



August 2002

## **Yucca Mountain and Nuclear Waste**

### **Background**

High-level radioactive waste is produced at commercial nuclear power plants and at nuclear materials production defense facilities. Nuclear fuel is made of solid pellets of enriched uranium. The pellets are sealed in tubes, which are bundled together to form a nuclear fuel assembly. The assemblies are put inside a nuclear reactor and used to generate heat to make electricity. The fuel will be used until it is spent or no longer efficient in generating heat. Once a year, approximately one-third of the nuclear fuel inside a reactor is removed and replaced by new fuel assemblies. The used, irradiated fuel - sometimes called "spent fuel" - is highly radioactive and is the primary form of high-level nuclear waste.

When irradiated fuel is removed from a reactor, it is extremely hot, so all nuclear power plants have "spent fuel pools," where the waste is placed in order to cool and allow some of the radioactivity to decay. Each reactor is allotted only a certain amount of pool space, and when the pools are full, the reactors either must shut down or move some of their older waste to above ground concrete or steel containers called dry casks. When the irradiated fuel is moved into dry cask storage, it is still highly radioactive.

### **Current Situation**

Past claims that nuclear energy would be "too cheap to meter" have proven false. Storage of nuclear waste is very expensive. Rather, than requiring the nuclear industry to be fully liable for the costs of long-term management of the waste it generates, the government has assumed this responsibility. Nuclear power plants add fees to their ratepayers' bills for the Nuclear Waste Fund, established by the federal government in 1982 to research ways to dispose of nuclear waste. The money in this fund, supplemented by defense appropriations, is being used to pay for the Yucca Mountain Project.

Yucca Mountain, located approximately 80 miles northwest of Las Vegas, Nevada, is the only site in the U.S. being considered for a high-level nuclear waste repository. The proposed repository would contain 70,000 metric tons (77,000 U.S. standard tons) of nuclear waste, including 63,000 metric tons of "spent fuel" from commercial nuclear power plants and 7,000 metric tons of high-level waste from the U.S. Department of Energy (DOE) weapons complex.

High-level radioactive waste is currently in storage at 77 sites in the U.S. Commercial nuclear power plants have generated about 45,000 metric tons of “spent fuel” to date and this amount is expected to at least double by 2035. In addition, U.S. weapons and research activities have produced more than 2,500 metric tons of “spent fuel” and approximately 100 million gallons of liquid high-level waste. Because a Yucca Mountain repository could not accommodate all the waste (it’s capacity would be capped at 70,000 tons), it is inaccurate to characterize the project as a proposal for nuclear waste consolidation. Moreover, since irradiated fuel must decay in a “cooling pool” for at least five years before it can be transported, at least five years worth of nuclear waste (100 – 150 metric tons) would remain at each operating reactor even if the proposed repository opens.

## **Yucca Mountain Project History and Timeline**

On February 14<sup>th</sup>, 2002, Energy Secretary Spencer Abraham officially recommended to the president that a nuclear waste repository be developed at Yucca Mountain. The next day President Bush approved this recommendation. Then, on April 9<sup>th</sup>, 2002, Nevada Governor Kenny Guinn issued a Notice of Objection, effectively vetoing the site recommendation. According to an expedited and tightly constrained procedure defined in the Nuclear Waste Policy Act of 1982, Congress could override Nevada’s objection with a majority vote in both Houses. On May 8 2002, the Republican-led House of Representatives voted 306-117 to override Nevada’s veto. Despite broad-based opposition from environmental and public interest organizations, the Republican-led House of Representatives capitulated to the nuclear industry's powerful pro-Yucca lobby and voted 306-117 to overturn Nevada's veto on May 8, 2002. On July 9, 2002, the Democratic-led Senate similarly approved the dangerous dump by a vote of 60-39.

The DOE must now apply for a license from the Nuclear Regulatory Commission (NRC) to construct and operate the repository. Although the Nuclear Waste Policy Act stipulates that a license application must be filed within 90 days of the recent Congressional action, the DOE does not expect to complete scientific studies at the site and submit the application until late 2004. If all goes according to the DOE’s plan, waste will be accepted at Yucca Mountain beginning in 2010 and will continue to arrive at Yucca Mountain for at least 24 years, with the final “emplacement” activities ending after 2035. However, delays are likely according to the General Accounting Office (GAO), the investigative arm of Congress. In May 2002, the GAO testified that “DOE currently does not have a reliable estimate of when, and at what cost, a license application can be submitted or a repository can be opened...”<sup>1</sup>

## **Problems with the Yucca Mountain Site**

### *Groundwater Contamination*

The DOE talks about “disposing of” nuclear waste. But nuclear waste cannot be disposed of; it only can be stored. When stored, there is always the danger that radiation will escape. The original concept of a geologic repository was for a site with "natural barriers" sufficient to

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<sup>1</sup> GAO. Nuclear Waste: Uncertainties About the Yucca Mountain Repository Project. Testimony Before the Committee on Energy and Natural Resources, U.S. Senate, May 23, 2002.

contain nuclear waste throughout the 240,000 years that it remains dangerously radioactive. But the DOE is finding more and more problems with the natural barrier system at Yucca Mountain, and the agency appears to be scrambling to piece together an engineered barrier system instead. DOE's repository design proposals have been criticized by the Nuclear Waste Technical Review Board for the high and unquantified levels of uncertainty involved in extrapolating performance expectations for engineered barriers (i.e. waste storage canisters). Indeed, it now seems to be a question of when - not if - the waste from a Yucca Mountain repository would contaminate the surrounding environment.

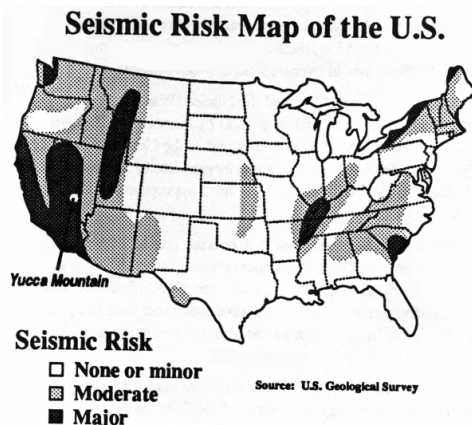
A freshwater aquifer lies beneath Yucca Mountain. If radioactive waste from a repository leaks, it would jeopardize the health of nearby residents, who depend on that aquifer as their sole source of drinking water. The National Academy of Sciences has identified the groundwater pathway as a significant pathway of exposure in the vicinity of the Yucca Mountain site.

In 2001, the U.S. Environmental Protection Agency (EPA) finalized radiation protection standards for the proposed repository that limit allowable groundwater contamination to 4 millirem per year (10 millirems is equivalent to one chest X-ray). During the long and complicated interagency review of this rule, compromises were made that reduce the effectiveness of the groundwater standard by promoting a reliance on dilution and dispersion – rather than containment – of contaminants to meet the standard.

Public Citizen, together with the Natural Resources Defense Council and other environmental and public interest organizations, filed a lawsuit in June 2001, challenging the weakest elements of the EPA rule. Meanwhile, the Nuclear Energy Institute, the powerful lobbying arm of the commercial nuclear industry, is also suing the EPA in an effort to further undercut this already weak rule by eliminating altogether the groundwater protection standard.

### *Earthquakes*

Nevada ranks third in the nation for current seismic activity (see map below). Since 1976, there have been more than 600 seismic events of a magnitude greater than 2.5 within a 50-mile radius of Yucca Mountain. Native Americans in the area call Yucca Mountain a rolling hill and speak of its constant movement. In 1992, an earthquake with a magnitude of 5.6 occurred that caused damage to a DOE field office building in the area. As recently as June 14<sup>th</sup>, 2002, an earthquake measuring 4.4 on the Richter scale was recorded just 12 miles from Yucca Mountain.



Should a strong earthquake hit the Yucca Mountain area while nuclear waste is stored there, disastrous consequences could result. The storage canisters could break open and portions of the mountain could collapse, restricting access to the broken canisters inside. Some scientists also believe that a significant rise in groundwater levels could occur as the result of an earthquake, possibly flooding the repository. This type of event would surely compromise the integrity of the nuclear waste containers and contaminate the groundwater beneath Yucca Mountain.

### **Transporting High-level Radioactive Waste**

If the Yucca Mountain repository proposal is approved and licensed, waste will be transported to Nevada from the 77 sites where it is currently stored. The DOE has not indicated whether it will transport the nuclear waste by truck or by train, but either way, the transportation will take at least 24 years and involve tens of thousands of shipments. The most recent analysis indicates that this deadly cargo would pass through 44 states and the District of Columbia en route to Yucca Mountain.

Although the DOE has refused to finalize the transportation routes it would use to haul this extremely hazardous material across the country, Department of Transportation regulations strictly limit the potential routes. Public Citizen teamed up with the state of Nevada's Nuclear Waste Project Office to determine which routes would be most likely candidates for the transportation of nuclear waste. Maps and descriptions of these routes can be found at [www.atomicroadshow.org](http://www.atomicroadshow.org). Subsequently, the DOE released its own set of maps showing potential shipment routes to Yucca Mountain. These were published in Appendix J of the Final Environmental Impact Statement, online at [www.ymp.gov/documents/feis\\_a/web\\_pdf/index\\_v2.htm](http://www.ymp.gov/documents/feis_a/web_pdf/index_v2.htm). Also, the Environmental Working Group hosts an interactive site that calculates the distance from any address to a likely Yucca Mountain nuclear waste transport route: [www.mapscience.org](http://www.mapscience.org).

Whether the waste is transported by truck or rail, it will be carried in transportation casks similar to the one pictured below. Current NRC regulations allow these casks to emit radiation equivalent to a chest x-ray (10 mrem/h) at 6.5 feet from the cask surface.



These casks have never been fully tested. In 1987, the NRC sponsored a study, commonly referred to as the “Modal Study,” by the Lawrence Livermore National Laboratories, that used computer modeling to predict cask responses to accident conditions. The study was inadequate in that it did not include full-scale physical testing of the casks, and the conditions that were used in

the computer analysis did not represent real-life scenarios. The NRC has contracted with Sandia National Labs to conduct another study (the "Package Performance Study"), but this new study will not be completed until 2005.

Transporting nuclear waste poses inherent dangers, particularly in the event of an accident (e.g., if an equipment failure or human error causes the waste to roll off the truck or leak) or crash. It is unclear whether hospitals, police and rescue personnel along transportation routes would have the capacity to respond effectively to a nuclear waste emergency.

State of Nevada analysis indicates that 161 accidents could be expected involving Yucca Mountain shipments under a "mostly truck" shipping scenario, or 390 under a "mostly train" scenario. As part of the 1986 Environmental Assessment for the Yucca Mountain repository site, the DOE conducted a study that found that a severe accident in a rural area involving a high-speed impact, lengthy fire and fuel oxidation would contaminate a 42-square-mile area, require 462 days to clean up and cost \$620 million. The health, economic and environmental impacts of such an accident could devastate a community.

Transporting high-level nuclear waste to Yucca Mountain could cause other problems for communities en route. The potential for terrorist attacks on waste shipments has not been satisfactorily addressed in DOE's Yucca Mountain proposals. Also, property values have been shown to decline along nuclear waste transportation routes even without an accident or act of sabotage.

Although the Yucca Mountain Project would launch an unprecedented nuclear transportation scheme, the DOE's repository proposal inadequately addresses transportation issues. Yet, logically, the safety and viability of getting the waste to Nevada is an intrinsic aspect of considerations surrounding the repository proposal. It would therefore be premature at best for Congress to accept a Yucca Mountain site recommendation from DOE with so many questions relating to transportation unanswered.

### **Flawed Process**

The dramatically flawed process that has characterized the repository project undermines the credibility of the DOE's site characterization and site recommendation activities at Yucca Mountain. Radiation protection standards (set by the EPA) and repository siting guidelines (set by the DOE) were rewritten to avoid disqualifying the Yucca Mountain site, sacrificing public health and safety to nuclear industry interests.

According to analysis by Public Citizen's Congress Watch, Energy Secretary Spencer Abraham accepted \$82,728 from the nuclear industry during the last election cycle (1995 through Sept. 30, 2000). A Public Citizen request that Abraham recuse himself from Yucca Mountain dealings because of this apparent conflict of interest was rejected.

In November 2001, a DOE Inspector General investigation uncovered other apparent conflicts of interest involving contractors on the Yucca Mountain Project. According to the report, the law firm Winston & Strawn was simultaneously employed as counsel to the DOE, working on the

Yucca Mountain Project, and registered as a member of and lobbyist for the Nuclear Energy Institute, the pro-repository nuclear industry trade group, between 1992 and 2001. Although Winston & Strawn resigned from the Yucca Mountain Project in the wake of this scandal, the firm's work was not withdrawn. A thorough review is urgently needed of the causes and consequences of DOE contractor conflict of interest and the apparent pro-industry bias in the agency's site characterization and site recommendation activities.

Sound science has also been compromised in the Yucca Mountain Project. A report issued last December by the General Accounting Office concluded that the DOE lacks the research and data to substantiate its repository proposal. Similarly, in a letter dated January 24, 2002, the presidentially appointed Nuclear Waste Technical Review Board advised Congress that "the technical basis for the DOE's repository performance estimates is weak to moderate."

Public Citizen advocates isolating high-level radioactive waste as close as safely possible to the reactor where it was generated until a satisfactory national solution to the nuclear waste problem is found.

**Links to more information:**

Public Citizen's Critical Mass Energy & Environment Program	<a href="http://www.citizen.org/cmep">http://www.citizen.org/cmep</a> <i>and</i> <a href="http://www.atomicroadshow.org">http://www.atomicroadshow.org</a>
Nuclear Information and Resource Service	<a href="http://www.nirs.org">http://www.nirs.org</a>
Nevada Nuclear Waste Task Force	<a href="http://www.nvantinuclear.org">http://www.nvantinuclear.org</a>
"MapScience" (Environmental Working Group)	<a href="http://www.mapscience.org">http://www.mapscience.org</a>
State of Nevada Nuclear Waste Project Office	<a href="http://www.state.nv.us/nucwaste/index.htm">http://www.state.nv.us/nucwaste/index.htm</a>
Yucca Mountain Project Office (DOE)	<a href="http://www.ymp.gov">http://www.ymp.gov</a>
Nuclear Regulatory Commission	<a href="http://www.nrc.gov">http://www.nrc.gov</a>
EPA Yucca Mountain Homepage	<a href="http://www.epa.gov/radiation/yucca">http://www.epa.gov/radiation/yucca</a>
Nuclear Waste Technical Review Board	<a href="http://www.nwtrb.gov">http://www.nwtrb.gov</a>
General Accounting Office Report	<a href="http://www.gao.gov/new.items/d02191.pdf">http://www.gao.gov/new.items/d02191.pdf</a>
DOE Inspector General Report	<a href="http://www.ig.doe.gov/pdf/invrpt.pdf">http://www.ig.doe.gov/pdf/invrpt.pdf</a>
NRC/Sandia Labs Package Performance Study Page	<a href="http://ttd.sandia.gov/nrc/modal.htm">http://ttd.sandia.gov/nrc/modal.htm</a>

## Roles of the Federal Government and Agencies

The chart below outlines the roles of Congress and the various agencies in the development and implementation of national nuclear waste policy.

<p><b>Congress</b></p>	<p>Passed the Nuclear Waste Policy Act in 1982 and amendments in 1987, mandating DOE to evaluate the suitability of Yucca Mountain as a potential geologic repository for nuclear waste. Voted to override Nevada's veto and approve the Yucca Mountain site in 2002. Appropriates funds for agencies and for Yucca Mountain activities (Yucca Mountain funds come from the Nuclear Waste Fund, fees collected from ratepayers, and the Defense budget).</p>
<p><b>Department of Energy (DOE)</b></p>	<p>Responsible for characterizing Yucca Mountain site and determining its suitability as a geologic nuclear waste repository. Amended repository siting guidelines in December 2001. Issued a final Environmental Impact Statement for the proposed repository and officially recommended to the president that the project move forward in February 2002. Responsible for the construction, management and operation of the potential geologic repository at Yucca Mountain. Will take title to nuclear waste and transport it to Yucca Mountain if the repository is licensed.</p>
<p><b>Nuclear Regulatory Commission (NRC)</b></p>	<p>Finalized site-specific licensing rule for the proposed repository in November 2001. Responsible for evaluating DOE's application for a license to construct and operate the repository (DOE is expected to submit a license application in 2004). Licenses nuclear waste transportation containers.</p>
<p><b>Environmental Protection Agency (EPA)</b></p>	<p>Finalized site-specific radiation protection standards for the proposed repository on June 6, 2001, which served as the basis for DOE's amended siting guidelines, NRC's site-specific licensing rule, and the Energy Secretary's site recommendation.</p>
<p><b>Department of Transportation (DOT)</b></p>	<p>Regulates nuclear waste transportation, including routing guidelines.</p>
<p><b>Nuclear Waste Technical Review Board (NWTRB)</b></p>	<p>Created by Congress and appointed by the president. Reviews scientific and technical basis for DOE activities pertaining to the management and disposal of commercial high-level waste.</p>

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