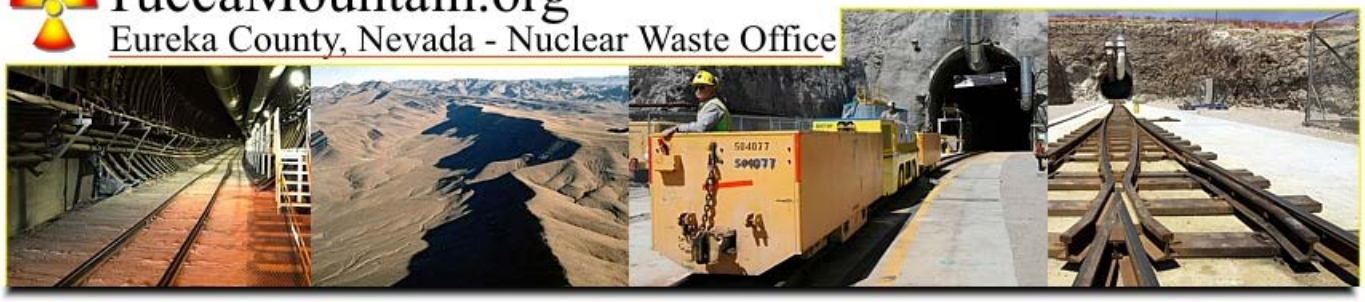
YuccaMountain.org
Eureka County, Nevada - Nuclear Waste Office



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Current Status of the Yucca Mountain Project

Background: As of 2015 the status of the proposed repository at Yucca Mountain remains uncertain. As way of background, in 2002 Yucca Mountain was officially designated as the site to store the nation's spent fuel and high-level radioactive waste. At that time Energy Secretary Spencer Abraham recommended the site to President George W. Bush, who approved it. As allowed under the Nuclear Waste Policy Act of 1982 (NWPA), then Governor Kenny Guinn of Nevada vetoed the decision, but the veto was subsequently overturned by Congress.

Prior to 1987, and as required under the NWPA, the Department of Energy had selected ten locations in six states for consideration as potential repository sites. After detailed studies of these sites, President Ronald Reagan approved three sites for detailed site characterization. The three sites were Hanford, Washington; Deaf Smith County, Texas; and Yucca Mountain, Nevada. In 1987 Congress amended the NWPA and directed DOE to study only Yucca Mountain. The Act did provide that if Yucca Mountain was found unsuitable, "site characterization studies" would be stopped. The amended law was subsequently labeled the "Screw Nevada Bill." (More details about how/why Yucca Mountain was chosen)

Site Investigation & Regulatory Oversight: The Nuclear Regulatory Commission (NRC) and the U.S. Department of Energy (DOE) are primarily responsible for the regulation and disposal of the nation's spent nuclear fuel. NRC regulates the construction and operation of commercial nuclear power plants and spent fuel repositories (e.g., Yucca Mountain). The NRC also regulates the storage and transportation of spent nuclear fuel. Under the NWPA as amended, DOE is charged with site investigation and constructions and operation of a federal geologic repository (e.g., Yucca Mountain). By law, the DOE must also apply to the NRC for a license to build the repository and the license must be granted before any construction begins. In 2008 the DOE submitted a license application to the NRC for Yucca Mountain. The 8,600-page license application was submitted by the Bush administration's Energy Department and was accepted for consideration and license review by NRC.

Existing Regulatory Status: In 2011 funding for the Yucca Mountain repository was terminated by the Obama Administration; effective via amendment to the Department of Defense and Full-Year Continuing Appropriations Act. This action left United States without any long term storage site for the disposal of civilian spent reactor fuel and defense generated High Level Waste.

Given funding limitations and other constraints, the DOE and the NRC subsequently and separately suspended their efforts to license the repository at Yucca Mountain; this action lead to law suits filed by several parties aimed at forcing the NRC to resume the licensing proceeding. Specifically, in 2011, the States of South Carolina and Washington, the National Association of Regulatory Utility Commissioners, and others, filed suit in the U.S. Court of Appeals for the District of Columbia Circuit asking for a writ of mandamus requiring the NRC to restart licensing proceeding for Yucca Mountain.

The court subsequently upheld the desires of the petitioners (granting the writ of mandamus) and on November 18, 2013, the NRC ordered the licensing proceeding restarted and directed its staff to complete work on the Yucca Mountain Safety Evaluation Report (SER). The SER contains NRC's review of the DOE license application, i.e., to insure compliance with NRC licensing regulations for Yucca Mountain. As of January, 2015 the NRC completed all five volumes of the SER. While the NRC staff has concluded that DOE's license applications is "acceptable" it is recommending the NRC deny construction of the repository because DOE doesn't own or have jurisdiction over the land where the repository would be built. Moreover, a supplement to DOE's environmental impact statement for Yucca Mountain has not yet been completed and DOE doesn't hold the necessary water rights to support the project. The land encompassing the repository site is currently under the control of several different federal agencies, including DOE, the Department of the Interior and the Department of Defense; and an act of Congress is needed to transfer the lands in question to DOE.

Regarding water rights, DOE would need to obtain those rights from the state of Nevada. Nevada has refused to appropriate the water and litigation challenging that refusal is stayed. Of note, in late February 2015 the NRC chairman said that the NRC on its own would complete the required above referenced supplemental environmental impact statement.

In any event, the NRC has not made a final decision on the repository license application, but the agency could easily vote on DOE'S application to build the repository once environmental reviews are complete, land and water issues are resolved, and after a series of lengthy and complex hearings on challenges from third parties are entertained.

Funding: Federal funding for DOE's repository program is currently nonexistent; as of January 2015, no federal appropriations have been authorized to support NRC licensing and/or DOE site investigations at Yucca Mountain. Nevertheless, and in compliance with the order by the Court of Appeals, and using limited carry over funds, the NRC is continuing to review DOE's Yucca Mountain license application. It's worth noting, however, to date the U.S. Department of Energy (DOE) has spent at estimated $8 billion studying the site and constructing the exploratory tunnel beneath Yucca Mountain. Moreover, to actually construct and operate a repository at Yucca Mountain, DOE's own estimate suggests the cost could reach $97 billion.

On The Ground Accomplishments: Today the Yucca Mountain site has been abandoned and nothing exists but a boarded up exploratory tunnel; there are no waste disposal tunnels, receiving and handling facilities, and the waste containers and transportation casks have yet to be developed. Moreover, there is no railroad to the site, and the cost to build a railroad through Nevada could exceed $3 billion. Today, the only thing that actually exists at Yucca Mountain is single 5 mile exploratory tunnel.

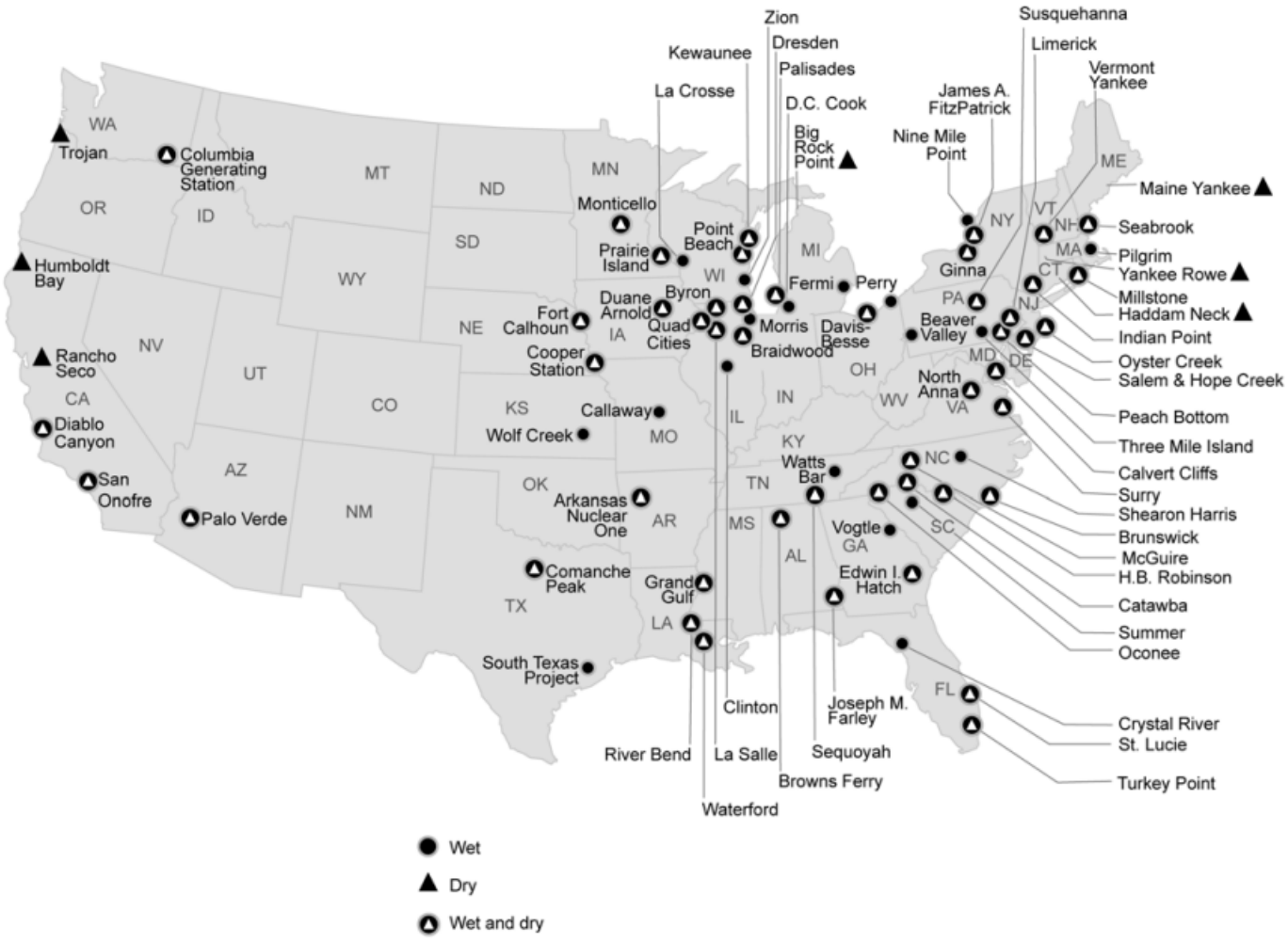
What are spent nuclear fuel and high-level radioactive waste?

Spent Nuclear Fuel: 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 Waste: High-level radioactive waste primarily results from defense nuclear activities. When spent nuclear fuel is processed to extract plutonium for nuclear weapons development, liquid high-level radioactive waste is a byproduct. The liquid waste is subsequently solidified. The Department of Energy (DOE) says all high-level radioactive waste destined for the Yucca Mountain repository would be in a solid, stable form before being transported, and cannot burn, explode, or leak.

As deipicted below, the national inventory of commercial spent nuclear fuel amounts to nearly 70,000 metric tons, which is stored at 75 sites in 33 states. These sites are located in a mixture of urban, suburban, and rural environments.



Why geologic disposal? Why not other solutions?

After years of study, the U.S. and most countries around the world have concluded that permanent geologic burial is currently the most acceptable solution for the final disposition of high-level nuclear waste. Other options, such as shooting the waste out into space, are far too risky.

Some countries in Europe and Asia reprocess their nuclear waste. Reprocessing both reduces the volume of spent fuel and provides uranium and plutonium that can be used to produce more energy. However, the U.S. currently opposes reprocessing because of concerns about the proliferation of nuclear material created.

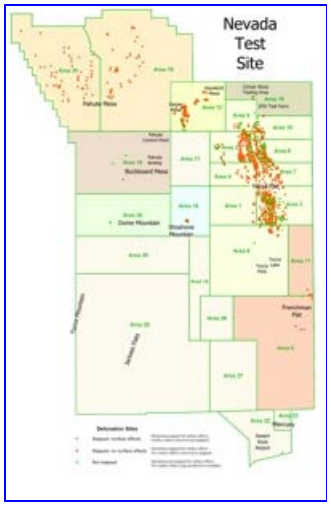
Moreover, liquid high-level radioactive waste is a by-product of reprocessing, and it must be vitrified, or combined with sand and other materials to form a stable glass. The resulting 'glass' presents the same problem as spent fuel: how can we dispose of it?

In theory, geologic disposal offers a multiple-barrier solution. Spent fuel and high-level waste would be placed in specially-engineered casks, and then interred deep below the earth's surface in a repository built in a geologically-suitable formation. High–level waste will remain radioactive for hundreds of thousands of years but there is no way to guarantee that human-engineered waste packages can effectively contain the waste for that long. Geologic disposal provides a second, natural barrier: rocks that would contain waste after containers fail.

Additionally, by locating the repository deep in the earth, spent fuel and high-level waste would be less vulnerable to sabotage and accidents.

However, geologic disposal contains its own risks. At Yucca Mountain, an underground repository could be susceptible to seismic activity, volcanism, and water percolation. If the radiation were to leak, it could contaminate underground water supplies. The key technical risks associated with Yucca Mountain, as a geological repository are discussed here .

What are the characteristics of the Yucca Mountain site?



Yucca Mountain is a 1,200-foot high flat-topped volcanic ridge extending six miles from north to south (see photo above). It is located in Nye County, Nevada, 90 miles northwest of Las Vegas on federally-controlled lands on the edge of the Nevada Test Site. (Note: The U.S. Department of Energy (DOE) recently changed the name of the Nevada Test Site (NTS) to "Nevada National Security Site"). As noted on the map to the right, the NTS was the primary testing location of American nuclear devices (bombs), and from 1951 to 1992 the DOE detonated some 928 nuclear blasts at the site, i.e., 100 above ground and the rest underground of which two-thirds were conducted in the vicinity of the groundwater table.

Yucca Mountain is comprised of "tuff," a rock made from compacted volcanic ash formed more than 13 million years ago. Yucca Mountain has a desert climate and receives about six to seven inches of rain and snow per year. The Mountain has a deep water table. The repository would be built approximately 1,000 feet below the land surface and 1, 000 feet above the water table.

Why Yucca Mountain?

Yucca Mountain was selected as the site for the nation's nuclear waste repository in a process that began in 1982 and ended in 1987 when Congress amended the Nuclear Waste Policy Act (NWPA).

NWPA established a comprehensive policy for permanent geologic disposal of the nation's spent fuel and high-level radioactive

waste. The Act laid out a step-by-step process for the government to search, study, select, and ultimately, construct a nuclear waste repository by the year 1998. NWPA directed the Department of Energy (DOE) to choose three potential sites for geologic disposal, analyze them in detail, and select the most suitable for recommendation to the President. If the President agreed with the recommendation and officially designated the site, the governor of the site's state could veto the decision, but the governor's veto could be overturned by a simple majority in both houses of Congress. All of this was supposed to happen before 1998, when the government had promised to start taking waste from the nation's nuclear power facilities.

By December 1984, the DOE had narrowed the candidates for repositories to sites in Texas, Washington State, and Nevada, at Yucca Mountain. However, the estimated characterization cost, $60 million for each site, had already grown to more than a billion dollars per site. As a result, Congress decided to select only one site for continued study. In 1987, Congress amended NWPA to name Yucca Mountain the sole site to be considered for a nuclear waste repository.

There is ongoing debate about whether Yucca Mountain is the nation's best place for a nuclear waste repository. The DOE maintains that Yucca Mountain was selected because it was consistently ranked as the site that possessed the best technical and scientific characteristics to serve as a repository. The Department says that Yucca Mountain is a good place to store waste because the repository would be:

- In a desert location
- Isolated away from population centers (Las Vegas, the nearest metropolitan area, is 90 miles away)
- Secured 1,000 feet under the surface
- In a closed hydrologic basin
- Surrounded by federal land
- Protected by natural geologic barriers
- Protected by robust engineered barriers and a flexible design

However, the State of Nevada and other groups believe politics played a huge role in the decision. Notably, when the 1987 NWPA amendments were passed, the Speaker of the House of Representatives was Jim Wright, from Texas, and the House majority leader was Tom Foley, from Washington State. Nevada was the smallest and politically weakest state of the three.

The State believes Congress sacrificed fairness for expediency with the 1987 NWPA amendments. As science and technology writer Gary Taubes pointed out, "By choosing Yucca Mountain as the only option for a nuclear-waste facility, Congress put the DOE in an untenable position. In effect, it sent the department out to prove that Yucca Mountain would work as a repository, rather than to do a dispassionate analysis of whether it could work or was the best possible site."
(More History & Commentary — The "scientization" of Yucca Mountain — *By Dawn Stover*)

There is also ongoing debate over whether the geologic features and proposed engineered barriers at Yucca Mountain will provide sufficient isolation for permanent disposal. A number of interested parties believe Yucca Mountain has certain characteristics that pose a concern for long-term isolation of highly radioactive material. The State of Nevada's Agency for Nuclear Projects has expressed concern about several of Yucca Mountain's geologic characteristics:

- Yucca's location in an active seismic (earthquake) region
- the presence of numerous earthquake faults (at least 33 in and around the site) and volcanic cinder cones near the site
- the presence of pathways (numerous interconnecting faults and fractures) that could move groundwater (and any escaping radioactive materials) rapidly through the site to the aquifer beneath and from there to the accessible environment.
- evidence of hydrothermal activity within the proposed repository block

Would a repository at Yucca Mountain protect public health and safety?
Who is responsible for health and safety standards?

Under the Energy Policy Act, the Environmental Protection Agency (EPA) is responsible for setting radiation protection standards for the Yucca Mountain repository. In 2001, the EPA issued a final safety rule outlining a 10,000 year limit on radiation containment at the site. Similarly, the Nuclear Regulatory Commission (NRC) established 10,000 year compliance periods that DOE must meet in order to qualify for a license to construct the repository.

Under these standards, the DOE is required to prove that spent fuel and high-level radioactive waste would be safely stored at Yucca Mountain for 10,000 years. However, in July 2004, the U.S. Court of Appeals in Washington, D.C. vacated the EPA's 10,000 year standard. The State of Nevada had filed suit against the EPA,

saying the 10,000 year period was both insufficient and illegal. The EPA had been required by law to base the safety standard on the recommendations of the National Academy of Sciences. The Academy, however, said the radiation safety standard should be set when the waste would be at its peak radiation levels - at least 300,000 years from the time the waste is sent to Yucca. The Court upheld Nevada's claim, ruling that the EPA deliberately rejected the National Academy of Sciences' recommendation. The EPA must promulgate another rule, or Congress must pass legislation to allow the 10,000 year standard.

Accordingly, in September 2008, the EPA issued new radiation standards for the proposed Yucca Mountain nuclear waste repository. The final standards are a key public health threshold that public officials will use when determining whether the repository should be built. The EPA took three years to finalize the standards after releasing a draft version in 2005.

The EPA issued a two-part standard as follows:

- Retain the dose limit of 15 millirem per year for the first 10,000 years after disposal;
- Establish a dose limit of 100 millirem annual exposure per year between 10,000 years and 1 million years;
- Require the Department of Energy (DOE) to consider the effects of climate change, earthquakes, volcanoes, and corrosion of the waste packages to safely contain the waste during the 1 million-year period; and
- Be consistent with the recommendations of the NAS by establishing a radiological protection standard for this facility at the time of peak dose up to 1 million years after disposal.

For a comparison, a chest X-ray exposes a person to 10 millirem. Americans receive approximately 360 millirem annually from radiation occurring in the environment, from natural sources such as soil, water, and vegetation, and man-made sources like building materials, televisions, and video terminals. (Read the details from EPA or read EPA's Fact Sheet) (Read More on this website)

Despite the ruling on the 10,000 year standard, the DOE maintains that a repository at Yucca Mountain "will perform in a manner that protects public health and safety." DOE engineers have designed waste canisters with two-inch walls of stainless steel protection, covered by half an inch of Alloy 22, a corrosion-resistant nickel-metal alloy. When studies revealed that there would be much more water percolation, or dripping, within Yucca Mountain than previously expected, engineers designed special titanium drip shields to be placed over the waste canisters.

The State of Nevada, however, says that the drip shields and DOE's reliance on waste packages underline the fact that Yucca Mountain is geologically unsuitable for a repository. The State points to the possibility of volcanism and seismic activity, and notes that the area is one of the most geologically active in the country. The Agency for Nuclear Projects also remarks that "the Yucca repository is the only repository under consideration in the world that is located above the water table, not below it."

The DOE says experts have calculated the risk of a volcano disrupting a repository to be virtually nonexistent. The Department also maintains that a repository would withstand the effects of an earthquake due to its location far below the earth's surface. Because vibratory ground motion decreases with depth, earthquakes have much less impact underground than on or near the surface.

On a national level, the DOE says a repository at Yucca Mountain would protect public health and safety by removing nuclear waste from 131 sites around the country and consolidating it into just one place.

Nevada lawmakers, however, call this the "one waste, one place" myth. They point out that by the time Yucca Mountain is filled to capacity, nuclear power plants around the country will have produced almost as much waste as they currently store. The Yucca Mountain repository would have a capacity of 77,000 tons. In 2003, 46,000 tons of high-level waste was stored around the country. Nuclear power facilities produce an additional 2,000 tons of waste a year.

How would nuclear waste be transported to Yucca Mountain?

On April 8, 2004 DOE published a Record of Decision (ROD) in the Federal Register that announced the selection, both nationally and in the state of Nevada of the mostly rail transportation mode for the shipment of 70,000 metric tons of SNF and HLW to Yucca Mountain, Nevada. DOE also decided in the same ROD to select the Caliente rail corridor in which to examine possible alignments for construction of a rail line that would connect the repository at Yucca Mountain to an existing main rail line in Nevada.

A Notice of Intent to develop a Rail Alignment EIS was subsequently published on the same day in the Federal Register. The Rail Alignment EIS considered alternative alignments within the Caliente corridor for construction of a rail line within Nevada

The Caliente rail corridor: Waste would be shipped on existing rail lines or highway routes to Caliente, in southeastern Nevada. The Caliente rail line would curve west around Nellis Air Force Base and then down to Yucca Mountain (see map). The rail line would cover a distance of 319 miles and is estimated by the DOE to take 4 years to build at a cost exceeding 1 billion. In accordance with the National Environmental Policy Act, DOE must complete an Environmental Impact Statement on the rail corridor before construction can take place. In a March 2004 supplemental document to the Record of Decision on Caliente, DOE revealed that legal-weight trucks might be used to ship casks of waste on existing Nevada highways for up to 6 years while the rail line is under construction. Under this scenario, waste shipped on existing rail lines across the U.S. would be transferred to trucks at intermodal stations in Nevada. These intermodal stations would need to be constructed.

If the Caliente railroad line is built in Nevada, to transport wast to Yucca Mountain, what impact would it have on the national railroad system?

On a national scale, the impacts of the proposed railroad line in Nevada would affect about 25,000 miles of rail lines in 44 states. In other words, if the proposed Caliente line is built, DOE would make thousands of shipment of waste for at least four decades, if not longer. DOE shipments to the Caliente rail line in Nevada would traverse about 836 counties past 190 US cities. Of note, if built the proposed Caliente rail line in Nevada would be the longest new track construction considered in the U.S. since the 1930's.

What are the national transportation routes?

Major transportation routes have not been formally identified by the DOE. The Energy Department says rail route consideration would involve the distance to be traveled, the number of interchanges between railroads, and operational input from carriers.

For the highway shipments, special Department of Transportation (DOT) guidelines dictate that waste 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 Nuclear Regulatory Commission (NRC).

Currently there are no rail routing regulations such as there are for highway routing of radioactive waste, and none are anticipated, according to Nevada transportation expert Robert Halstead. Rail rights-of-way are privately owned and restrict the regulatory abilities of state, tribal, and local governments. As a result, units of government below the federal level will have only limited input into routing rail shipments of spent fuel. Federal law requires that the DOT study both dedicated (radioactive waste only) and general-commerce trains to identify the advantages and disadvantages for each mode of transport.

Can waste be safely shipped to Yucca Mountain?

The U.S. has a good safety record of nuclear material transportation. Since 1965, government and industry groups have transported more than 10,000 spent fuel assemblies in more than 2,700 shipments over more than 1.6 million miles. While there have been a few accidents (four highway and four rail) involving the transport vehicles, none has resulted in the breach

of a cask or the release of radioactive materials.

However, spent fuel and high-level radioactive waste would be shipped to Yucca Mountain on an unprecedented scale. According to a recent study completed by the National Academy of Sciences, just one year of waste shipments to Yucca Mountain would exceed all shipments made in the past 30 years. Kevin Crowley, director of the study, said research is showing 2,500 tons of spent nuclear fuel were shipped in the United States by truck or rail between 1964 and 1997. In the future, DOE estimates shipping 3,000 tons of spent nuclear fuel to Yucca Mountain annually for 24 years.

Are the transportation casks safe?

Casks used to contain the spent fuel and high-level radioactive waste are an important part of transportation safety. All casks must be certified by the Nuclear Regulatory Commission (NRC). To be certified, each transportation cask design must be able to withstand all of the following tests, in the given sequence:

- A drop from 30 feet onto an unyielding surface,
- A drop from 40 inches onto a shaft 6 inches in diameter,
- A fully engulfing fire at 1475 F for 30 minutes, and
- Immersion in 3 feet of water

The State of Nevada and other groups remain concerned, however, because these tests are conducted on computer models or on smaller-scale models of the casks. The State has long advocated full-scale testing of several truck and railroad cask designs, as well as rigorous stress testing to determine a cask's breaking point. In May 2004, the NRC authorized new testing of a full-sized cask, but only in a crash and fire scenario.

Will the shipments be secure?

In light of the September 11, 2001 terrorist attacks, shipping thousands of tons of highly toxic radioactive waste across America has serious implications. Waste shipments could be easy and predictable targets for terrorists.

The Nuclear Regulatory Commission (NRC) has established safety rules designed to protect the public from harm that could result from sabotage or terrorist attack on waste shipments. These 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

DOE would be required to follow these rules when shipping waste to Yucca Mountain.

What happens if there is a transportation accident?

In an emergency such as a radiological rail accident, state, local, and tribal governments would be responsible for responding to the accident, with federal assistance available on request. Federal law requires that DOE provide states and tribes with technical assistance and money to train people in radiological emergency response, but not provide the training itself. According to the DOE, this assistance would begin 3 to 5 years before shipments start. If an accident were to occur, DOE has special-response teams in eight coordinating offices across the country to assist.

Nevada Transportation expert Robert Halstead said the state is concerned about accidents and emergency response along rail corridors, where access is often difficult, and a number of questions about emergency radiological response remain unanswered. He cited the difficulties of planning for radiological accidents along rail lines; there is a lack of access along rail corridors, and private ownership of rail rights-of-way makes it uncertain who would control accident sites.

The state is concerned about the effects of the rail corridor on the overall health of communities through which the train travels. Current NRC regulations allow certain amounts of neutron and gamma radiation to be emitted from shipping casks during routine operations and transport (1,000 mrem/hour at the cask surface, and ten mrem/hour 2 meters from the cask surface). The health effects of these low levels of radiation are not fully understood; any emission from casks could increase

health risks.

Who is liable in case of an accident?

Liability for a nuclear accident, whether along a truck or rail route or at a nuclear reactor site, is determined by the Price-Anderson Act. The Price-Anderson Act was first passed in 1957 as an amendment to the 1954 Atomic Energy Act. Originally enacted to help an infant industry get off the ground, the purpose of the act is to protect the nuclear industry from a potential accident liability so large that it would threaten the future of nuclear power, and to ensure that the public would be compensated for any damage resulting from a nuclear accident. The act was amended in 1998 to bring the nuclear-related activities of the Department of Energy (DOE) and its contractors under the same liability coverage - meaning that any accident occurring during the transportation and storage of nuclear waste would also be covered under the Price-Anderson Act.

Under the act's "no-fault" liability system, the amount nuclear power utilities must pay in the event of a catastrophic reactor accident is capped. Reactor owners must obtain $200 million in liability coverage from a private insurance company. If an accident were to exceed $200 million in damages, each of the country's 103 reactor operators must pay up to $88 million per reactor. Therefore, privately financed insurance would cover a total of $9.3 billion in damages. In exchange for this limit on financial liability, in the event of an "extraordinary nuclear occurrence," nuclear utilities must waive legal defenses against paying claims. This is intended to relieve victims of the necessity of proving negligence.

In the event of an "extraordinary" accident involving DOE contractors, as would be the case with nuclear waste transportation, an indemnity agreement would be arranged. This means that the contractors would not be held liable - even if proven so in a court of law - and the government would pay all damages incurred up to the commercial reactor liability limit. In both cases, whether the accident involved a nuclear power utility or a DOE contractor, if the damage costs exceeded the $9.3 billion liability limit, it would be up to Congress to enact legislation to provide full compensation to the public.

However, critics of the Price-Anderson Act question whether the coverage it provides is adequate. A 1982 Nuclear Regulatory Commission study found that a severe nuclear accident could cost as much as $560 billion in 1999's dollars. The $9.3 billion provided by the industry would therefore cover less than two percent of the damages incurred in such an accident, leaving the industry largely immune while the government foots the vast majority of the bill.

In 2002, Congress renewed the provisions of the Price-Anderson Act that protect DOE contractors at government facilities in case of an accident. Provisions related to insurance for commercial nuclear power plants were not extended. See our transportation page for more information on the Price-Anderson Act.

How could the transportation of nuclear waste affect property values?

In the event that the Yucca Mountain repository is opened, trucks and trains would begin transporting waste to the site from across the country. In areas where rail lines would be needed, or where bypasses or overpasses are necessary, the government would buy the land, or if landowners were unwilling, the land would be condemned and bought under the government jurisdiction of eminent domain.

A number of issues may affect property owners and residents. Communities along a rail or highway route could be affected largely by emergency response, health and safety issues and quality of life considerations. Property values along shipments routes could decrease.

It is unclear how property values statewide in Nevada would be affected by a nuclear waste repository. Real estate values are influenced by what occurs in the economy and state leaders are concerned that a nuclear waste repository would tarnish the image of Nevada as a tourist mecca, thereby reducing income from tourism.

Although the DOE has selected the Caliente rail corridor, it is still unclear exactly how residents will be affected and whether they will receive any compensation. In Eureka County, Nevada's 2004 Caliente Rail Line Scoping Comments, the county noted that construction and operation of a rail line through southern Nevada could have negative effects on water resources,

grazing, and mining. Additionally, socioeconomic impacts could aversely affect economies, property values, tourism, and recreation. At the same time, the project could bring some economic opportunities to the region. To this end, the County encouraged DOE to allow shared use of the rail line to benefit industries such as mining and agriculture.

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

In order to protect the shipments, the Nuclear Regulatory Commission (NRC) requires shippers of radioactive materials to safeguard information about the exact time of shipments. For this 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.

What are the alternatives to Yucca Mountain? What alternative technologies might eliminate the need for a repository?

The DOE says alternative technologies and options have been, and will continue to be, evaluated for the responsible management of high-level radioactive waste. Some of the alternative technologies to geologic disposal include:

- use of nanotechnology to separate and neutralize waste elements
- transmutation to convert waste elements into less harmful materials
- genetically engineered microbes to "eat" the waste elements
- reprocessing to remove useable fuels and higher-level radionuclides
- high-energy magnetic fields to separate waste components

However, some of these options, such as transmutation and reprocessing, produce liquid high-level waste as a by-product. Although the overall volume of high-level waste would be reduced in these processes, the resulting liquid waste would still need to be dealt with.

The State of Nevada has suggested a dry storage alternative to a nuclear waste repository at Yucca Mountain. The Nuclear Regulatory Commission (NRC) has determined that spent nuclear fuel can safely be stored at nuclear reactor sites in robust dry storage casks for at least the next 100 years. Utilities have already built numerous dry storage facilities. (More from the NRC)

The State says dry storage is a cheaper and safer alternative, one that would allow time for the development of other waste disposal technologies and eliminate the risk of transporting thousands of tons of nuclear waste across the country. In a 2003 document (If not Yucca Mountain, Then What?), the Nevada Agency for Nuclear Project outlined the advantages of dry storage:

- Keeping spent fuel in dry storage would allow the government to search for a new repository or develop alternative technologies while preserving the future use of spent fuel as an energy resource.
- Dry storage facilities permit easy human monitoring and maintenance. Their safety records worldwide are unblemished.
- Leaving spent fuel in local dry storage facilities would save federal money by eliminating the costs of shipping nuclear waste to Yucca Mountain.
- Dry storage facilities are located away from metropolitan areas and are heavily guarded. The industry, the U.S. General Accounting Office, and the NRC have repeatedly proclaimed these facilities safe against terrorists and natural disasters.
- A DOE study concluded that the cost of continued storage at reactors is not high enough to affect the economic competitiveness of nuclear power as an energy option.
- Dry storage facilities are in locales that now share the risks and benefits of nuclear electric plants. These communities have well-established emergency plans and workforces familiar with nuclear power

.

Nevada also advocates government management of dry storage facilities, as has occurred at the PECO Peach Bottom Plant in Pennsylvania. In July 2000, DOE and PECO Energy reached an agreement where the government took title to the spent nuclear fuel, but left it in dry storage at PECO's site. The agreement put an end to PECO's lawsuit against the government for not taking the spent fuel by 1998 as had been promised. The State of Nevada says such agreements could effectively end utility rate bases and state utility commissions' jurisdiction and lawsuits, as well as allow utilities to take waste liabilities off their corporate books.

What are other countries doing about their nuclear waste?

After years of study, most countries have concluded that permanent geologic burial is the most acceptable solution for the final disposition of high-level nuclear waste. Countries in Europe and Asia also reprocess their nuclear waste. Reprocessing both reduces the volume of nuclear waste and provides uranium and plutonium that can be used to produce more energy. However, some nations regard spent fuel as waste and have rejected reprocessing as a viable option due to economic, environmental, and proliferation concerns.

Those countries that do reprocess nuclear waste are planning to entomb the remaining wastes in underground repositories with other high-level wastes that have accumulated. Those that do not reprocess plan to bury their spent fuel as is. In the meantime, the wastes are being kept in various types of interim storage facilities.

The issue of nuclear waste storage and disposal is complex and fraught with controversy. As in the United States, nearly every nuclear waste disposal program around the world has fallen behind schedule due to scientific uncertainty and public opposition.

GEOLOGICAL INVESTIGATIONS

COUNTRY	GEOLOGIC ENVIRONMENTS CONSIDERED OR INVESTIGATED	INDIGENOUS UNDERGROUND RESEARCH LABORATORY ESTABLISHED
United States	Salt, basalt, granite, tuff, clay, and shale	The Exploratory Studies Facility at Yucca Mountain served the function of an underground research laboratory (tuff).
Belgium	Clay and shale	Mol (clay)
Canada	Granite and sedimentary rock	Pinawa (granite)*
China	Granite	None
Finland	Granite, gneiss, grandiorite, and migmatite	Construction of ONKALO underground rock characterization facility in Eurajoki began in 2004 and is continuing (granite).
France	Argillite and granite	Bure (argillite)
Germany	Salt	Gorleben (salt)
Japan	Granite and sedimentary rock	Tono (granite) Mizunami (granite) Horonobe (sedimentary rock)
Republic of Korea	Granite	Korea Underground Research Tunnel (granite)**
Spain	Granite, clay, and salt	None
Sweden	Granite	Äspö (granite)
Switzerland	Clay and granite	Mont Terri (clay) and Grimsel (granite)
United Kingdom	No decision made.	None

*In the process of being decommissioned

**At shallow depth only

In October 2009 the Nuclear Waste Technical Review Board (NWTRB) prepared a report for Congress about how other countries are managing their high-level nuclear waste.The report looks at the top 13 countries who account for 83% of the world's nuclear power generating capacity. Most of these countries are considering deep geologic disposal for their nuclear waste, but only three countries are close to implementing a repository that is both technically and politically accepted.

Finland, France, and Sweden all currently expect to begin placing radioactive waste in geologic sites within roughly the next 10 to 15 years. Three other countries have a projected timeline of 30 to 40 years from now, but only one of them has yet initiated a process to find a geologic site. [For more information download the report] by the Nuclear Waste Technical Review Board (NWTRB) to Congress. The 2009 report examines programs in 13 selected countries, which account for 83 percent of worldwide nuclear power generating capacity. These countries illustrate the broad range of options and considerations that structure national programs around the world. [The Report is 76 Pages @ 1.2MB]. Of note, an update to the 2009 report was published in 2011; Download the 2011 report. [67 Pages @ 5.2MB]

What happens after the repository closes?

DOE's current plan is to monitor the potential repository for 50-300 years once the last waste package has been placed in the repository. Of note, and after the first 100 years DOE's plan is to install titanium drip shields over each of the waste canisters in the repository, even though it may not even be physically possible to install these shields.

After the 300 year monitoring phase is over, DOE plans to seal the tunnels and post a guard at the gate for as long as necessary. It is impossible to predict which government institutions may evolve or disappear over the next 10,000 years, so at the time of permanent closure DOE plans to use "passive" measures to warn people against disturbing the site. Monuments, warning markers, and widespread records would be used to inform people of the contents of the Yucca Mountain

site and to keep people from intruding into the site.

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