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Yucca Mountain: A Nuclear Waste Repository

Abstract:

Yucca Mountain, located in the Mojave Desert about 100 miles Northwest of Las Vegas, Nevada, is the prime candidate for a nuclear waste repository. There are many issues; geologic, political, and other, that are key in deciding whether or not Yucca Mountain will be used in the future as a storage facility for tens of thousands of years, at the least.

Introduction:

Right now, there are over 100 sites in 42 states that provide a temporary home to the nation's 40,000 metric tons of nuclear waste. It has been determined in the last 50 years that geological isolation is the best method of storing the nuclear waste. Since this discovery has been made, the problem has been finding and experimenting with a site that fits the necessary requirements for a nuclear waste repository. Yucca Mountain in Nevada has been the subject of many tests and experiments and with some additional work may soon become the United States' first large-scale nuclear waste storage facility.

Nuclear waste is a global and national problem that must be addressed now in order to plan for a safe and healthy future. The most important issue that goes along with nuclear waste is the issue of how to manage it. There are many elements integrated in to the waste; some of which are hazardous for only a few years and others that can remain a threat for thousands of years. This is an important topic to know about because of the implications that this storage facility will have on life as well as natural processes in the future.

Yucca Mountain, in Nye County, Nevada is a mass of volcanic tuff that was created as a product of an explosive super volcano, the eruptions of which ended about 12 million years ago.

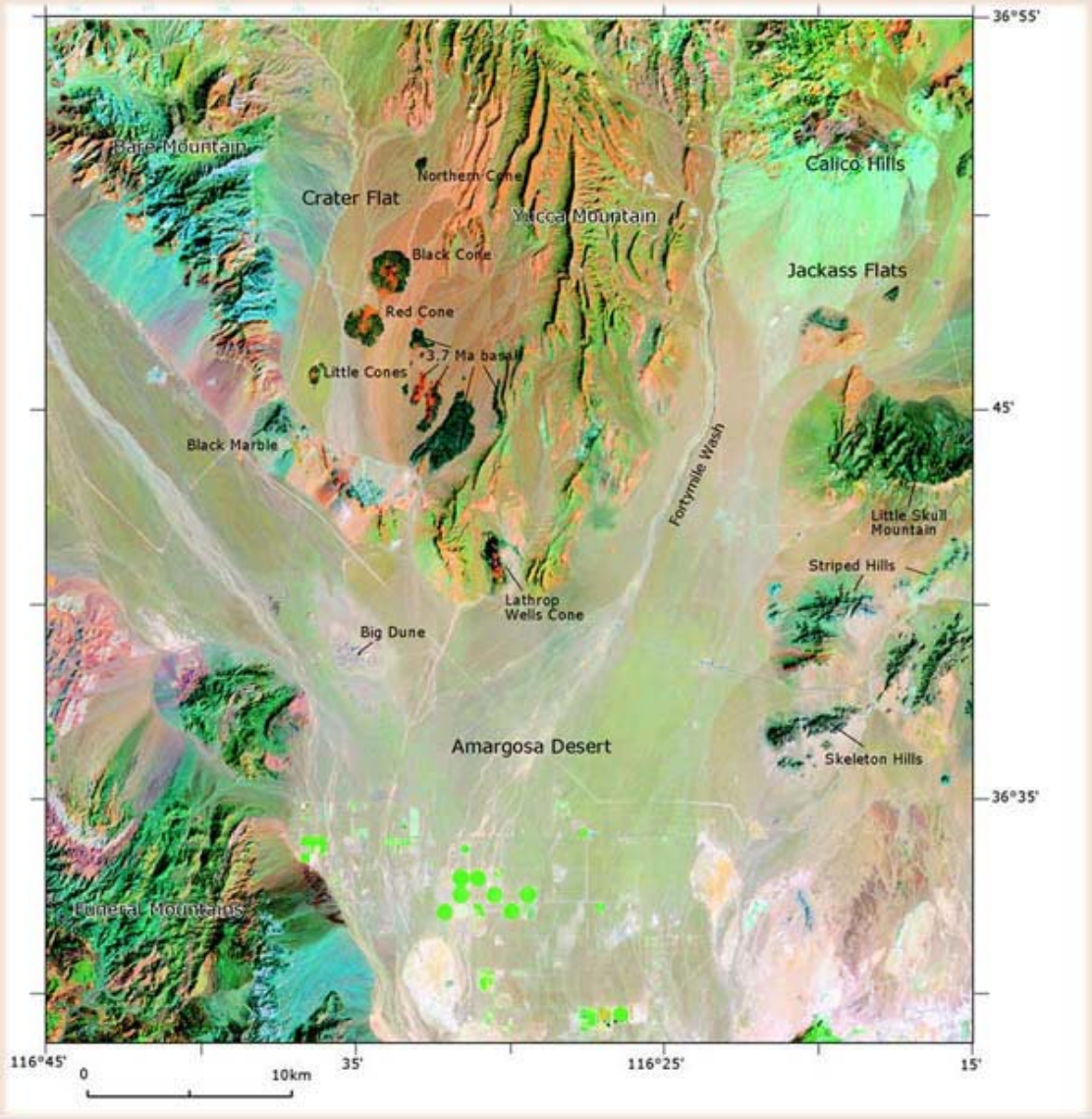
Map of location of Yucca Mountain in Nevada, compared to Las Vegas.
Image from <http://www.cnn.com/EARTH/9803/27/nuclear.waste.ap/>

Why Yucca Mountain?

There are several important reasons why this storage facility has been chosen to store the country's nuclear waste. The most prominent threat to safe storage is the movement of water. Water has the power to erode, to transport, and to change with the slightest variations in temperature. These characteristics make water something that can be dangerous when in proximity to the nuclear waste. Yucca Mountain is an area that is fairly arid and dry. There is, of course, some water in the area, but the dry climate along with the amount of open space makes this land ideal for making a nuclear waste repository.

In 1982, Congress passed the Nuclear Waste Policy Act, stating that the U.S. Department of Energy had to create and maintain a geological repository. Originally after this act was past, the Department of Energy found nine potential sites, evaluated them all, and created proposals. The options were then narrowed down to three, and now all of the hope of a repository in the United States rests on Yucca Mountain.

The area of Yucca Mountain is remote, arid, and geologically stable. The Mountain receives an average of 7.5 inches of rain per year, and all most all of the water or rain is taken by plants, run off, or evaporated. The remaining amount of water (about five percent of the original rain or snow fall) must go through hundreds of feet of rock, and then will be in contact with parts of the repository. (Department of Energy).



False-color Landsat image shows local geographic features and Plio-Pleistocene volcanic centers near Yucca Mountain. Image modified from D.W. O'Leary, and others (2002).

Image retrieved from < http://water.usgs.gov/ympb/siesmicandvocanichazards.htm>

The Basics of a Geological Repository:

All the waste that is put in to a deep geological repository must be solid so that workers can use durable containers for the sake of storage. Radiation emitted will not escape the containers, keeping the area safe. Since the containers in themselves are so powerful, the basis of the repository is not necessarily just for storage, but mostly for protection from water. When

water comes in to contact with the containers, it slowly creates a decaying process and can corrode through to the solid waste. Once water comes in contact with the waste it can begin to break it up in to smaller particles that can be carried by the water, creating a dangerous environment for both people and nature.

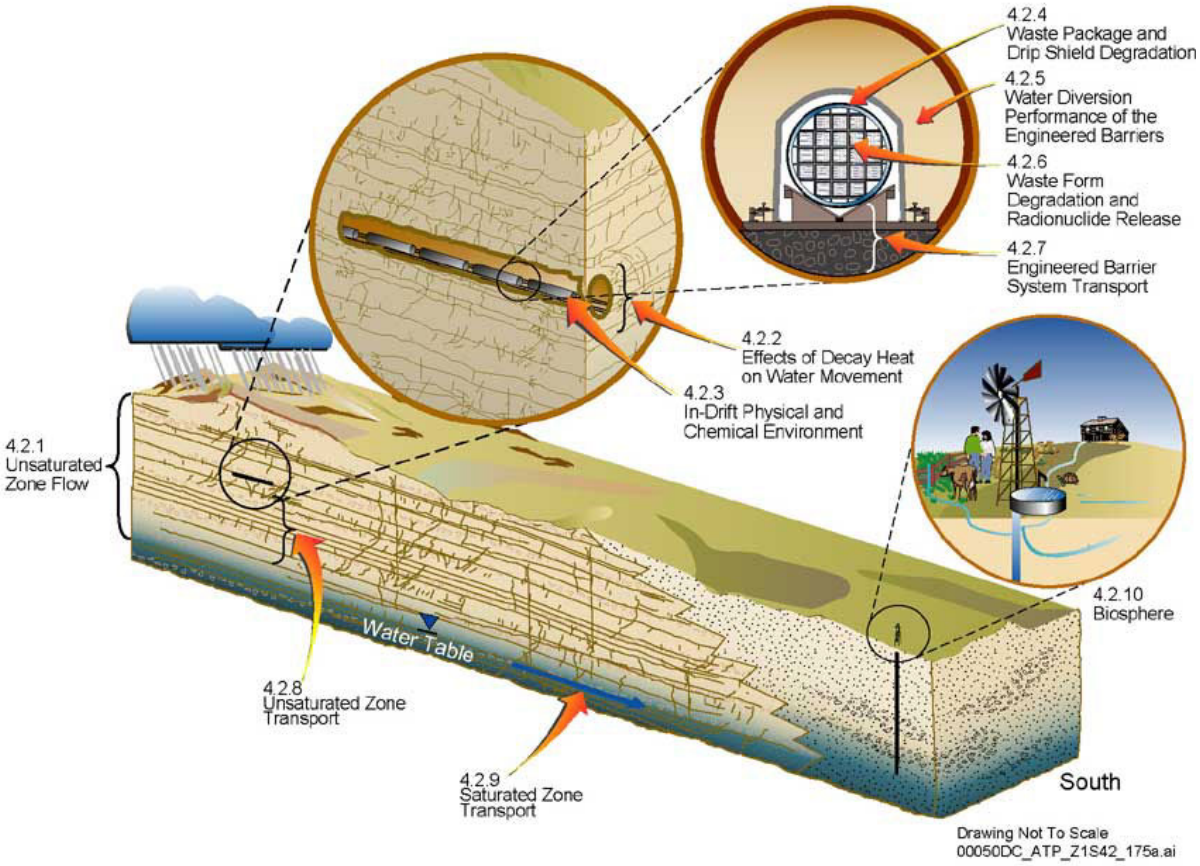


Image with details of Yucca Mountain Repository technologies
Image retrieved from <http://www.engin.umich.edu/class/ners211/project2002/pro/images/security_diagram.jpg>

Above and below the repository there is unusually thick rock whose minerals tend to attract and hold radioactive materials. Built within the repository would be a system of barriers, keeping water from reaching the material, one at a time. Scientists have done various studies in the environmental, physical, and chemical characteristics that play a role in the success of the Yucca Mountain Project.

The repository will have around 60 miles of tunnels carved in to the rock, as deep as 1400 feet below the mountain, but over 550 feet above the water table located deep within the mountain.

The Threat of Water/ Keeping Yucca Mountain Safe:

As was mentioned above, only about five percent of all precipitation is left to threaten the repository after nature has used what it can. The water travels toward the repository through cracks and fractures in the hundreds of feet of rock directly beneath the surface of the mountain. The repository is protected both naturally and by innovative technology. Generally in nature, water has the tendency to flow around tunnel walls rather than directly in to them.

The amount of water that comes in contact with the waste is also limited by man-made devices for deflecting the water from the vulnerable waste. There are five different barriers that the department of energy has created as a defense mechanism. Drip shields keep large amounts of water from coming in to contact with the package that the solid waste is in, and the package itself protects the waste itself, helping to keep water out. A third mechanism, cladding, is a series of metal tubes that are corrosion-resistant, keeping water away from waste as well. Finally, floors of volcanic rock and steel have been added to the tunnels. These floors, called inverts, assist in minimizing the release of hazardous material (Department of Energy).

After getting through these man-made barriers, the water would once again be slowed by natural blocks. Since the hazardous material is solid, it takes time to break that down in to moveable particles, and more time to travel through hundreds more feet of solid, compacted rock. Beneath this rock, thousands of feet below the surface of the mountain, is the water table. It

would take hundreds more years for the radioactive material to come in contact with groundwater, which never leaves the basin of Death Valley, the lowest area in the nation.

The Framework of Political Policy:

Since the Yucca Mountain Project's boundaries are so wide-reaching, the political and national groups involved are both numerous and diverse. Congress is an important medium in passing laws for Yucca Mountain. The Environmental Protection Agency is important for creating environmental standards with input and other work from the Nuclear Regulatory Commission. Finally, the United States Department of Energy is depended on to create license applications, conduct tests, and be a middleman to the public. (Boutte).

There are six basic steps of evolution that the repository will go through before waste will actually be stored. The first phase is Site Characterization Phase, which is still an important and current part of the project. In this first phase, data and information was gathered to decide whether or not Yucca Mountain would be a good place to have a geologic repository. The second phase is site approval/license review. In this phase, the repository must be recommended to the President. If the President and congress approve the site, the Department of Energy must submit an application for a license to the Nuclear Regulatory Commission, who can then authorize construction. The third phase after this is the construction phase, in which the facilities on the surface will be built, and there will be more excavation and building of containers. The fourth phase of the project is the operations phase. In this phase, waste is received, handled, and emplaced. In the fifth phase, after all the waste packages have been emplaced, there will be additional monitoring of the area. The last phase, the closure phase, happens after the Nuclear Regulatory Commission grants a license to close the repository. This is a vital part of the

process, with things like putting the drip shields over the packages and sealing the openings. (US Dept of Energy)

The Effect on People and the Environment:

Yucca Mountain is an extremely isolated area; the nearest year-round residences are over 12 miles away. This will certainly have somewhat of an effect on the environment, given that the processes needed to put the Yucca Mountain Project in to action are manmade and not natural. The most prominent and likely problem that could arise many years in to the radioactive storage at Yucca Mountain is the chance of leakage. If the waste canisters were to corrode, water would eventually be carried in to ground water. This water is used by people in surrounding areas for washing, drinking, and irrigation.

Opposition to the Yucca Mountain Project:

The Yucca Mountain Project is in opposition to many organizations' viewpoints. One organization that readily opposes the creation of the repository is a non-profit group called Public Citizen. It is a public interest group with over 150,000 members worldwide, working to create sustainable energy policies and protect people from the dangers of nuclear waste. Their hypotheses suggest that rather than resisting the water, the type of rock is ideal for leakage. Yucca Mountain lies on volcanic tuff, which has a porous nature and is fractured due to volcanic activity. There are over 30 volcanic faults in the immediate area, and it is expected that more will develop over time, acting as a tool with which to carry water to the table several hundred feet below the ground.

Public Citizen points out that this water table is the source of drinking water for the residents of parts of Inyo County, California, and Amargosa Valley, Nevada. This water table provides a welcoming pathway for radioactive material to flow in to other areas and have a negative effect on the environment and life in the area.

Because of volcanic activity in the past, one might assume that the greatest hazard in this area would be the chance of a volcanic eruption. Scientists and experts have calculated, however, that the likelihood of an eruption happening is somewhere in the vicinity of 1 in 63 million per year. (Public Citizen website).

The Current Situation:

Right now in the United States, there is only one repository site for high-level nuclear waste—Yucca Mountain. There is over seven billion dollars invested in this site, and as the only one in the country, there are a lot of people and organizations dependent on its success. If the project, for some reason, fails to move forward at this point, the country is at a standstill in terms of the disposal of nuclear waste.

Right now at Yucca Mountain, there is an Exploratory Studies Facility, being run by the Department of Energy. This laboratory is underground and allows scientists to be able to work directly with the material at the mountain. The laboratory has a tunnel that's about five miles long, with a few areas for research attached to it. The purposes of most of the studies done at this lab are to decide whether or not Yucca Mountain is a good place to have a geological repository.

There are three different types of testing at these laboratories. First, there's surface-based testing. In this type, scientists and engineers research the rock and soil in the area, and study the

movement of water. The second type of testing is underground. In underground testing, there is still a focus on examining the rock, simply at deeper levels. Finally, there are laboratory analyses. This type of testing is generally more diverse, ranging from the analysis of mineral and rock samples to the collection of data on underground activity. The tests that the scientists and engineers create and study help understand the geologic processes both in the area and at Yucca Mountain specifically (Fact Sheet).

Outlook on the Future:

It is predicted that it will be at least 2010 before the repository can begin the process of storing the material. There are several things that must be addressed, however, before the geologic repository can be used. The Environmental Protection Agency must propose standards for radiation protection and human health, which must be approved. The state of Nevada has the power to override this approval, and is known to have some negative feelings toward the Yucca Mountain Project in general. The Nevada veto, however, can be overridden by a vote in Congress. Before the Department of Energy can construct the repository, it has to apply for different licenses, be reviewed, and be authorized by the Nuclear Regulatory Commission. An official date has yet to be released. The Environmental Protection Agency has not yet finished a final radiation protection standard that will have to be approved (Zacha).

Since Yucca Mountain is in a fairly active region, there is some fear of earthquakes disrupting the radioactive waste storage system. However, since the repository is located so far underground and in fairly stable rock, the vibratory ground motion will most likely not effect the contents. (Why Yucca Mountain?)

Conclusion:

The problem of nuclear waste has been one that has been plaguing out country for many years now. Until this point, nuclear waste has been stored in smaller quantities across the country, in impermanent homes. Nuclear waste storage has our government and country in a landlocked position. The most viable option, according to most, is to put material at Yucca Mountain, hundreds of feet under the surface.

References

Boutte, Marie. “Studies of Potential Yucca Mountain Health Effects Seek to Learn from Past Experience.” State of Nevada. <http://www.state.nv.us/nucwaste/yucca/health01.htm>

Yucca Mountain Project: A Briefing. United States Department of Energy- Office of Civilian Radioactive Waste Management. Las Vegas, Nevada.

Fact Sheet on Yucca Mountain. United States Department of Energy- Office of Civilian Radioactive Waste Management.

Reference Design Description for a Geologic Repository. United States Department of Energy- Office of Civilian Radioactive Waste Management. Las Vegas, Nevada. January 2001.

Why Yucca Mountain? Frequently Asked Questions. United States Department of Energy- Office of Public Affairs. Washington, DC.

Public Citizen Website. “Testimony of Joan Claybrook, President, Public Citizen, Yucca Mountain: The Hazards of Nuclear Waste Storage and Transportation.” <http://citizen.org/cmep/energy_enviro_nuclear/nuclear_power_plants/nukewaste/yucca/articles.cfm?ID=7434>

Zacha, Nancy J. “What’s Next for Yucca Mountain?” American Nuclear Society, Radwaste Solutions, Magazine May/June 2006. Pgs 12-18. <http://www.ans.org/pubs/magazines/rs/docs/2006-5-6-5.pdf>