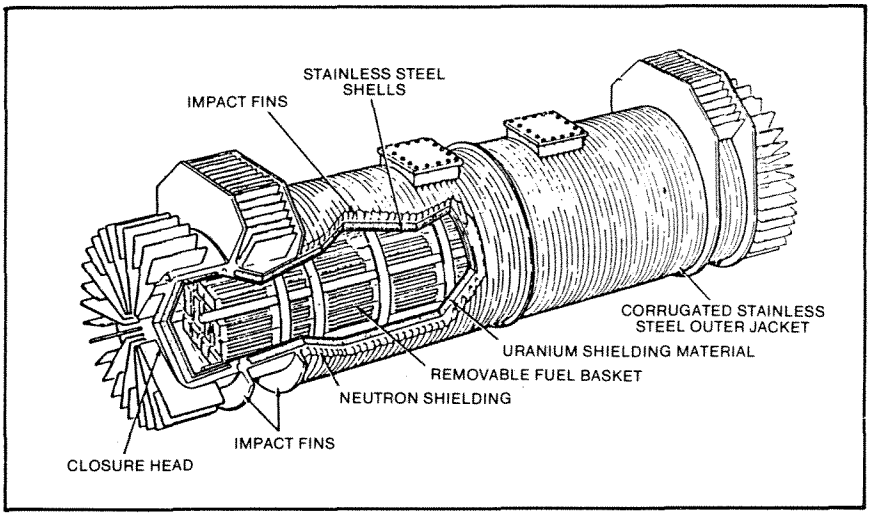
DOT
- Regulate carriers of radioactive materials
- Regulate the conditions of transportation - e.g., routing, handling and storage, vehicle requirements, driving and parking, driver qualifications
- Establish requirements for labeling packages and placarding vehicles

FEMA
- Assist federal and state agencies in developing emergency response plans
- Coordinate federal agencies' emergency response in the event of an accident

ICC
- Regulate economic aspects of transportation

The spent fuel is presently transported in shipping casks similar to the cask pictured below. A new generation of transportation casks will likely be developed to transport spent fuel and HLW under the NWPA. DOE has primary responsibility for the design, development, and testing of the casks to be used in shipments to the repository or an MRS facility. In a Procedural Agreement between the NRC and DOE, however, DOE expressed its intention to use

NRC-approved casks for shipments from NRC-licensed facilities to the repository, MRS or federal interim storage facility, unless such packaging is unavailable or would not allow DOE to accomplish its mandate under the NWPA.



The NRC cask standards require shipping casks to be designed so as to prevent the loss or dispersal of the radioactive contents, provide for adequate shielding and heat dissipation and prevent "nuclear criticality" (the critical point at which a spontaneous nuclear reaction occurs) under both normal and accident conditions of transportation. The normal transportation conditions which a cask must withstand are related to heat, pressure differential, vibration, water spray, impact, compression and penetration.

Hypothetical accident conditions which the casks must withstand, without losing their contents or emitting unacceptable levels of radiation, are simulated by subjecting the casks to a series of four tests. The free drop test drops the cask 9 meters (30 feet) on to an essentially unyielding surface. This test is more stringent than it appears because the obstacles faced by a shipping cask during transportation are not unyielding. The transport vehicle, other vehicles, bridge abutments, water, and even the earth, will yield upon impact, thus absorbing much of the energy of the accident. The second accident test is a puncture test in which the cask is dropped 1 meter (40 inches) onto a 15 cm (6 inch) diameter vertical steel bar. The thermal test exposes the cask to heat of 800 degree Celsius (1475 degrees Fahrenheit) for at least 30 minutes. Finally, the cask must survive immersion in 0.9 m (3 feet) of water for eight hours. The cask must also pass a fifth test (which is not part of the above series) in which the cask is immersed in 15 m (50 feet) of water for eight hours.

The above tests are not required to be performed on an actual cask for NRC licensing. Instead, the ability of a cask to withstand the tests can be evaluated by subjecting a scale model of the cask to actual testing or by substituting an engineering analysis and computer simulation for actual testing.

While commercial spent fuel and HLW are being transported, shippers and carriers must comply with the regulations established by the NRC and DOT. The NRC's safeguard regulations for spent fuel shipments, designed to protect shipments from sabotage, currently require the use of a physical protection system. The basic elements of the system are prenotification to NRC and the states of upcoming shipments, procedures for handling acts of sabotage, a communications center to monitor the shipment's progress and report emergencies, advance approval by NRC of the routes to be used, arrangements with local law enforcement agencies along the route, use of escorts (armed escorts in heavily populated areas), and avoiding intermediate stops where practicable. The NRC also establishes lifting and tie-down standards for casks.

Shippers and carriers of spent fuel and HLW must also comply with DOT's shipping requirements. Some of the DOT regulations are designed to ensure that people coming in contact with the shipments are aware of the radioactive nature of the vehicle's contents. Thus, packages must be labeled and vehicles placarded with the standardized labels and placards which identify radioactive materials, and the shipping papers carried by the carrier must describe the contents in more detail. DOT also regulates the handling (loading, unloading and arrangement of packages) of HLW during transportation. The handling regulations also establish the maximum amount of radiation which may be emitted from the packages during transportation. Drivers of motor vehicles used to transport spent fuel and HLW must meet the DOT requirements for qualifications and training.

DOT has also developed routing requirements which shippers and carriers must comply with in selecting the routes for individual shipments by highway. (No rail routing requirements exist at the federal level.) Shipments of highway route controlled quantities of radioactive materials must be along the "preferred routes," which are the interstate highways (by-passes and beltways around cities are to be used when available) or a state-designated route selected by a state routing agency using a routing analysis which adequately considers overall risk to the public.

The above discussion applies to commercial shipments of spent fuel and HLW. Significant amounts of spent fuel and HLW, however, have been generated by atomic energy defense activities. As discussed previously, DOE is responsible for the nuclear defense wastes, which will be commingled with commercial wastes in a repository. DOE also ships civilian spent fuel and

HLW under its research and development program. Under the current system, DOE shipments are subject to some of the same requirements as the commercial shipments discussed above, but will be exempt from others. It is the objective of the DOE Office of Civilian Radioactive Waste Management to have all waste shipments to a repository subject to the same regulatory requirements.

Currently, DOE shipments are exempt from NRC's regulations for packaging and safeguards, but DOE has developed similar requirements for its shipments. In a procedural agreement with NRC, DOE has also stated its intention to use NRC-approved packaging for NWPA shipments. DOT's transportation requirements (labeling, placarding, routing, etc.) must be complied with for all DOE shipments except for those defense waste shipments which are designated as requiring protection for national security reasons. Where national security interests are involved, DOE is exempt from all of the DOT requirements. DOE has, however, adopted internal standards for national security shipments which closely parallel the DOT regulations.

These federal regulations are designed to ensure that spent fuel and HLW are transported safely to the repository. The possibility of an accident or other emergency always exists, however. In the event of an accident, the carrier has the initial responsibility for minimizing radiological hazards to the public and for notifying state and local authorities, the shipper, the driver's own management and appropriate federal agencies. Shippers, if contacted following the incident, are required to provide any useful information they have about the shipment. State and local governments have the primary responsibility for implementing measures at the scene of the accident to protect life, property, and the environment. Federal agencies will provide technical assistance to the state and local governments upon request.

If an accident occurs en route to the repository, funds to compensate the injured public will generally be available under the federal Price-Anderson Act. The Act establishes an insurance and indemnification system which covers the liability of all persons who cause or contribute to a HLW transportation accident. The amount of money available would be $500 million to $640 million, depending on the nature of the facility which shipped the materials. Generally, the extent of financial liability and types of costs to be reimbursed would be determined by applicable state law.

FINDINGS AND RECOMMENDATIONS

The High-Level Radioactive Waste Committee of the Western Interstate Energy Board (the Committee) believes that the successful development and operation of a national spent fuel and HLW transportation system can best be accomplished through an open process based on the common sense approach of taking all reasonable measures to minimize public risk and performing whatever actions are reasonably required to promote public acceptance.

Public acceptance is not an easily quantifiable factor to be used in weighing alternative solutions to a problem. Clearly, minimizing risk alone will go far toward enhancing public acceptance. However, in transportation routing, there arise questions of frequency of shipments, interference with other traffic, etc., which may be indifferent as to an increase in radiological risk but quite significant to public acceptance. Moreover, public perceptions of risk can be at odds with actual risks. In these circumstances, the Committee believes that public acceptance can best be maximized through a combination of taking all reasonable actions to minimize risk, while ensuring that the public is well-informed and participates in the decision-making process.

The Committee notes that the national high-level radioactive waste transportation system to be established under the Nuclear Waste Policy Act of 1982 will be developed over the ensuing ten to fifteen years. The Committee finds that at present many uncertainties surround the nature and integration of features of the transportation system under the NWPA, such as the impact of a Monitored Retrievable Storage (MRS) facility, cask configuration and capacities, route analysis, etc. Similarly, the timing of decisions on the various features of the transportation system has not yet been specified, although the Department of Energy is developing information to address many of these issues. The Committee believes that with appropriate planning, transportation under the NWPA can be conducted safely, with a high degree of public confidence.

The Committee recommends that the Department of Energy develop a Comprehensive Transportation Plan to provide a framework for all transportation decisions under the Nuclear Waste Policy Act. Development of a comprehensive plan is essential given the number of federal, state and local government entities involved and the extended period over which the transportation system will be developed and used. The Plan should include a schedule for the identification, definition and implementation of the various plan elements and the development of a process for corridor state participation, including coordinated state-federal route-specific analysis and planning.

The Comprehensive Transportation Plan, in the Committee's view, should

have a number of elements and certain of these plan elements should be *integral parts of the site selection process.*

Other plan elements would not need to be implemented until the late 1990s, assuming repository operation begins in 1998. The identification and definition of a process for implementing such plan elements, however, is needed much sooner. The Committee believes that the identification and definition of such plan elements, including a commitment and schedule for implementation of such elements, need to be accomplished as soon as practical. It is important that the identification and definition of such plan elements be completed at the latest by the time of application for a license for a repository/MRS facility since licensing is the last significant milestone in the siting process prior to construction and operation.

Many elements of the plan, such as routing and emergency response, directly affect state responsibilities as well as federal agency responsibilities. Adequate treatment of such elements requires coordinated action by many federal, state and local government entities. Accordingly, the development and implementation of the plan must be done in close cooperation with and among all levels of government.

To achieve the needed cooperation and to maximize public acceptance, the process for developing and implementing the plan should include the active participation of all affected states, with particular emphasis on corridor states.

While the Committee recommends the development of a Comprehensive Transportation Plan by the Department of Energy to provide a framework for and to guide all transportation-related decisions and activities under the Nuclear Waste Policy Act, it recognizes that many of the elements of such a plan are currently being addressed by the Department of Energy. To assist in this process, the Committee has, therefore, developed a "Plan Outline" to structure in a comprehensive and constructive way the range of transportation issues of particular concern to the western states at this time. This approach reflects the importance the Committee attaches to coordinating the review of all transportation issues within the context of a single and comprehensive planning process. Many of the preliminary suggestions of the states contained in the "Plan Outline" are initial benchmarks based on the state of information about the NWPA program as of early 1985. Many of the suggestions are based on the insights of the members of the Committee and are not necessarily a product of definitive analysis at this early stage in the NWPA process. Nevertheless, the recommendations have been developed to assist in an on-going and cooperative process between federal and state agencies to assure that when the transportation system begins to function toward the turn of the century, it will be extremely safe and broadly acceptable to both the general and directly affected publics and not unreasonably burden the nation's consumers of nuclear generated elec-

tricity who will bear most of the system's cost. Continuing careful state review of the topics discussed below is important as the repository program develops.

Following is a discussion of the elements to be included in the Comprehensive Transportation Plan.

SUGGESTED PLAN ELEMENTS

Selection and Analysis of Transportation Modes and Routes
- Selection of transportation modes
- Analysis of transportation modes and routes
- Potential models for risk analysis

Defense High-Level Waste Shipments
- Regulation of defense waste shipments
- Volumes of defense waste to be shipped

Routing for Waste Shipments and Infrastructure
- Route designation
- Rail routing regulation
- DOE control over routes used by carriers

Casks
- Integration of cask-related activities into the repository program
- Testing of a new generation of casks

Liability
- Federal government liability
- Monitored retrievable storage
- Reimbursement for precautionary evacuation and emergency response costs
- Liability coverage for diversions and sabotage

Inspection and Enforcement and Incident Reporting
- Responsibility for the adequacy of inspection and enforcement
- Funding state and local inspection and enforcement activities
- Transportation incident reporting

Emergency Preparedness and Response
- Federal emergency response obligations
- Equipment needs for emergency response/cleanup
- Establishment of emergency planning parameters
- Training for emergency response personnel
- Funding for emergency response and training

Operational Issues
- Driver training
- Placarding and vehicle identification
- Transportation safeguards
- Notification of shipments
- Application of the ALARA concept
- Special precautions for rail shipments

Highlights of Suggested Plan Elements

Selection and analysis of transportation modes and routes. The Committee believes that the foundation of a Comprehensive Transportation Plan must be the analysis of the mode(s) of transport (rail, barge, truck) and the routes that will be used. The Committee recognizes the difficult analytical problem in attempting to deal simultaneously with variables related to casks, modes, facility configuration and routes. The Committee supports DOE's plan to conduct route-specific analyses of nuclear waste transport by highway and rail during the site-characterization stage of the repository program. The Committee suggests that the transportation analysis at the environmental assessment stage be based on a number of route-specific factors (e.g., accident rates, stop times and emergency preparedness). At the characterization stage, the transportation analysis of route-specific factors should be expanded. Such data, however, should not be so detailed that data collection becomes an end in itself, rather than a means to insure that NWPA transportation is conducted safely.

Defense high-level waste shipments. Nuclear waste related to defense and weapons production will be disposed of along with commercial nuclear waste in one repository. DOE has begun to evaluate potential impacts of transporting such waste to a repository. The Committee suggests that several issues be addressed by DOE in its evaluation, including whether classified shipments will be made to a repository, and whether defense waste shipments will be held to the same regulatory requirements as are applied to commercial waste shipments (for example, prenotification and highway routing requirements).

Routing for waste shipments and infrastructure. Regulations issued by the Department of Transportation established a "preferred" routing system for certain highway route-controlled quantities of radioactive materials, where carriers must travel using an interstate highway system or a state-designated route selected by a state routing authority. The Committee encourages the Department of Energy to participate in regional efforts of state and local governments to develop acceptable routes for transporting waste to a repository. In addition, the committee recommends that DOE formally endorse a policy under which the Department will develop a cooperative process with the Department of Transportation and the states to specify which routes are to be used by carriers of spent fuel and high-level waste destined for disposal in a repository.

In related issues, the Committee suggests that DOE work with states to evaluate the need for "safe havens" to minimize radiological exposure

during normal transportation stops and to evaluate any infrastructure deficiencies which should be corrected before transportation to the repository begins. The Committee also urges DOE to support reevaluation by the Department of Transportation of the need for rail routing regulations.

Casks. The Committee encourages DOE to conduct full-scale tests of shipping casks in order to test the cask and increase public confidence in the integrity of a new generation of transport casks likely to be developed under the NWPA. The western states are interested in participating with DOE in designing full scale cask tests in order to simulate accident scenarios that might be encountered along a shipping route. The Board also recommends that the Plan identify how the significant work being done for DOE by TVA and others on cask design will be integrated into transportation decisions under the NWPA.

Liability. The Price-Anderson Act currently provides extensive liability coverage for damages suffered by the public as the result of certain nuclear incidents, including those involving the transportation of nuclear materials to or from facilities covered under the Act. Congressional review of the federal regulatory scheme is to be completed by 1987, at which time the Act will expire unless reauthorized. Accordingly, DOE has an excellent opportunity to review the Act in terms of options for liability coverage for incidents involving the operation of a repository, or the transportation of nuclear waste to a repository. The Committee encourages DOE to continue to investigate appropriate liability limits, clarify the application of the Act to activities related to a monitored retrievable storage facility, define the source of coverage for federal government liability, examine whether all potential sabotage events are covered and clarify its position as to the recovery under the Act of emergency response costs incurred by state and local governments.

Inspection, enforcement, and incident reporting. The examination of an issue cannot end with the adoption of regulations. No matter how well-designed regulations may be, it is also necessary to ensure adequate implementation. In the area of nuclear waste transportation, inadequate implementation could jeopardize public safety and health. Accordingly, the Committee suggests that DOE and the states work together to examine possible shortcomings in the quality of enforcement of federal and state inspection and safety regulations, and develop methods for improving the current system of inspection, enforcement, and transportation incident reporting.

Emergency preparedness and response. The Committee believes a major consideration under the Nuclear Waste Policy Act's repository program is the adequacy of federal, state, and local emergency response capabilities to respond to possible nuclear waste transportation accidents. The Committee urges the federal government to continue to define federal agency duties and capabilities for assisting state and local governments in responding to serious transportation accidents involving nuclear waste. The Committee further encourages the federal government to examine, in cooperation with state emergency response agencies, the potential need to expand federal emergency response training programs. DOE should also continue to work with the states to investigate and define state emergency response and training funding requirements, and to develop acceptable funding mechanisms.

Operational issues. The operational aspects of handling and transporting nuclear waste to a repository represent another area of significant interest to the Committee. Particular areas which the Committee believes merit continued examination include: the quality of driver training; the possibility of DOE working with DOT to further identify nuclear waste shipments by developing a more detailed placarding system; application of the ALARA concept (which would limit radiation exposure to levels "as low as reasonably achievable") to nuclear waste transportation to a repository; the evaluation of new real-time tracking technologies and their potential application to waste transport; and the retention of current transportation safeguards to protect shipments of spent fuel from acts of sabotage. (It should be noted, however, that several western states do not approve of the use of armed guards as required by present safeguard requirements.)

Recommendations for State Action

While the concerns discussed above may best be dealt with at the federal level (with the cooperation of the states), there are also issues that deserve close attention at the state level. Such issues include: intrastate coordination and participation of cities, counties, interest groups, industry and Indian tribes; examination of state law to ensure sufficient compensation will be made available to the public in the event of a serious transportation accident involving nuclear material; the possible development of inspection and enforcement agreements among the states (similar to the Commercial Vehicle Safety Alliance, and tailored to special needs related to transporting nuclear waste); and the consideration of coordinated state permit systems, in order to ensure consistency among state laws and reduce burdens on interstate commerce.

Intrastate Coordination

All states must recognize their responsibility to provide for full participation in NWPA planning among affected interests in the state. These include cities, counties, interest groups, industry, and interested Indian tribes. The Oregon experience, for instance, involves an internal task force with a geographically representative membership from those interests mentioned above. This task force serves to coordinate the concerns and interests of its members into a comprehensive state-wide review of plan elements and will serve as a forum for the state's participation in route-specific analyses with the Department of Energy and the Department of Transportation. Most of this work will be performed at the site characterization stage.

Price-Anderson Act

State law plays a vital role in determining how people injured in nuclear material transportation accidents will be compensated for personal injury and property damages. The Price-Anderson Act establishes the method for paying for damages suffered by the public as the result of a nuclear incident. In the absence of an "Extraordinary Nuclear Occurence," state law governs with respect to standards of liability, calculations of damages, methods of proof, and statutes of limitations. The Committee therefore urges the western states to examine their own laws to ensure that their citizens receive sufficient compensation in the event they are damaged by a nuclear materials accident.

Many states have restricted statutes of limitations; injured parties must file suit within a certain number of years after the *date of an accident.* Since the effects of exposure to radioactive material are often not evident for many years after a nuclear incident, restricted statutes of limitations may prevent recovery for such damages. States may not have taken action to apply a standard of strict liability in the event of a nuclear incident and instead require proof of negligence, which may be difficult to prove for nuclear material transportation accidents. Injured persons also may have difficulty in proving that their illnesses were caused by exposure to radiation under traditional rules of causation. Finally, in the absence of a state's waiver of its immunity, the state is not liable. Thus, the Price-Anderson Act will not provide coverage for the portion of damages attributed to the state's role in causing or contributing to a nuclear incident.

The Committee recommends that states review these aspects of their laws and consider changing them as they apply to nuclear materials transportation accidents.

The Committee also recommends that states consider amending state law to define certain unique costs associated with responding to transportation

accidents involving radioactive materials as elements of public liability, and thus reimbursable using Price-Anderson monies.

Agreements Among States on Inspection and Enforcement

The Committee recommends that states consider multi-state agreements on inspection and enforcement, similar to the Commercial Vehicle Safety Alliance but tailored to the needs of spent fuel and HLW transportation. Such agreements could improve the efficiency of inspection and enforcement efforts and reduce the burden on interstate commerce.

Multi-State Permit and Fee Systems

State permit and fee systems covering shipments of hazardous materials, including HLW, are viewed by some as an attractive source of funding for state and local inspection, enforcement, and emergency preparedness/response activities. The U.S. Department of Transportation, however, has consistently opposed permit and fee systems. Coordinated multi-state permit and fee systems present an opportunity to lessen the perceived degree of interference such schemes present to interstate commerce, and to eliminate duplicative state inspection activities.

The Committee recommends that the states investigate the use of multi-state compacts or agreements governing multi-state permit and fee systems, cooperative inspection of hazardous materials shipments, and cooperative enforcement of applicable safety regulations.

The information in this White Paper draws on an extensive set of recommendations of the High-Level Radioactive Waste Committee and a 550+ page primer on high-level waste and spent fuel transportation. Following is the table of contents of the transportation primer.

Contents of
Spent Nuclear Fuel and High-Level Radioactive Waste Transportation Primer

Appendices

The 550+ page report is available for purchase from the Western Interstate Energy Board.

This White Paper capsulizes the more detailed recommendations of the High-Level Radioactive Waste Committee of the Western Interstate Energy Board. The detailed recommendations may also be obtained from the Board.