CHAIRMAN Resource

From: Ace Hoffman <rhoffman@animatedsoftware.com>
Sent: Thursday, September 26, 2013 6:24 PM
Subject: High Burn-Up Fuel: The problems multiply...

9/26/2013

Dear Readers,

Spent fuel is hot stuff. It's thermally hot -- about 400 degrees Fahrenheit. That's not residual heat from when the fuel was in the reactor, it's decay heat from fission products with relatively short half-lives - from days or weeks to about 30 years for most of them (most isotopes of iodine, cesium, strontium, etc.). The fuel will stay well above the boiling point of water for centuries or even millennia, although the temperature will keep dropping over time.

(Note: The term "short" for the half-lives of most fission products compares to Uranium, which is a billion years or more, or even Plutonium, which is 10s of thousands of times more radioactive (SHORTER half-life) than Uranium. Fission products are thousands of times more deadly than that, not counting Pu and U's heavy metal horrors.)

And speaking of the boiling point of water, above that you get steam. Steam is particularly hazardous to the zirconium cladding of the fuel rods. The zirconium separates the hydrogen from the oxygen in the water molecules of the steam, and the hydrogen atoms combine with each other as H2, which is explosive. Because it's so hot and radioactive inside the dry cask, they can't monitor this process near where it's happening, inside the "dry" cask. They need to monitor the water content, as well as the hydrogen, oxygen, helium, and "fission gasses" that are emitted.

After draining the fuel rods by slowly lifting the entire dry cask assembly out of the spent fuel pool (about 15 years after it was used in the reactor) about 25 gallons of water will remain in the fuel assembly. This water must be removed through repeated drying processes which are only partially successful each time. After that, water seepage into the dry cask is also an ever-constant threat.

There are now about 50 and will be approximately 150 dry casks at San Onofre. Each one will need a constantly-operating monitoring system to know the levels of hydrogen and other gasses in each cask. Such systems have not been designed for horizontally-stored casks such as are used at San Onofre. Instead, walk-by monitoring will be done for escaping radiation. That's not sufficient.

The threat of water intrusion comes from many sources. The dry casks will supposedly be submersible to 50 feet of water, according to regulations. But on the other hand, they will barely be above sea level, and the California State coast and waterways brochures state that everywhere along California's coast, 50 foot tsunamis are possible. Should we risk these "dry" casks on a coast with 9 million people within 50 miles and with so little margin of error?

In some ways, it's too bad the fuel isn't hotter, because if the temperature is above the "brittle/ductile boundary temperature" (which varies for every alloy of cladding and everything else in a fuel rod assembly) then it's much easier to move. But instead, the fuel has been cooling to well below that temperature, and now it's very brittle and difficult to deal with. As it gets older it also gets more and more embrittled, and so, even more difficult to deal with. That is where we are heading here at San Onofre.

Additionally, in high burn-up fuel, the ceramic pellets of Uranium Dioxide, which forms the bulk of the mass of the fuel rods (uranium is 1.7 times more dense than lead) fuses to the zirconium cladding. This is a very serious problem during later transport of the fuel, especially during postulated (let alone, greater-than-postulated) accidents, because the weight of the fuel on the ring of zirconium cladding is all concentrated on the very thin areas between the fuel pellets. So a force that was supposed to be spread out along the length of a pellet (about an inch) is instead borne nearly entirely by mere fractions of a millimeter. A crack means deadly fission products escape, a full rupture of a fuel rod means pellets drop out and could cause a criticality event when they gather at the bottom of the cask.

There are no shipping containers which the NRC has licensed for transporting high burn-up fuel, and worries about criticality events is one reason why. There aren't even any dry cask storage containers which have been licensed beyond the 20-year period for storage of high burn-up spent fuel. As recently as last March, the NRC's own experts can be heard at a meeting stating that tests for the quality of such containers should take at least 10 years to conduct -- and that's after the regulators have already conducted preliminary experiments to determine the type of testing that needs to be done! But it's the nuclear industry's job to actually do the tests (according to the NRC). The tests need to be done for each type of cladding. All zirconium alloys behave uniquely, and the industry hasn't even started to develop a plan for a test, let alone started a test of there systems for long-term storage or for transport afterwards.

However, despite these "known unknowns," high burn-up fuel IS being used around the country, and IS being loaded into dry casks, which are currently licensed for up to 20 years sitting on site wherever they happen to be produced. Never mind the pressures from vibrations of ocean waves and rails and truck routes a few feet away and all those unknowns. Never mind that there is no national plan to move the fuel ever. Never mind all that, so that operating reactor sites can keep making more waste.

High burn-up fuel allows reactor companies to keep operating even when they would otherwise be unprofitable. It also wears out the steam generators and/or other components of the reactor faster. It's no bargain for society to let the utilities get away with using high burn-up fuel!

Sincerely,

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