
THE CONTROVERSY – RADIOACTIVE WASTE STORAGE

The storage of radioactive waste generated by the use and production of radioactive materials within the United States remains a contentious national security issue. The security of these materials, many taking thousands of years to decay, requires not only security measures to prevent tampering or theft, but also important considerations of the physical environment of waste storage. Site selection must ultimately be based upon minimizing the potential for leakage and long-term environmental damage.

In the 1960s, nuclear power gained popularity as a means of producing electricity for civilian use. During the next two decades, several nuclear power plants were built, but there was little consensus about how to best dispose of radioactive waste. Waste from plants, as well as from military and defense operations, was usually stored on site or in nearby storage facilities. Low-level waste, such as that from hospitals, research labs, and power plants is generally placed into containment facilities on-site. However, the disposal of high-level waste, materials that are highly radioactive, remains more problematic. Spent nuclear fuels from power plants are sometimes shipped to containment facilities, and sometimes stored in specially constructed containment pools on-site. Radioactive waste is thus, stored in various locations, governed by federal regulations. Forty-three states in the United States, and several Canadian provinces, currently have nuclear waste storage facilities. In the late 1990s, the government proposed plans for a central storage facility for high-level waste at Yucca Mountain, Nevada. In May, 2002, the United States House of Representatives approved a measure that would establish the site at Yucca Mountain, and approval was pending as of June 2002. The proposed site has sparked ongoing controversy over the environmental impact of nuclear waste storage, much of which focuses on the unique geological and environmental conditions of the region.

When looking for a site for permanent storage of high-level waste, engineers and geologists took several factors into consideration, including: water table, geological stability, rock composition, seismic (earthquake) activity, and proximity to population areas. Furthermore, the site must have a high probability of remaining undisturbed for tens of thousands of years, or as long as the materials in storage are radioactive. Yucca Mountain is located in a rural region, with sparse population. Las Vegas, 100 miles (160 km) from the site, is the nearest metropolitan area. Within a 100-mile radius of the proposed site, there are approximately 35,000 inhabitants. Thus, Yucca Mountain is relatively secluded.

Yucca Mountain itself has a desert climate, receiving less than six inches of rain per year. The lack of rain means that cave systems within the mountain are dry, and that there is minute seepage from the surface of the mountain to the deep water table 2000 feet (670 meters) below ground. This ensures that waste stored in the mountain would have fewer chances of polluting ground water if specially engineered storage containers ever rupture. The deep location of the water table at the site also means that the cavity, or storage room, would lie equidistant from the surface of the mountain to ground water stores—about 1000 feet, or 304 meters. This isolates the waste, and removes the chance of accidental disturbance from future drilling or other means of exploration.

Some aspects of the geological composition of the mountain itself further makes Yucca Mountain a candidate for a nuclear waste repository. Dense volcanic rock, as well as thick and nearly impenetrable bedrock mean Yucca Mountain's interior is relatively stable, not very porous, and resistant to water and heat. Under the most-extreme conditions, this deep and solid rock could

help contain minor seepage, as well as insulate the repository—possibly making it as safe as a band of untapped uranium ore.

Yucca Mountain's unique geology and environment is unequaled by that of any of the nation's other current nuclear waste repositories, many of which pose a greater potential threat to cities, drinking water, and their local environments. Centralization could potentially lead to tighter regulation of waste, better handling, and less environmental damage.

While Yucca Mountain does meet much of the criteria for a safe storage site, it is not a perfect location. The region around Yucca Mountain contains several faults and fractures (cracks in the Earth's crust where movement causes earthquakes), and is considered seismically active. Earthquakes could change the patterns of water flow inside the mountain, as well as endanger the integrity of the storage cavities within the mountain. Increased hydrothermal activity could promote seepage and water contamination.

Researchers also explored the possibility of the storage cavity filling with water, thus exposing the aquifer and groundwater to radioactive contaminants. Geologists studied core samples and cave linings to determine the extent to which minerals permeated the walls of the cavities. The scientists found that there were only scant traces of opal and calcite, telltale signs of flooding and water seepage, at the lower levels of the mountain. Thus, the cavities did not have a history of filling with water. A corresponding study of the geological history of the mountain further confirmed the relative stability of the site's water table, drainage, and seepage.

However, under Yucca Mountain is a deep aquifer. In the desert region, the aquifer provides drinking and irrigation water. As metropolitan centers, such as Las Vegas, continue to grow, the aquifer might play a significant role as a water resource for the region. The nuclear storage site would have to remain stable and well sealed for tens of thousands of years in order to insure the continued safety of the aquifer.

Part of the problem in designing high-level waste storage facilities is the time span for which these sites must remain secure and safe. Lab tests are inadequate to insure the stability of the mountain, the fortitude of containers and casks, and the security of the site from accidental intrusion for the tens of thousands of years necessary for radioactive waste to be rendered harmless. Project planners face not only design difficulties such as preventing accidents and mitigating environmental impact, but also how to document the site in ways that will ensure that people 10,000 years from now will recognize the hidden danger of the mountain storage facility. People today have only scant artifacts and generalized understanding of civilizations and people that lived ten thousand years ago.

Geologists and other scientists disagree on the possible effect that the waste could have on the behavior of the mountain itself. Some predict that heat generated by the waste could alter the mountain's geological and hydrological behavior, causing rocks to crack and water to seep into and out of the storage cavity in ways that we cannot predict. Some raise concerns over the unpredictable nature of seismic activity in the area. Other scientists assert that the stable pattern of geological processes at Yucca Mountain will remain unchanged, and that the site is predictably stable. Geologists have to account for not only the mountain's history, but also predict its future in order to insure the safety of the site for future generations.

While much of the scientific community's assessment of the safety of the Yucca Mountain project centers on geology, public concerns focus on technology. Though waste is currently stored in forty-three states, little of the nation's spent nuclear materials travel long distances. The creation of the Yucca Mountain site would require that waste be shipped by truck and rail to the central

storage facility. Engineers and researchers have developed safe casks, or storage bins, which are impervious to accidents, water, and fire specifically for shipping high-level waste, but many people are discomforted simply by the perceived risk (the threat that people feel is associated with a given project, not the statistical risk) of shipping nuclear materials.

The controversy surrounding the proposed Yucca Mountain waste repository is both political and scientific. The perceived threat of nuclear materials heavily influences public opinion, and environmentalists are reticent to trade many smaller environmental problems for a large potential hazard. Some people cite the Yucca Mountain facility as a means of centralizing the problem of nuclear waste. Project proponents claim that the repository will lessen environmental risk and keep volatile, dangerous materials secure and controlled.

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