



Q: *What makes Yucca Mountain a good place to store waste?*

A: Yucca Mountain is located in a desert, isolated from population centers, in a region where the land is controlled by the federal government, including the U.S. military. Most of the land in this region is under federally restricted access. Waste placed in Yucca Mountain would be located 1,000 feet underground — compared to its current location in temporary surface facilities at 131 sites in 39 states. Natural and engineered barriers would work in concert to isolate radionuclides from the accessible environment for tens of thousands of years.

Yucca Mountain has five key attributes that are important to long-term performance:

Limited Water Entering Emplacement Tunnels - The climate at Yucca Mountain is arid, with precipitation averaging about 7.5 inches per year. Future climates during the regulatory compliance period are expected to be slightly cooler and produce a higher mean annual precipitation of about 12.5 inches. Little of this precipitation percolates (seeps) into the mountain; nearly all of it (about 95 percent) either runs off, is picked up by the root systems of vegetation, or is lost to evaporation. This significantly limits the amount of water available to infiltrate the surface, move down through the thousand feet of unsaturated rock, and seep into emplacement tunnels.

Yucca Mountain consists of alternating layers of welded tuff (volcanic ash that was laid down when it was very hot and welded itself into a solid mass of rock) and nonwelded tuff (volcanic ash that was laid down when it was cool and became a cohesive mass when compressed by overlying rock). The mountain is layered with welded tuff at the surface, welded tuff at the level of the repository, and an intervening layer of nonwelded tuffs. These nonwelded units contain few fractures; thus, they delay the downward flow of moisture into the welded tuff layer below, where the repository would be located. At the repository level, a significant portion of what little water is

A repository at Yucca Mountain would be:

- In a desert location
- Isolated away from population centers
- Secured 1,000 feet under the surface
- In a closed hydro-logic basin
- Surrounded by military and other federal land
- Protected by natural geologic barriers
- Protected by robust engineered barriers and a flexible design

available in small fractures has a tendency to remain in the fractures rather than flow into larger openings, such as tunnels, due to capillary action. Just as water poured slowly from a glass tends to run slowly down its side, rather than drip straight down, what little water does seep into a tunnel could run down its side walls — and not drip on waste packages.

Long-Lived Waste Package and Drip Shield –

Chemical conditions that would promote corrosion are not expected to occur in the repository environment, and both the titanium drip shield and the nickel-based alloy (Alloy 22) outer barrier of the waste package are expected to have extremely long lifetimes. In the repository environment, Alloy 22 is very corrosion-resistant, with general corrosion penetrating only about 0.03 inches in 10,000 years. The Titanium Grade 7 is also corrosion-resistant, with general corrosion penetrating only about 0.08 inches in 10,000 years. Only about 1 percent of the waste packages are projected to lose some of their integrity during the first 80,000 years.

Limited Release of Radionuclides from the Engineered Barriers –

Even though the waste

packages and drip shields are expected to be long-lived in the repository environment, the advanced computer simulations predict some eventual loss of waste package integrity. If water were to penetrate a breached waste package, several characteristics of the waste forms and the repository would limit radionuclide releases. First, because of the warm temperatures of the waste, much of the water that might penetrate the waste package will evaporate before it can dissolve or transport radionuclides. Neither spent nuclear fuel nor glass waste forms will dissolve rapidly in the water expected in the repository environment. In addition, the invert, part of the engineered barrier system under the waste package and support pallet, would contain crushed tuff that would also delay the transport of radionuclides into the unsaturated host rock.

Delay and Dilution of Radionuclide Concentrations by the Natural Barriers –

Eventually, the engineered barrier systems could experience a decrease in their integrity, and small amounts of water could contact waste, dissolve it, and carry some radionuclides out of the repository and into the rock below. As water flows through fractures,



This piece of corrosion-resistant stainless steel still has a mirror-like finish after 60 years' exposure to the corrosive salt-waves and blasting winds of the Atlantic Ocean. The stainless steel for waste packages is even more corrosion resistant.



This picture shows samples of Alloy 22 and a high-quality steel, after exposure to an accelerated aging corrosion experiment. Alloy 22 is expected to lose its integrity very slowly in the repository environment.

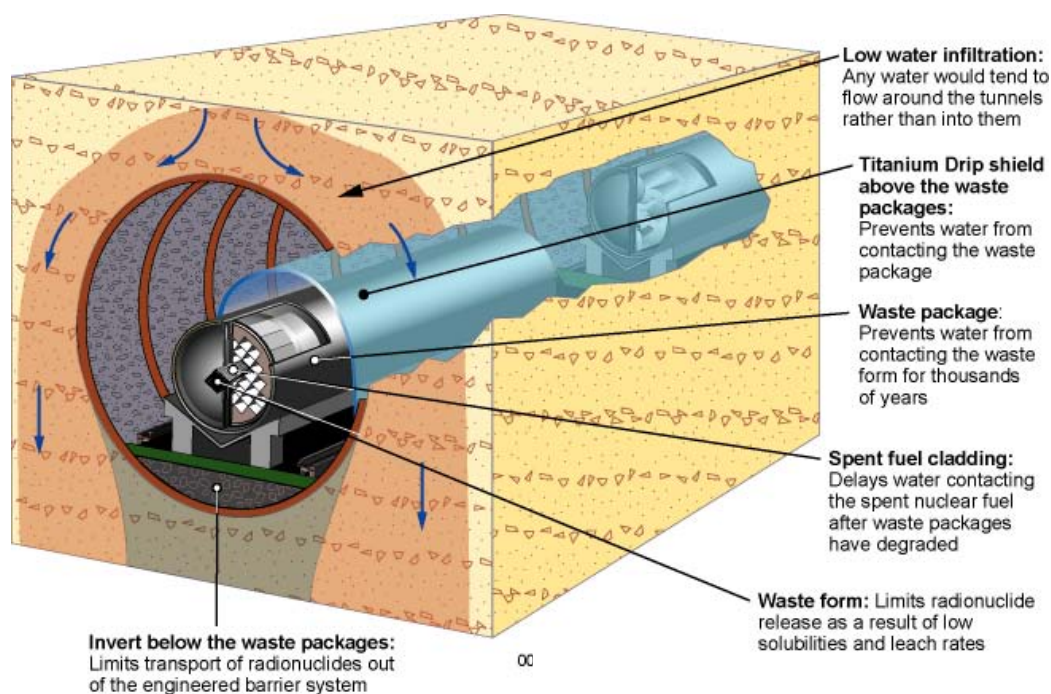
dissolved radionuclides would diffuse into and out of the pores of the rock matrix, increasing both the time it takes for radionuclides to move from the repository and the likelihood that radionuclides will be exposed to sorbing minerals (minerals that attract and hold them).

Radionuclide migration through the unsaturated and saturated zone is affected in two ways. First, radionuclides are exposed to minerals in the rocks called “zeolites” that trap many species of the radioactive waste; this delays the transport of radionuclides. Second, dispersive processes that occur during transport through the saturated zone dilute and reduce radionuclide concentrations in groundwater.

Once the saturated zone, which is about 1,000 feet below the repository, is reached the flow paths are generally southerly toward the Amargosa Desert and Death Valley. Yucca Moun-

tain is located in a closed hydrologic basin. The boundaries of this basin are defined and understood. Water in this basin does not flow into any rivers or oceans, and is isolated from the aquifer systems of Las Vegas and Pahrump, the largest community in Nye County. Isolated hydrologic basins are a relatively rare geologic feature. The groundwater system in this basin conforms to the mountainous topography, and drains inward.

Low Likelihood of Potentially Disruptive Events - The DOE considered three specific disruptive processes and events (i.e., volcanism, seismic events, and nuclear criticality) that could impact the performance of a repository at Yucca Mountain. Seismicity is considered as a nominal, or expected, event and is treated as such in the analyses. Criticality was found to have such a low likelihood that it is not necessary to consider further, according to the regulations.



Natural features work with engineered features to limit the amount of water that can contact waste forms, dissolve them, and transport radionuclides out of the repository. Natural forces cause the very small amount of available water to flow around, rather than into, the tunnels. Drip shields, waste packages, and cladding (metal tubes holding ceramic fuel pellets) are made of metals that resist corrosion, further protecting the waste forms, which are ceramic and glass.

Of the three, volcanism resulted in a low but calculable dose when considering the remote probability of a volcanic disruption. The likelihood of the repository being disrupted by a volcano is extremely small (about 1 in 70 million, or a chance of 0.0000014 percent, per year). Following regulatory guidelines, the calculated peak dose would be less than one percent of the radiation protection standards set by the Nuclear Regulatory Commission and the Environmental Protection Agency.