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Can't We Just Throw Our Nuclear Waste Down A Deep Hole?

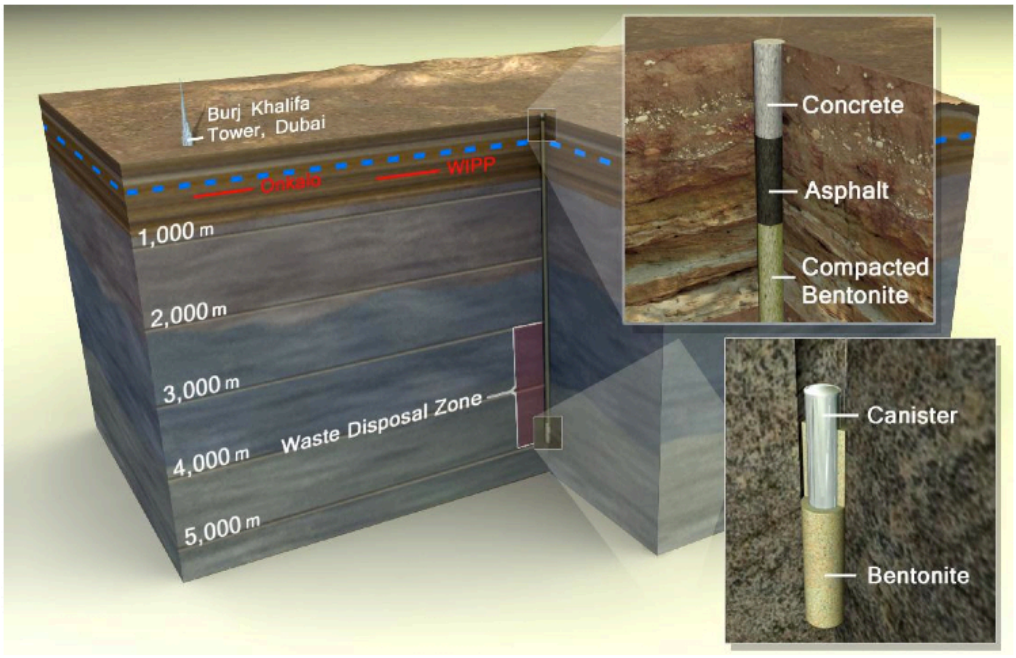
Um…yes, we can. It's called Deep Borehole Disposal and is pretty easy for some nuclear waste. Especially some highly radioactive materials that have sat in some fairly small capsules for almost 40 years.

This was exactly the topic of discussion in Washington this week when Secretary of Energy Ernest Moniz answered questions from Rep. Dan Newhouse (R-WA) at a House Science, Space and Technology committee hearing (Tri-City Herald).

The answer from Moniz was positive. He discussed a pilot project that would demonstrate the idea of deep borehole disposal using these capsules.

Deep borehole disposal is simple. Drill a *very* deep hole – 3 miles or so – put the waste in it and fill it up with some special layers, but mainly crushed rock and cement. As geologists, we know how many millions of years it takes for anything to get up from that depth in the Earth's crust.

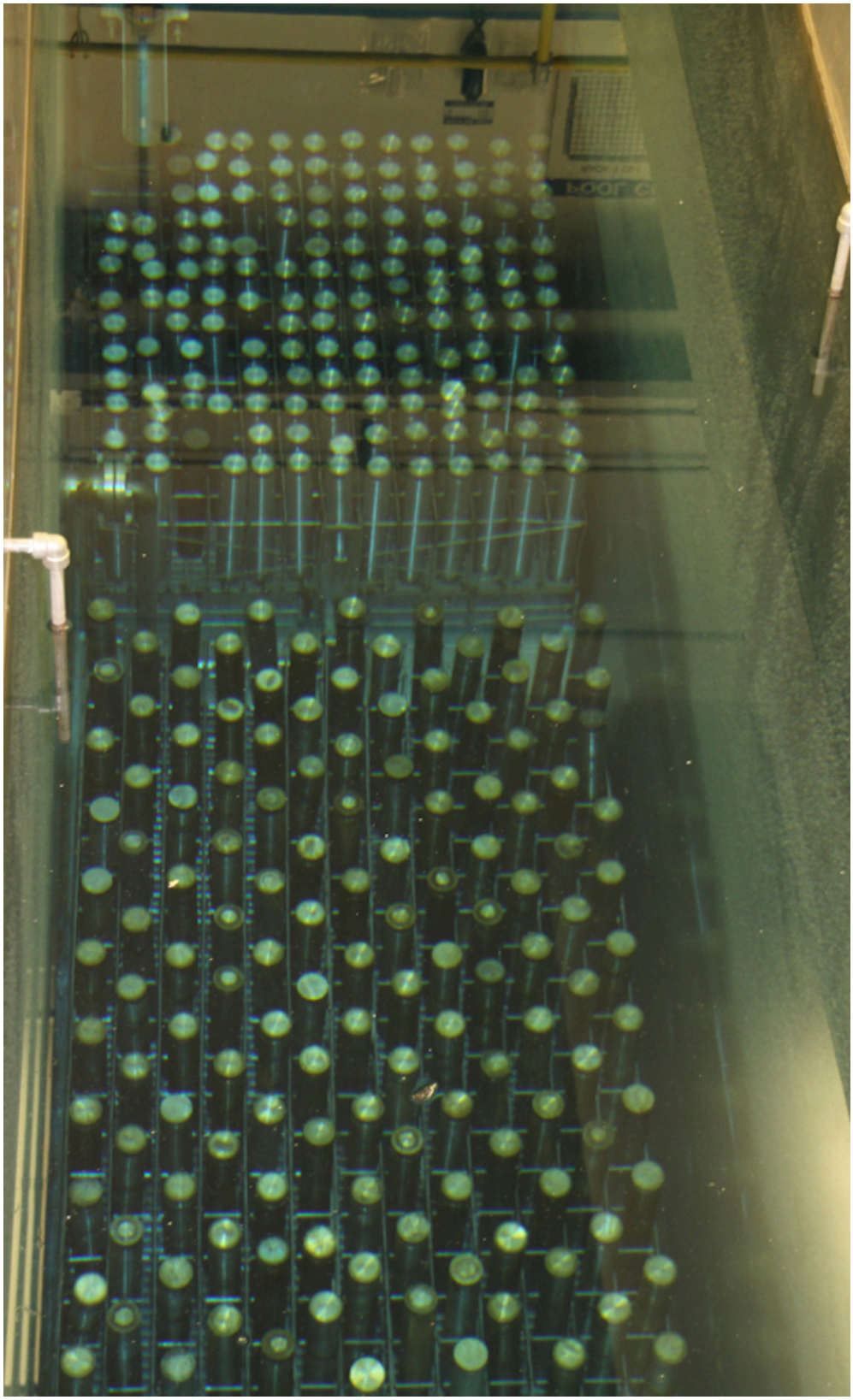
As long as you don't put it under an active volcano!



Deep Borehole Disposal uses a combination of the natural properties of deep crustal rocks plus engineered barriers like asphalt, bentonite and concrete to isolate waste for geologic time. At these depths, you're so deep in the crust that the overlying rocks don't matter. The water table doesn't matter. The climate doesn't matter. Human activities don't matter. Because of its size, it will take more technological advances for most of our nuclear waste, but some waste is small and perfect for this approach. Source: Sandia

The nice thing about deep borehole disposal is that it doesn't matter where you put it in the country. At that depth, you're so deep in the crust that the overlying rocks don't matter. The water table doesn't matter. The climate doesn't matter. Human activities don't matter.

But why these capsules? Because the material, cesium-137 and strontium-90 chloride salts (137CsCl and 90SrCl2), is in an easy waste form compared to that sludgy gooey stuff that makes up most of the tank waste left over from weapons production. These capsules are dry solid material in relatively small containers – less than 3-inches in diameter and only 2-feet long – very small compared to the large spent fuel assemblies and high-level waste glass logs usually discussed in geologic disposal plans.



Radioactive capsules containing highly radioactive isotopes of cesium and strontium are stored underwater at the Waste Encapsulation Storage Facility at DOE's Hanford site in Washington State. Because these radionuclides, left over from plutonium production for weapons, are the primary heat-generator in nuclear waste, they were separated from the rest of the waste almost 40 years ago to reduce heat. A total of 1,335 cesium capsules and 601 strontium capsules are stored at the WESF facility in pools of water 13 feet deep. The water shields workers from radiation and keeps the capsules cool. Source: DOE Hanford

Deep borehole disposal for the larger waste containers is trickier and more expensive because we haven't yet drilled large-diameter holes that deep. Like all technological advances, we will (Sandia National Labs; Ethan Bates et al

2014). But these capsules are less than 3-inches wide, and we've drilled 6 and 8 inch holes that deep many times, so nothing really new needs to be developed for this project.

There are 1,936 capsules filled with radioactive 137CsCl and 90SrCl2 that are stored underwater at the Waste Encapsulation Storage Facility at DOE's Hanford site in Washington State. Because these radionuclides, left over from plutonium production for weapons, are the primary heat-generator in nuclear waste, they were separated from the rest of the waste almost 40 years ago to reduce heat in the tanks, as well as to use in research.

Cesium-137 chloride (137CsCl) powder is highly radioactive, with a strong gamma-ray, and is used in radiation therapy and food and medical supply irradiation industry. It is produced by reprocessing spent nuclear reactor fuel. A few hundred tons exist worldwide. Some of America's stockpile left over from weapons production is in small capsules sitting in pools of water at DOE's Hanford site in Washington State.

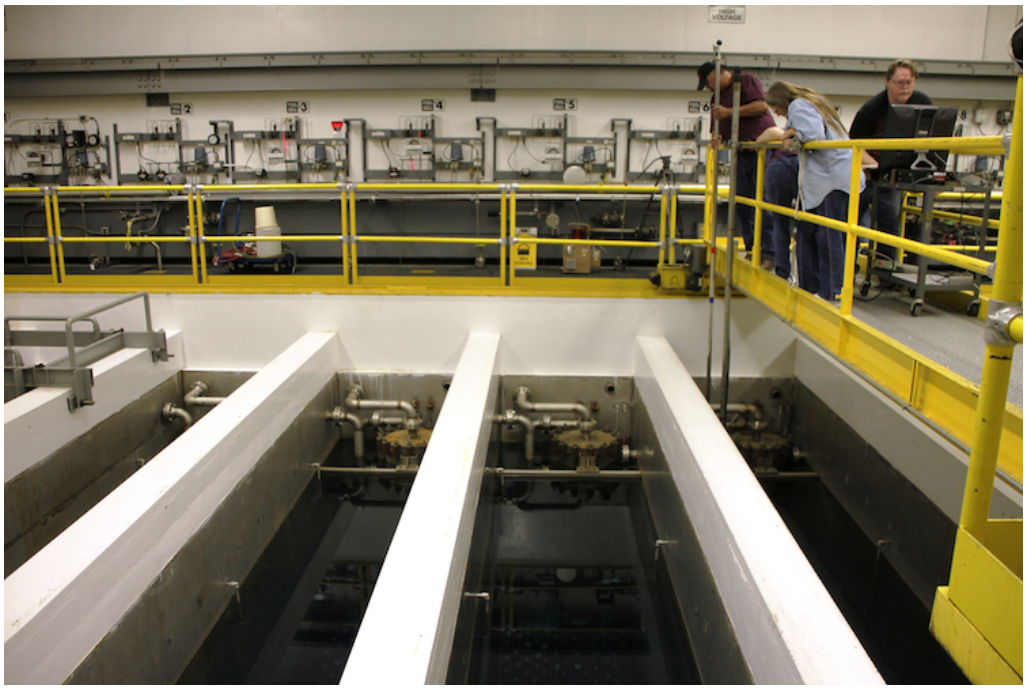
But there is a time-sensitive nature to these capsules. Although CsCl doesn't melt until 645°C (1,193°F), it goes through a bizarre solid-state phase change at 450°C (842°F). This means that without melting it's atoms change their arrangement in space from one structure to another with a very different density. So as the temperature changes across this boundary, the material swells and shrinks. And that tends to degrade the containers it's in.

The existing containers are beginning to get a little degraded, so best to get rid of them as soon as possible. They're small, so deep borehole disposal would be cheap and easy.

Since there isn't much of this boutique nuclear waste, only 5 cubic yards, and it's in a great form, this is a perfect opportunity to demonstrate deep borehole disposal and clean out this facility.

Like all really hot nuclear waste, these capsules were destined for the proposed deep geologic nuclear waste repository at Yucca Mountain, Nevada, which was halted in 2010. Since a new permanent federal repository for high-level waste won't be chosen for decades, we need to rethink our nuclear disposal program.

And this is a good idea, one of the few looked at by the President's Blue Ribbon Commission on America's Nuclear Future that was formed to come up with a new strategy in the wake of Yucca Mountain's closure. Their recommendations were basically to pick disposal options suited to the waste and the need. And to get everyone to buy off on them *before* you start!



Inside the Waste Encapsulation Storage Facility, CH2M HILL workers rearrange these radioactive Cs and Sr capsules to distribute heat. CH2M HILL Plateau Remediation Company is managing the facility and safely storing nearly 1,936 capsules containing these highly radioactive materials. Source: DOE Hanford

These capsules "*could be very well suited perhaps for much earlier disposal through a borehole approach*," Moniz said. "*We have to drill — we have to do the demonstration project, do the science, which is what we want to do in 2016.*"

Budget proposal documents show $2 million for technology development to support plans in fiscal 2016 for what is anticipated to be a multi-year test using a non-radioactive waste substitute. Since Yucca Mountain was projected to cost over $200 billion, this is a steal.

The test would demonstrate technology for sealing the borehole, tools to characterize waste in the borehole and controls on waste isolation. DOE has also sought communities interested in being the site for the borehole test.

There are a few towns already angling for it.

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