

# WHY USED REACTOR FUEL SHOULD GO TO YUCCA MOUNTAIN

*George S. Stanford*

## Background Information

Currently, the nuclear "waste" being discussed is the used reactor fuel that is now on hand. It has three components of interest (not counting cladding, containers, etc.) (See Note 1):

1. Most of it (~94-1/2%) consists of **uranium isotopes**. The uranium is only mildly radioactive, and could safely be stored above ground if it were not mixed with the other stuff. It is too depleted in U-235 to be re-used as fuel in today's "thermal" light-water reactors (LWRs), and the U-236 content makes it unsuitable for re-enrichment. However, it would make a good fuel for the Canadian "CANDU" reactors, which are moderated by heavy water—In fact, the "spent" LWR fuel could be used almost as-is in CANDUs.
2. Some 3-1/2% consists of **fission products** (the remains of atoms that have undergone fission). The great preponderance of the radioactivity in this component will be gone in a few hundred years. This is the true waste, and Yucca Mountain would not be a bad place to put it (but the sea bottom would be easier).
3. The remainder, ~1%, is made up of "**transuranic actinides**"—elements heavier than uranium (above it in the periodic table), mainly plutonium. These are former U-238 atoms that soaked up neutrons when the reactor was running. Almost all the long-lived radioactivity is in this component. This is also the component of proliferation concern, since it contains the plutonium.

About 96-1/2% of the energy originally in the fuel remains in the used fuel that is currently called "waste." Almost all (99%) of that energy is in the uranium, and the remaining 1% is in the transuranic actinides.

We know how to make reactors (AFRs—advanced fast reactors) that could utilize all of this left-over energy. Although for some time the demand for energy will not be sufficient to require consumption of much of the uranium, it would be possible to fuel new AFRs with the transuranics, mixed with some of the uranium. With proper management, the result can (and probably will) be that only the fission products go into the Mountain.

## Why the Yucca Opponents are Wrong

*Claim: Shipped waste in transit poses an unacceptable risk,*

Wrong, because:

- The waste canisters are incredibly rugged.
- An anti-tank weapon could not cause the release of more than a negligible amount of radioactivity. People would probably be kept a few hundred yards away from the scene.
- A terrorist could do vastly more damage by attacking a gasoline tanker.
- There will be thousands of gasoline shipments around the country for every nuclear waste

shipment.

- A traffic accident with a tanker holding gasoline or other hazardous chemical can have locally serious consequences. Not true of a nuclear waste shipment.
- The hot-fire-in-a-tunnel scenario is spurious, because there will be no tunnels along the routes used.

*Claim: We can continue to store the used reactor fuel at the reactor sites.*

True in principle, but not very practical, because doing that would be expensive, resulting in an unneeded addition to electricity bills.

*Claim: The waste will remain lethal for hundreds of thousands of years.*

Wrong:

1. Even if the used fuel stays there permanently, there is no long-term hazard. In 500 or 1000 years, even if some of the waste enters the ground water, by the time it reaches the surface (perhaps in Death Valley), the radiation level would not be much above background.
2. In 500 or 1000 years, the radioactivity in the repository will have decayed to the point where there will be more (natural) radioactivity in the soil above and near the repository—much closer to humans.
3. The repository is adjacent to the Nevada nuclear test site, where hundreds of underground tests were conducted. The radioactive bomb residue is still there, completely uncontained. There's more radioactivity there than ever could be expected to leak from the repository. Nobody seems to worry -- and nobody should.
4. In Oklo, Gabon, Africa, there were a number of low-power natural reactors operating about 1-1/2 billion years ago. They ran, off & on, for millions of years. The fission products have traveled a few yards.
5. Assume, however, that we do the right thing and burn the transuranics in fast reactors. Then all that goes into Yucca Mountain is the fission products, which will have become innocuous well within 500 years.

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**Note 1:** In the U.S. once-through "throw-away" cycle, irradiated LWR fuel has approximately the following composition:

- U-238 94.3%
- U-235 0.8%
- U-236 0.5%
- Fission products 3.5%
- Transuranic actinides (mainly Pu isotopes) 0.9%

The burnup in the above example is 3.5%, meaning that 96.5% of the energy is still there. I think some reactors achieve a slightly higher burnup fraction.

Letter to the Editor, to be published in the *Washington Post* Saturday, July 27, 2002

The July 18 KidsPost story "Where Should We Put Nuclear Waste?" gave kids some big-time misinformation. Please tell Fern Shen that used fuel from nuclear reactors is nowhere near as dangerous as she says.

The used fuel would be somewhat radioactive after 10,000 years, to be sure, but so feeble that it would pose no danger at all. Shen could have told the kids that, for example, after only about 1,000 years the waste's radioactivity would be less than the amount of natural radioactivity already in the land near the repository.

"It can eat through flesh and cause cancer and birth defects," she says. *Scary*. But we safely handle larger quantities of other hazardous materials (such as household lye, arsenic and mercury) that can eat through flesh and cause cancer and birth defects.

"About 3,000 people live and farm in the area, some as close as 12 miles away [from the repository]," she says. Twelve miles is a long way. Realistically those people are not in danger.

"The government has spent about \$8 billion so far studying the site," she says. *Misleading*. That's not tax-

payer money. It has been collected by the utilities from electricity consumers to pay for waste management.

Shen says that an accident on the way to Yucca Mountain "would be serious." *Nonsense* (although many people believe it). She should have pointed out that accidents involving a gasoline tanker can be far worse than what could happen with the incredibly sturdy fuel casks.

She refers to "last summer's big fire in a Baltimore train tunnel, where the containers would have melted, spilling their dangerous cargo." But it will be strict policy, we hear, as well as common sense that no flammable cargo will be near enough to a fuel cask to trap it in such a fire.

Finally, she writes, "Yucca Mountain would be full by 2034." That's true, under current plans. But with good preparations, advanced reactors will be making electricity before then by consuming the plutonium and most of the other long-lived components of the used fuel. Then there will be lots of room down there to store the real waste: the fission products, which will be harmless within 500 years.

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