

## **Stranded Used Nuclear Fuel in the United States**

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March 7, 2014

*With uncertainty surrounding the implementation of an interim storage facility or deep geologic repository in the United States, there is a growing possibility that used nuclear could become stranded at decommissioned nuclear sites.*



***Onsite dry cask storage of used nuclear fuel (Image taken from Wikimedia Commons)***

By the year 2050, all of the nuclear reactors currently operating in the United States will be shutdown. It is uncertain whether a geologic repository or interim storage facility will be in place by this time, meaning that the used nuclear fuel from these reactors could become stranded onsite for many years. Originally, a geologic repository was planned for Yucca Mountain, Nevada. However, the Yucca Mountain site has suffered many setbacks and it is unknown whether this project will come to fruition.

William Alley is the Director of Science and Technology for the National Ground Water Association and previously oversaw the U.S. Geological Survey studies of Yucca Mountain from 2002 to 2010. In an article recently published in *Environmental Science & Technology*, Alley describes the current stalemate that the United States is facing when it comes to used nuclear fuel, as well as why tactics need to change in order to solve this problem. As Alley says in his article, "It is increasingly difficult to make the case for a new nuclear plant when the waste from the last plant has nowhere to go".

This is a problem that is not unique to the United States. In fact, it is a problem facing all countries with a nuclear energy program, including Canada. "Despite 435 nuclear power reactors in 31 countries and the worldwide scientific consensus on the

need for geologic disposal, no geologic repositories for used nuclear fuel exist anywhere in the world” claims Alley. The only two countries that could be considered close to building geological repositories are Finland and Sweden. They expect to have operational repositories in the 2020-2025 time frame.

Currently in the United States, all used nuclear fuel is stored onsite at either an operating nuclear power station or at a decommissioned nuclear power station. For onsite storage, the spent fuel is stored in dry casks which usually consist of a metal container that is surrounded by a concrete overpack, and are generally stored on an outdoor concrete pad. Onsite storage can be part of a responsible nuclear waste disposal plan, but there are issues with storing used fuel onsite for an extended period of time. One such problem is that it is difficult to monitor the conditions of the interior of the sealed casks, making it tough to tell when the casks would need to be replaced. From a financial viewpoint, extended storage onsite is not ideal, because storing the fuel onsite after the nuclear reactors have been decommissioned is quite costly. Storing used fuel onsite where there is an operating nuclear plant is relatively cheap because the required infrastructure is already in place, especially when it comes to security; but if the used fuel is being stored at a decommissioned nuclear site, the annual cost is about \$8 million.

The two alternatives to onsite storage are interim storage and disposal in a deep geologic repository. The U.S. Department of Energy has purposed to have a pilot interim storage facility for used fuel in operation by 2021, and a larger interim storage facility in place by 2025. In terms of a geologic repository, Yucca Mountain was the sole candidate in the U.S. beginning in 1987 when the Nuclear Waste Policy Act was amended. The state of Nevada has boldly opposed a geologic repository at Yucca Mountain. One of the reasons for the states opposition was a study done by the Los Alamos National Laboratory, which indicated that water was moving through the walls in the mountain. This study raised doubts as to whether the natural barrier of the mountain would be able to contain the waste in the event of the failure of a disposal container. To this day, the Yucca Mountain project is in a state of political deadlock. In 2009 the Obama administration announced that it would terminate the project, but in 2013 a federal court ordered the Nuclear Regulatory Commission to complete its review of the Yucca Mountain license application. The Obama administration wants to look into new locations for a geological repository. On the other hand, the Republicans are pushing for a repository to be put in place at Yucca Mountain before any other site.

This political deadlock needs to break in order to prevent nuclear waste from being stranded onsite. Alley recommends that “...the United States should pursue interim storage and investigate multiple sites for a repository”, but he does not believe that they should give up on Yucca Mountain. “With so much invested, Yucca Mountain should remain an option, as others are sought. The tactics must change; however, with an open-ended dialogue addressing Nevadan’s concerns”.

- 1. Some communities have been willing to host a geological repository or interim storage facility, but often this has been stopped at the state level. What is usually offered to these communities to entice them to host? Have there been cases where similar offers are made to the state, or do you know if this is something that any of the nuclear utilities are looking into?**

Both the community and the state are usually offered funding, but it depends on the situation. The state of Nevada was offered money for the Yucca Mountain repository when the Nuclear Waste Policy Act was amended, but they thought it was bribery and rejected it. The draw for the individual communities hosting one of these sites is that it will create jobs for the community. However, as you move outside the community that is hosting the repository to surrounding areas, these communities are not getting as much benefit but still have some risks such as having nuclear waste being transported on their highways. Similarly for the state, they are not benefiting as much as the host community.

- 2. You mention in your article that Finland and Sweden have made substantial progress towards developing geological repositories and expect operations to begin in the 2020-2025 time frames. What have they done that Canada and the United States, as well as many other countries have not? What has allowed them to make this substantial progress?**

Culturally they simply have a more cooperative society. They also have no states, so they don't have the problem of a community volunteering to host and then the state rejecting it. Another reason is that the sites that have been selected already have nuclear plants nearby. Also, the amount of waste that they have is much less than we have in the U.S.

- 3. Why does it cost more to store used fuel at a decommissioned site when compared to a site with ongoing nuclear operations?**

When storing the used fuel at a site with ongoing nuclear operations, the infrastructure is already in place. There is security onsite, and many other things that are needed are already there. So there is not much more additional cost to store the used fuel.

- 4. Would there be any difference in the storage containers for onsite, interim, or storage in a geological repository? How would these containers stand**

**up to a natural disaster, say an earthquake? Would geological repository storage be better or worse in this scenario?**

The container design would depend on the storage facility, regardless of whether it was interim storage or storage in a repository. For instance there would be different container size requirements depending on where the waste was being stored. There are containers that have been approved for both storage and transport, but none have been approved for disposal as there have not yet been any definite regulations set. I'm not too sure about which storage site would be best in the case of an earthquake. If the waste was being stored in a repository underground, the seismic risk would be less, however there would be the possibility of falling rocks and debris.

**5. You mention that after a century or so of storage, "Used fuel's radioactivity will diminish to where it no longer presents a significant barrier to the plutonium." What exactly does this mean?**

If someone wanted to break into a canister containing used fuel in order to steal the plutonium, this would initially be very difficult because of the radioactivity of the short-lived isotopes. However, after a century or so of storage, the radioactivity from short-lived isotopes in the used fuel will be relatively low and it would be much easier to get into the container.

**6. In your article you talk about one of the challenges in the Yucca Mountain studies which was that "bomb-pulse levels of chlorine-36 were found in exploratory tunnels". What is meant by bomb-pulse levels? Where was the Cl-36 coming from?**

The Cl-36 was left over from atomic bomb tests in the Pacific Ocean and at Nevada test sites. Cl-36 is a good tracer for water, so when the Los Alamos lab found these levels of Cl-36 in their sampling of the walls of Yucca Mountain, it indicated that water was moving through the mountain. Having water moving through the mountain was a big problem for storing the waste there. However, these studies were repeated and did not show these levels of Cl-36.

**7. After the Blue Ribbon Commission in 2012, it was recommended that the United States begin a consent-based approach to finding a community to host an interim storage site or geological repository. Do you know how much progress has been made on this front or which communities have expressed an interest?**

Well, not much progress has been made. The community at the Waste Isolation Pilot Plant (WIPP) site in New Mexico, which is a repository for radioactive

wastes that does not currently include used fuel, has expressed an interest in hosting a repository. There have been a few other places that have expressed some interest, such as communities in Texas and Mississippi. But this recommendation from the Blue Ribbon Commission has been held up mostly due to politics. The Republicans want a repository built at Yucca Mountain before we start looking into other sites, because Yucca Mountain was the original plan. However, the Democrats want to look into other locations for a geological repository.