

# Transporting Spent Nuclear Fuel and High-level Radioactive Waste to a National Repository

## Answers to Frequently Asked Questions



## **Introduction**

**Radioactive materials play an important role in our lives. They are used in the fields of medicine, industry, research, defense, and power production. Any process that uses radioactive materials generates radioactive waste in some form. This radioactive waste must be handled, packaged, transported, and disposed of properly to protect the health and safety of present and future generations.**

**Currently, thousands of tons of high-level radioactive waste and spent nuclear fuel are stored in temporary government and commercial storage facilities in 39 states. Some radioactive elements in spent nuclear fuel and high-level radioactive waste are hazardous to human health and the environment for only a few years; others are hazardous for hundreds of thousands of years.**

**The Nuclear Waste Policy Act of 1982 established a comprehensive national policy for the permanent disposal of the nation's spent nuclear fuel and high-level radioactive waste. The Act directs the U.S. Department of Energy (DOE) to site, construct, operate, and eventually close a deep geologic repository as a permanent disposal facility. Within DOE, the Office of Civilian Radioactive Waste Management is responsible for**

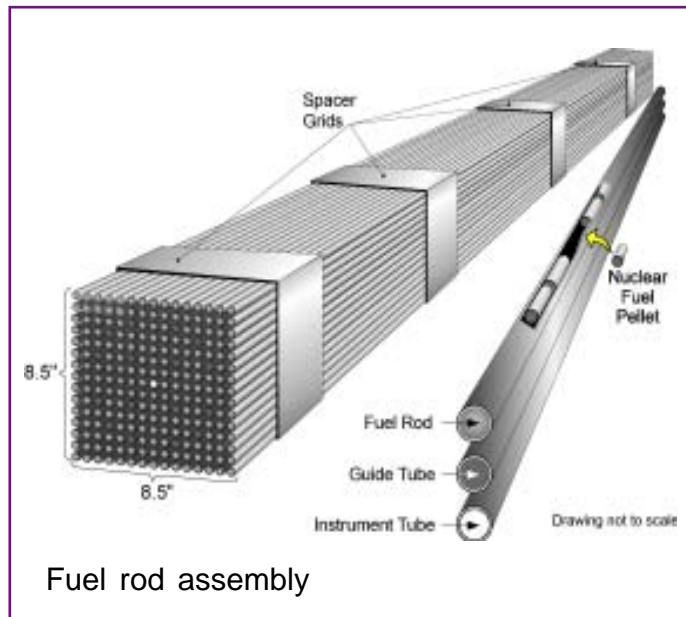


**this program. In 1987, Congress amended the Act to direct the DOE to study only one site: Yucca Mountain in Nye County, Nevada, 90 miles northwest of Las Vegas. In July 2002, Congress and the President approved the development of Yucca Mountain site for the nation's first repository.**

If the Yucca Mountain site were licensed by the U.S. Nuclear Regulatory Commission (NRC), it would be necessary to transport spent nuclear fuel and high-level radioactive waste to the site. This brochure provides answers to questions concerning the transportation of spent nuclear fuel and high-level radioactive waste to a repository at Yucca Mountain.

## What are spent nuclear fuel and high-level radioactive waste?

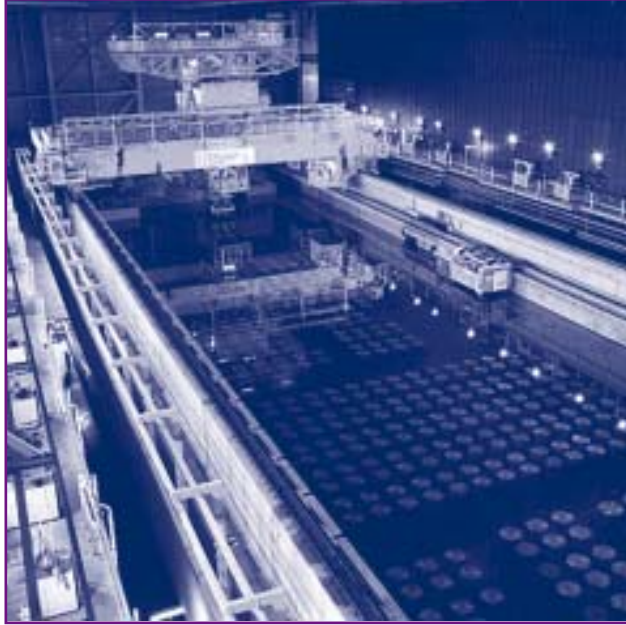
Spent nuclear fuel is used fuel that comes mostly from commercial nuclear power plants, as well as from government and university



nuclear research reactors and reactors on nuclear submarines and ships. Nuclear reactors use solid, ceramic pellets containing uranium for fuel. The pellets are sealed in strong metal tubes, which are bundled together to form a nuclear fuel assembly. Depending on the type of reactor, the fuel assemblies can be as long as 16 feet and weigh up to 1,900 pounds.

After three or four years in a reactor, the fuel is no longer efficient as an energy source and the assembly is removed. After removal, the spent nuclear fuel assembly is highly radioactive and thermally hot, and therefore requires shielding and remote handling.

High-level radioactive waste primarily results from defense nuclear activities. All high-level radioactive waste and spent nuclear fuel destined for the Yucca Mountain repository would be in a solid, stable form before being transported, and cannot burn, explode, or leak.



Onsite pool storage



Onsite dry cask storage

## Where are spent nuclear fuel and high-level radioactive wastes now stored?

Spent nuclear fuel and high-level radioactive waste are currently located at 131 sites in 39 states, including commercial power reactor sites and some DOE facilities. These sites are located in a mixture of urban, suburban, and rural environments.

## What containers would be used for shipments?

Containers used for shipments of spent nuclear fuel and high-level radioactive waste are large, robust, metal casks certified by the NRC. They provide multiple layers of shielding of the radioactivity to protect public health and safety

during transportation. A loaded rail cask may vary in weight from 70 to 150 tons and is about 18 feet long and 7 feet in diameter. A loaded truck cask weighs about 24 tons and is about 18 feet long and 4 feet in diameter. Casks are typically constructed of stainless steel with lead or other shielding materials.



## When would shipments begin?

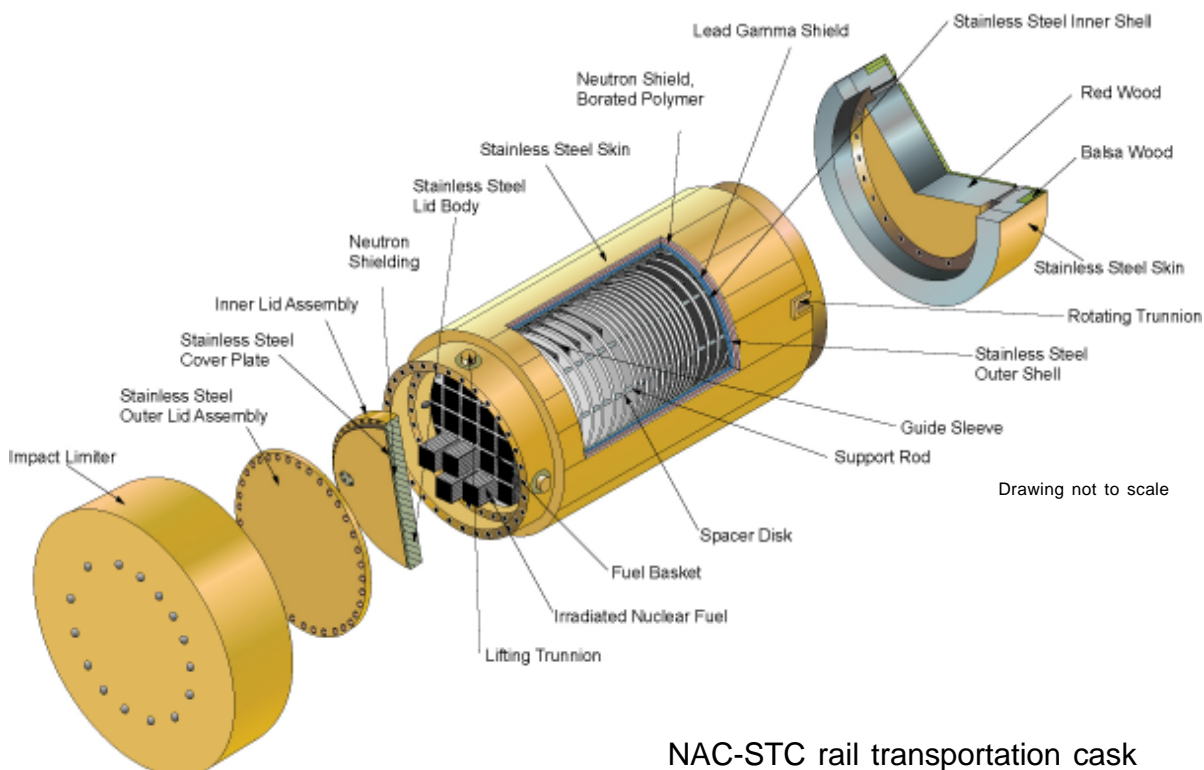
Under the current schedule, 2010 is the earliest date that shipments to Yucca Mountain could begin. The DOE would begin moving spent nuclear fuel and high-level radioactive waste from current storage sites to Yucca Mountain only after the NRC grants the DOE a license to receive waste at the site.

## How many shipments would there be by rail or by road?

The DOE would use some combination of trains and trucks to move spent nuclear fuel and high-level radioactive waste to a repository. The method of transport would depend, in part, on the cask handling capability and the transportation infrastructure of the individual sites of origin. Some sites, for example, do not have the capability to handle large rail casks, so trucks would be used.

The DOE prefers to use mostly rail shipments to Yucca Mountain. Using mostly rail, DOE estimates there would be approximately 175 truck and train shipments per year over a 24-year period: approximately 3,200 train movements and less than 1,100 truck shipments. The Nuclear Waste Policy Act limits the amount of waste that could be sent to the Yucca Mountain repository to 70,000 metric tons.

3



NAC-STC rail transportation cask

## What is the safety record for shipments of spent nuclear fuel?

Over the past 30 years, both government and industry have safely completed more than 2,700 shipments of spent nuclear fuel over 1.6 million miles in the United States. While a small number of shipments have been involved in traffic accidents, none has resulted in an injury from the release of radioactive materials.

There is extensive worldwide experience with spent nuclear fuel transportation. More than 70,000 metric tons of spent nuclear fuel (an amount roughly equal to what is expected to be shipped over the entire active life of the Yucca Mountain Project) have been safely shipped in the last 25 years.

## Who regulates the transport of spent nuclear fuel and high-level radioactive waste?

The DOE would be responsible for safely transporting the spent nuclear fuel and high level radioactive waste and would ship the waste in accordance with all applicable regulations.

4

The U.S. Department of Transportation (DOT) and the NRC share primary responsibility for establishing and enforcing requirements for the safe transport of radioactive materials in the United States. Their regulations are based on international standards that have been used to safely ship radioactive materials worldwide for more than 50 years.

DOT regulations set the standards for packaging, transporting, and handling radioactive materials, including routing, labeling, shipping papers, placarding, loading, and unloading. These regulations also specify training needed for personnel who transport hazardous materials.

The NRC regulates the performance of packaging and transport operations of shippers of spent nuclear fuel and high-level radioactive waste. It sets design and performance standards for the casks that carry these materials. The ability of a cask to survive accidents may

be demonstrated by comparing designs to similar certified casks, engineering analyses (such as computer simulation), or by scale-model or full-scale testing. In most cases, a combination of methods is used.

NRC regulations also establish safeguards and security measures designed to reduce the likelihood of diversion or sabotage of spent nuclear fuel shipments.

## **How does the DOE take into account the possibility of terrorist attacks on shipments of spent nuclear fuel and high-level radioactive waste?**

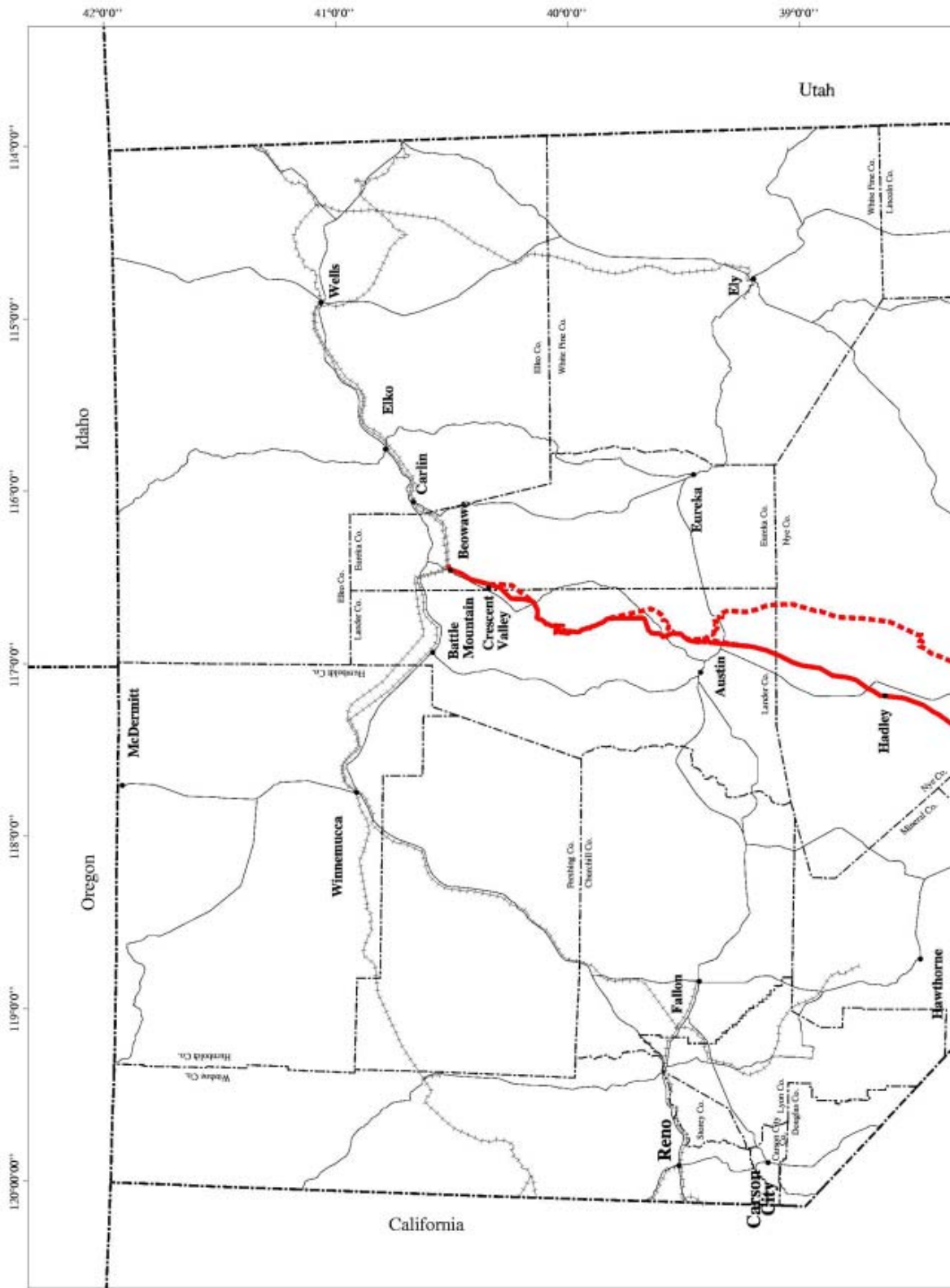
The NRC has a set of rules specifically designed to protect the public from harm that could result from sabotage of spent nuclear fuel casks. The objectives of these security rules are to minimize the possibility of sabotage and facilitate recovery of spent nuclear fuel shipments that could come under the control of unauthorized persons. Security measures include:

- escorts for all shipments
- monitoring through a communication center with 24-hour staffing
- safeguarded schedule information
- coordinated logistics with local law enforcement agencies

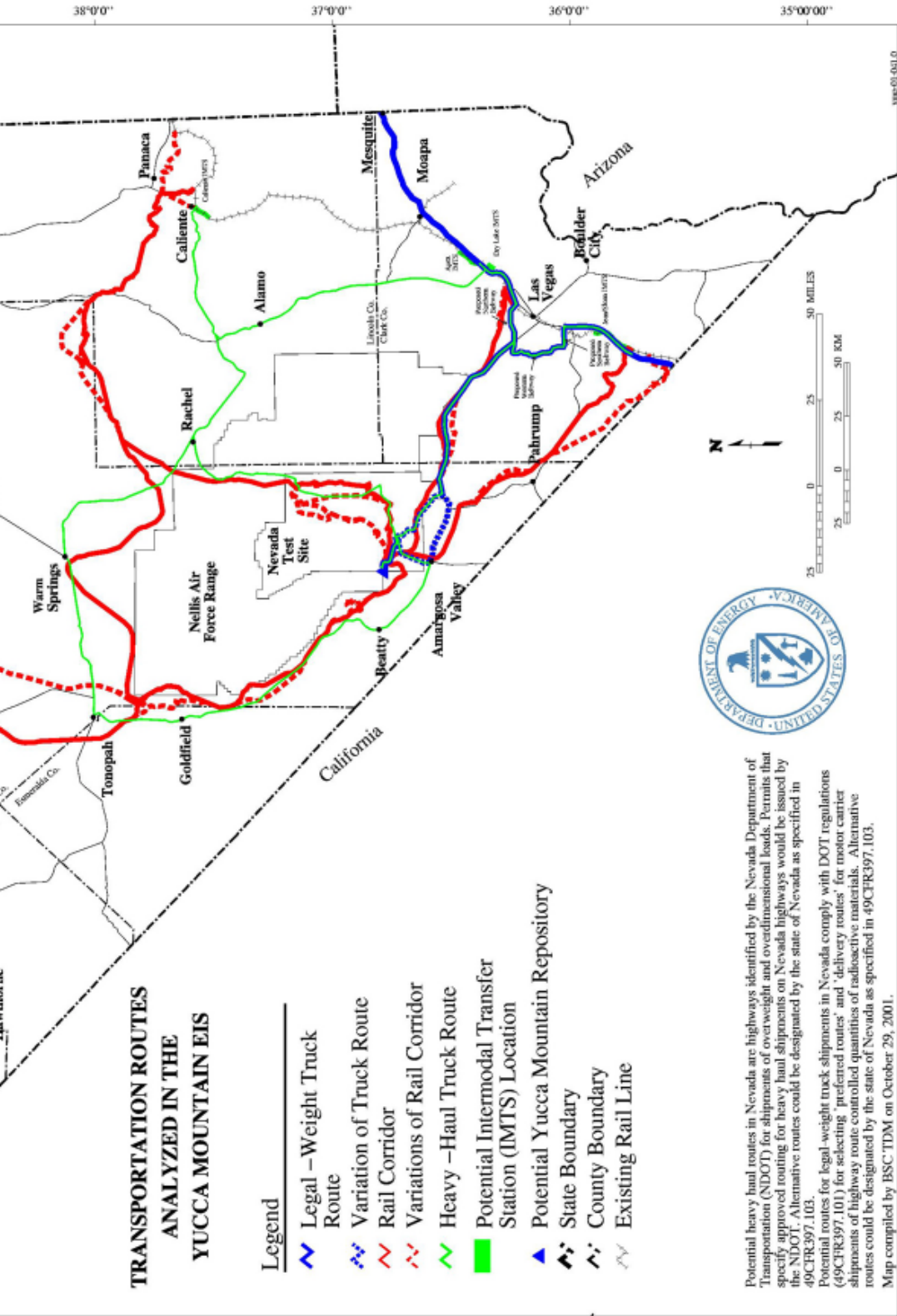
Since September 2001, the NRC, DOE, and other federal agencies have undertaken comprehensive security reviews that will reexamine transportation procedures and requirements. The DOE's Office of Civilian Radioactive Waste Management will ship in accordance with all applicable regulations, including any new requirements, resulting from this review.

## **How would transportation routes to a repository be selected?**

Since Congress has approved Yucca Mountain as suitable for further development as our nation's first high-level radioactive waste repository, the DOE is accelerating the process of detailed transportation planning. This will eventually include working with states and tribes after the preliminary identification of routes.







**TRANSPORTATION ROUTES  
ANALYZED IN THE  
YUCCA MOUNTAIN EIS**

- Legend**
- Legal-Weight Truck Route
  - Variation of Truck Route
  - Rail Corridor
  - Variations of Rail Corridor
  - Heavy-Haul Truck Route
  - Potential Intermodal Transfer Station (IMTS) Location
  - Potential Yucca Mountain Repository
  - State Boundary
  - County Boundary
  - Existing Rail Line

Potential heavy haul routes in Nevada are highways identified by the Nevada Department of Transportation (NDOT) for shipments of overweight and overdimensional loads. Permits that specify approved routing for heavy haul shipments on Nevada highways would be issued by the NDOT. Alternative routes could be designated by the state of Nevada as specified in 49CFR397.103.

Potential routes for legal weight truck shipments in Nevada comply with DOT regulations (49CFR397.101) for selecting "preferred routes" and "delivery routes" for motor carrier shipments of highway route controlled quantities of radioactive materials. Alternative routes could be designated by the state of Nevada as specified in 49CFR397.103.

Map compiled by BSC-TDM on October 29, 2001.



Transportation routes analyzed in the Yucca Mountain Environmental Impact Statement (EIS)

Rail routes would be selected in coordination with rail carriers. Route consideration would involve the distance to be traveled, the number of interchanges between railroads, and operational input from carriers.

For highway shipments, the DOT classifies spent nuclear fuel and high-level radioactive waste as a “Highway Route Controlled Quantity.” This means that the transport of these materials is subject to special regulations. Under DOT guidelines, the shipments would travel on Interstate highways, beltways, or bypasses. State and tribal routing agencies, following DOT regulations, may designate alternate highway routes through their jurisdictions. Shipment routes will be surveyed and approved by the NRC.

At this time – many years before shipments could begin – it is impossible to predict with certainty many of the specific transportation details, including actual routes and shipping modes. Preliminary shipping routes would be identified about five years before any shipments would begin.

## **How would casks be transported in Nevada?**

**8**

Under current plans, truck shipments entering the state would continue in the same vehicles to the Yucca Mountain site. Rail shipments would either continue to the repository on a newly constructed rail line or be transferred to trucks capable of handling a rail cask. These shipments would travel on existing highways that could require upgrades.

## **What inspections would be made of shipments to a repository?**

Federal, state, or carrier inspectors would perform both equipment and radiological inspections prior to every shipment, whether by rail or by highway.

For rail shipments, inspections would be required to assure compliance with applicable federal and state regulations, Association of American Railroads rules, and industry standards. Federal Railroad Administration or authorized state agency officials could inspect rail shipments at suitable locations (for example, rail yards) while en

route. Radiological inspections at destination points would also be required.

For highway shipments, the DOE would comply with both the DOT regulatory requirements and the enhanced standards developed by the Commercial Vehicle Safety Alliance (CVSA). The CVSA is an organization of state inspection agencies that developed enhanced inspection procedures specifically for truck shipments of spent nuclear fuel, high-level radioactive waste, and certain other radioactive materials.

Specially trained state and federal authorities would conduct inspections at the points of origin, along the routes, and at the repository. If any of these inspections show the shipping vehicle is non-compliant with applicable standards, the vehicle would not be allowed to proceed until the deficiency is corrected.

## **Who would be responsible for training rail crews and truck drivers?**

Rail carriers would be required to train their crews in areas such as the operation of specific package tie-down systems, the use of radiation detection instruments, and the use of a satellite tracking system that DOE would provide for these shipments. Crews would also be trained for hazardous material handling in accordance with railroad operating rules.

Highway carriers would be responsible for developing a driver qualification and training program that meets DOT requirements. The DOE would also implement additional measures that exceed DOT regulatory standards for driver training. For instance, truck drivers who transport radioactive waste would be required to become proficient in CVSA enhanced inspection procedures and to attend training for hazardous materials emergency response, adverse weather response, and safe parking procedures.

## Would communities know when to expect shipments of spent nuclear fuel and high-level radioactive waste?

In order to protect the shipments, the NRC requires shippers of radioactive materials to safeguard information about the exact time of shipments. For this important reason, the public would not be notified in advance of spent nuclear fuel and high-level radioactive waste shipments.

However, to ensure that state and other officials are prepared for the shipments, the NRC requires governors or their designees to be notified when and where spent nuclear fuel and high-level waste shipments would be coming through their jurisdictions. The NRC has proposed changes to its regulations to include Native American governments under its notification rule. As required by the regulations, the DOE would notify state and tribal points of contact at least seven days prior to shipments. The points of contact would then work with local officials to prepare for shipments.

10

## How can rail cars and trucks carrying spent nuclear fuel and high-level radioactive waste be identified?

If a vehicle is carrying radioactive waste, placards and labels provide valuable information to emergency responders in the event of an accident. Rail cars or trucks carrying radioactive waste to a repository would have a diamond-shaped placard showing the distinctive radioactive material symbol, or “trefoil.” Transportation casks would also have a label identifying the contents of the cask and its radioactivity level.



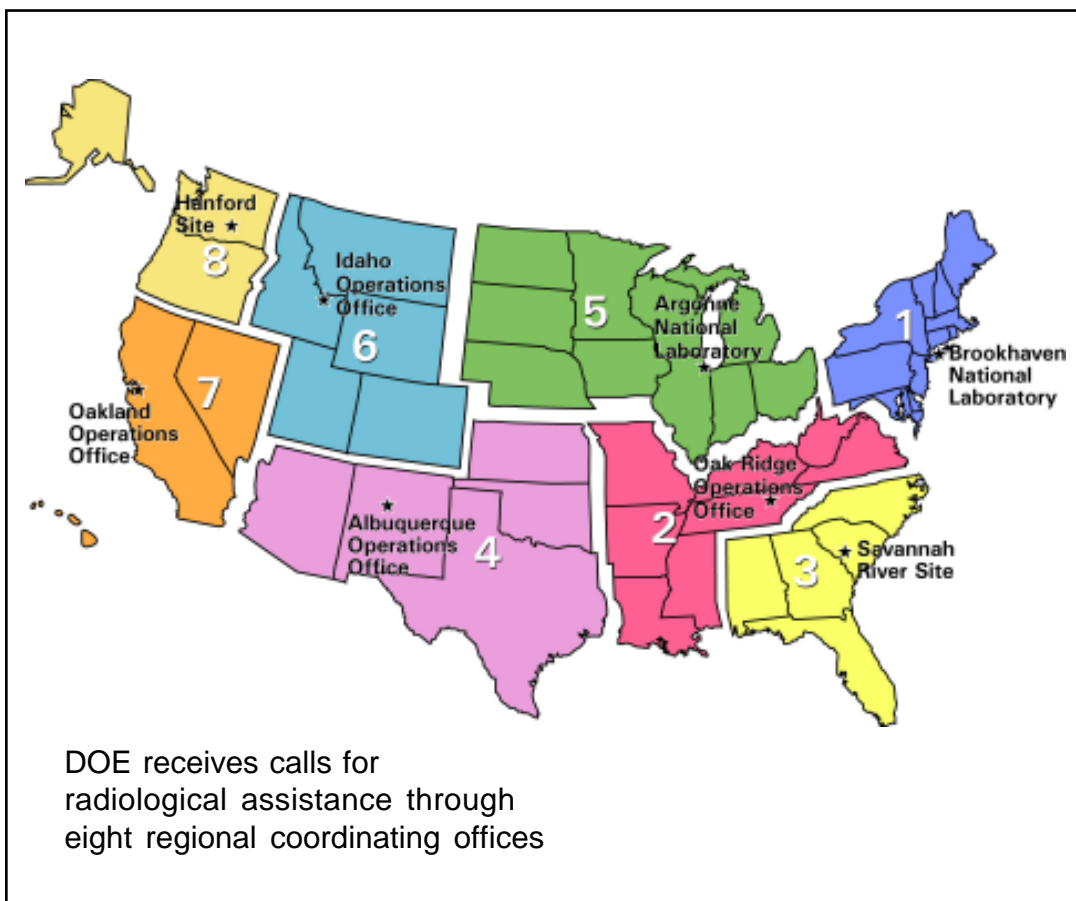
Radioactive warning placard for Highway Route Controlled Quantity (14.25" square)

## How would public safety officials prepare for or respond to emergencies involving radioactive waste shipments?

In an emergency, state, local, and tribal governments are responsible for the safety of their residents and responding to accidents in their

jurisdictions. The key to effective emergency response is training and preparation. Section 180(c) of the Nuclear Waste Policy Act directs DOE to provide technical and financial assistance to states and tribes for training public safety officials in procedures for safe, routine transportation and emergency response procedures. This assistance would begin about three to five years before shipments start.

In the unlikely event of an accident, state, local, and tribal emergency responders would have federal resources available, if requested, to help them with emergency response activities. Highly-trained DOE special-response teams from eight regional coordinating offices are available to assist with any transportation accident involving radioactive materials. These special-response teams assess the emergency situation and advise decision-makers on what further steps could be taken. Their expertise includes assessment, area monitoring, air sampling, as well as exposure and contamination control. In addition, other federal agencies are available to provide assistance, including the Federal Emergency Management Agency (FEMA), DOT, NRC, and the Environmental Protection Agency (EPA).





## **Who would pay for cleanup in the event of an accident involving spent nuclear fuel or high-level radioactive waste?**

All highway carriers are required to carry at least \$5 million liability insurance. Rail carriers are self-insuring. Although DOE officials anticipate accidents could occur in transporting spent nuclear fuel and high-level radioactive waste to the repository, it is extremely unlikely that any accident would lead to a release of radioactive materials from a shipping cask. If such an accident were to occur, any resulting damages would be covered by the Price-Anderson Act, which established a type of “no-fault” insurance and federal indemnification that ensures that up to \$9.43 billion is available to compensate for damages suffered by the public. If the damage from a nuclear incident appears likely to exceed that amount, the Price-Anderson Act contains a congressional commitment to thoroughly review the particular incident and take whatever action is determined necessary to provide full and prompt compensation to the public.

**12**

## **What can the public do to become better informed about spent nuclear fuel and high-level radioactive waste?**

Many opportunities exist for people to learn more about spent nuclear fuel and high-level radioactive waste issues. The DOE operates three public science centers in Nevada, and provides a speakers bureau that arranges for project experts to speak at public events. Access to scientific and technical information is available through the Office of Civilian Radioactive Waste Management website ([www.ocrwm.doe.gov](http://www.ocrwm.doe.gov)), and at public reading rooms located throughout the country. Citizens can discuss their concerns and receive answers to their questions via the Yucca Mountain Project’s toll-free number (1-800-225-6972), via e-mail, or by writing to:

**Yucca Mountain Site Characterization Office  
Office of Civilian Radioactive Waste Management  
U.S. Department of Energy, M/S 025**

**P.O. Box 364629  
North Las Vegas, NV 89036-8629**

**Or**

**Office of Acceptance, Integration, and Transportation  
Office of Civilian Radioactive Waste Management**

**U.S. Department of Energy  
1000 Independence Avenue, S.W.  
Washington, D.C. 20585**

**Additional information available from:**

U.S. Department of Energy ..... [www.energy.gov](http://www.energy.gov)

Office of Civilian Radioactive Waste Management .....

..... [www.ocrwm.doe.gov](http://www.ocrwm.doe.gov)

DOE National Transportation Program ..... [www.ntp.doe.gov](http://www.ntp.doe.gov)

U.S. Environmental Protection Agency ..... [www.epa.gov](http://www.epa.gov)

U.S. Department of Transportation ..... [www.dot.gov](http://www.dot.gov)

U.S. Nuclear Regulatory Commission ..... [www.nrc.gov](http://www.nrc.gov)

U.S. Federal Emergency Management Agency ..... [www.fema.gov](http://www.fema.gov)

State of Nevada, Nuclear Waste Project Office .....

..... [www.state.nv.us/nucwaste](http://www.state.nv.us/nucwaste)



U.S. Department of Energy  
Office of Civilian Radioactive  
Waste Management

## YUCCA MOUNTAIN PROJECT

YMP/DOE-0602

---

P.O. Box 364629  
North Las Vegas, NV 89036-8629  
(702) 794-5555  
(800) 225-6972  
<http://www.ocrwm.doe.gov>

December 2002