It's Not 'Waste': Nuclear Fuel Is Renewable

The first thing to know about nuclear waste is that it isn't "waste" at all, but a renewable resource that can be reprocessed into new nuclear fuel and valuable isotopes. The chief reason it is called "waste," is that the anti-technology lobby doesn't want the public to know about this renewability. Turning spent fuel into a threatening and insoluble problem, the anti-nuclear faction figured, would make the spread of nuclear energy impossible. And without nuclear energy, the world would not industrialize, and the world population would not grow—just what the Malthusians want.

The truth is that when we entered the nuclear age, the great promise of nuclear energy was its renewability, making it an inexpensive and efficient way to produce electricity. It was assumed that the nations making use of nuclear energy would *reprocess* their spent fuel, completing the nuclear fuel cycle by renewing the original enriched uranium fuel for reuse, after it was burned in a reactor.

When other modern fuel sources—wood, coal, oil, gas—are burned, there is nothing left, except some ashes and airborne pollutant by-products, which nuclear energy does not produce. But spent nuclear fuel still has from 95 percent to 99 percent of unused uranium in it, and this can be recycled.

This means that if the United States buries its 70,000 metric tons of spent nuclear fuel, we would be wasting 66,000 metric tons of uranium-238, which could be used to make new fuel. In addition, we would be wasting about 1,200 metric tons of fissile uranium-235 and plutonium-239. Because of the high energy density in the nucleus, this relatively small amount of fuel (it would fit in one small house) is equivalent in energy to about 20 percent of the U.S. oil reserves.

Ninety-six percent of the spent fuel can be turned into new fuel. The 4 percent of the so-called waste that remains—2,500 metric tons—consists of highly radioactive materials, but these are also usable. There are about 80 tons each of cesium-137 and strontium-90 that could be separated out for use in medical applications, such as sterilization of medical supplies. Using isotope separation techniques, and fast-neutron bombardment for transmutation (technologies that the United States pioneered but now refuses to develop), we could separate out all sorts of isotopes, like americium, which is used in smoke detectors, or isotopes used in medical testing and treatment.

Right now, the United States must import 90 percent of its medical isotopes, used in 40,000 medical procedures daily. These nuclear isotopes could be "mined" from the so-called waste. Instead, the United States supplies other countries with highly enriched uranium, so that those countries can process it and sell the medical isotopes back to us!

How Fuel Becomes 'Spent'

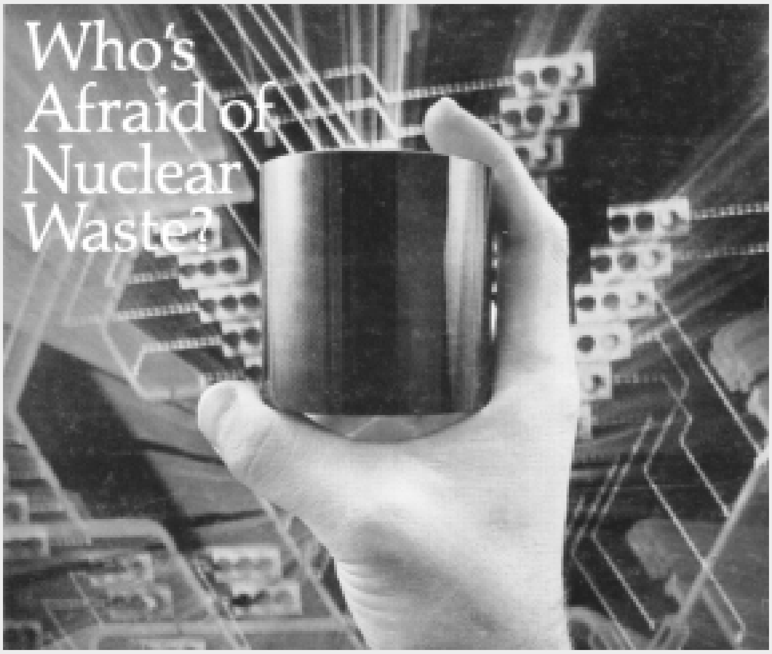
The fuel in a nuclear reactor stays there for several years, until the concentration of the fissile uranium-235 in the fuel is less than about 1 percent at which point, the nuclear chain reaction is impeded. A 1,000-MW nuclear plant replaces about a third of its fuel assemblies every 18 months.

Initially, the spent fuel is very hot, and is stored in pools of water which cool it and provide radiation shielding. After one year in the water, the total radioactivity level is about 12 percent of what it was when it first came out of the reactor, and after five years, it is down to just 5 percent.

Unlike other poisons, radioactive isotopes become harmless with time. This decay process is measured in terms of "half-life," which refers to the amount of time it takes for half of the mass to decay. Although a few radioisotopes have half-lives on the order of thousands of years, most of the hazardous components of nuclear waste decay to a radioactive toxicity level lower than that of natural uranium ore within a few hundred years.

The spent fuel includes uranium and plutonium, plus all the fission products that have built up in its operation, and very small amounts of some transuranic elements (those heavier than uranium) or actinides, which have very long decay times. If this spent fuel is not reprocessed, it takes hundreds of thousands of years for its toxicity to fall below that of natural uranium.

What are we really wasting? The spent fuel produced by a single 1,000-megawatt nuclear plant over its 40-year lifetime, is equal to the energy in 130 million barrels of oil, or 37 mil-



Battelle Pacific Northwest Laboratories

A glass cylinder illustrating the total amount of radioactive waste generated for one person if his lifetime electricity needs were supplied by nuclear energy.

ESTIMATED ELECTRICAL ENERGY FROM DIFFERENT FUELS

Fuel	killowatt hours of electricity from 1 kilogram of fuel
Hardwood	1
Coal	3
Heavy oil	4
Natural gas	6
Natural uranium	50,000
Low-enriched uranium	250,000
Uranium with reprocessing	3,500,000
Plutonium with reprocessing	5,000,000

This comparison of the approximate electricity that can be derived from currently available fuels, indicates why nuclear energy was viewed as such a breakthrough and came under such attack from the Malthusians. When electricity is cheap and plentiful, populations can prosper.

Source: John Sutherland, "Nuclear Cycles and Nuclear Resources," June 27, 2003.

lion tons of coal, plus strategic metals and other valuable isotopes that could be retrieved from the high-level waste.

Why We Don't Reprocess

The United States, which pioneered reprocessing, put reprocessing on hold during the Ford Administration and shut down the capability during the Carter Administration, because of fears of proliferation. This left reprocessing to Canada, France, Great Britain, and Russia (plus the countries they service, including Japan, which is now developing its own reprocessing capability). In addition, new methods of isotope separation using lasers, such as the AVLIS program at Lawrence Livermore National Laboratory, were shut down, or starved to death by budget cuts.

As a result, today we have 40,000-plus metric tons of spent fuel safely stored at U.S. nuclear plants, which the anti-nuclear fear-mongers rail about, even though they are the ones who created the problem. The plan to permanently store the spent fuel at the Yucca Mountain repository in Nevada, has become bogged down in what looks like a permanent political battle.

Technologically speaking, we can safely store nuclear waste in a repository like that of Yucca Mountain. But why should we spend billions of dollars to bury what is actually billions of dollars' worth of nuclear fuel, which could be supplying electricity in the years to come?

The commercial reprocessing plant in Barnwell, S.C. shut down in 1977, but we could start reprocessing at the national nuclear facilities at Hanford in Washington State, and at Savannah River in South Carolina. And we could have a crash program to develop more advanced technologies for reprocessing.

—Marjorie Mazel Hecht