NUCLEAR SPENT FUEL RECYCLING

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Over the past few years, recycling nuclear power spent fuel has gained a lot of attention. Advocates, such the Heritage Foundation, a conservative think-tank, argue that, "95 percent of the used fuel from America's 104 power reactors... could be recycled for future use." Heritage points out that nuclear recycling "can be affordable and is technologically feasible. The French are proving that on a daily basis. The question is: Why can't oui?"

As is common with nuclear technologies, the answer, like the devil, is in the details.

Nuclear Recycling and the Environment

The key to recycling is being able to reuse materials while reducing pollution and saving money. On all accounts, nuclear recycling fails the test. In order to recycle uranium and plutonium in power plants, spent fuel has to undergo treatment to chemically separate these elements from other highly radioactive byproducts. As it chops and dissolves used fuel rods, a nuclear reprocessing plant releases about 15 thousand times more radioactivity into the environment than nuclear power reactors.[1] Unlike direct disposal of spent nuclear fuel, a long standing U.S. policy, reprocessing generates several dangerous waste streams. If placed in a crowded area, a few grams of waste would deliver lethal radiation doses in a matter of seconds. They also pose threats to the human environment for tens of-of-thousands of years.

In Europe reprocessing has created higher risks and has spread radioactive wastes across international borders. Radiation doses to people living near the Sellefield reprocessing facility in England were found to be 10 times higher than for the general population.[2] Denmark, Norway, and Ireland have sought to close the French and English plants because of their radiological impacts. [3] For instance, discharges of Iodine 129, a very long-lived carcinogen, have contaminated the shores of Denmark and Norway at levels 1000 times higher than nuclear weapons fallout.[4] Health studies indicate that significant excess childhood cancers have occurred near French and English reprocessing plants[5] [6] [7] [8] Despite a firestorm of criticisms from the nuclear industry, experts have not been able to rule out radiation as a possible cause.

Nuclear recycling in the U.S. has created in one of the largest environmental, legacies in the world. Between the 1940's and the late 1980's, the Department of Energy (DOE) and its predecessors reprocessed tens of thousands of tons of spent fuel in order to reuse uranium and make plutonium for nuclear weapons. By the end the Cold War about 100 million gallons of high-level radioactive wastes were left in aging tanks that are larger than most state capitol domes. More than a third of some 200 tanks have leaked and threaten water supplies such as the Columbia River. The nation's experience with this mess should be serve as a cautionary warning. According to DOE, treatment and disposal will cost more than $100 billion; and after 26 years of trying, Energy has processed less than one percent of the radioactivity in these wastes for disposal. [9] By comparison, the amount of wastes from spent power reactor fuel recycling in the U.S. would dwarf that of the nuclear weapons program -- generating about 25 times more radioactivity.

Recycled Uranium

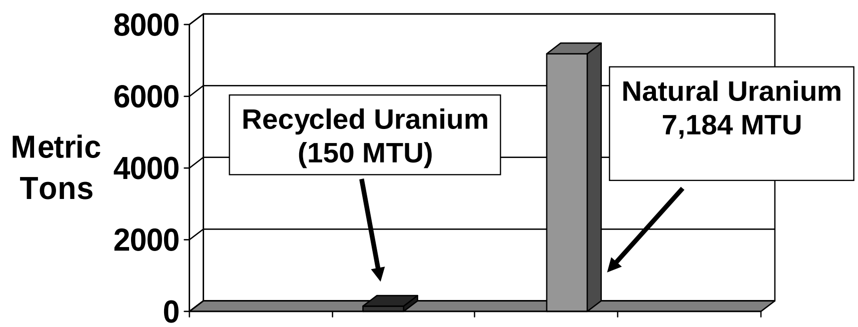
In 2007 the International Atomic Energy Agency concluded that "reprocessed uranium currently plays a very minor role in satisfying world uranium requirements for power reactors." [10] About 2 percent of uranium reactor fuel in France comes from recycling. (See figure 1) There are several reasons for this.

Uranium which makes up about 95 percent of spent fuel cannot be reused in the great majority of reactors without increasing levels of a key source of energy, uranium 235, from 1 to 4 percent, through a complex and expensive enrichment process.

Reprocessed uranium also contains undesirable elements that make it highly radioactive and reduces efficiency of the fuel. For instance the build up of uranium 232 and uranium 234 in spent fuel creates a radiation hazard requiring extraordinary measures to protect workers. Levels of uranium-236, a "poison" in used fuel, impedes atom splitting in a reactor. To compensate for energy loss, recycled uranium has to undergo costly "over-enrichment" to add higher levels of uranium 235.

Contaminants in reprocessed uranium also foul up uranium enrichment facilities, as well as new fuel. Once it is reused even larger amounts of undesirable elements build up – increasing the expense of reuse, storage and disposal. Given these problems, it's no surprise that DOE is planning to dispose of future reprocessed uranium in landfills.

Figure 1 Annual Use of Recycled Uranium in France (2004)



Source-- OECD/IAEA Uranium:2005: Resources, Production and Demand NEA No. 6098

Plutonium Recycling

Proponents have argued that plutonium has significant energy potential if it used in "fast" reactors. For over a half century plutonium- fueled reactors not been able to fulfill their promise of producing electricity, while converting plutonium into less troublesome materials.

Plutonium makes up about 1 percent of spent nuclear fuel and is a powerful nuclear explosive, requiring extraordinary safeguards and security to prevent theft and diversion. It took about 6 kilograms to fuel the atomic bomb that devastated Nagasaki in 1945. Unlike plutonium bound up in highly radioactive spent nuclear fuel, separated plutonium does not have a significant radiation barrier to prevent theft and bomb making.

Since the 1950's, the experience with plutonium-fueled "fast" reactors is marked with failure. At least 15 "fast" reactors have been closed due to costs and accidents in the U.S., France, Germany, England, and Japan. There have been two fast reactor fuel meltdowns in the United States including a mishap near Detroit in the 1960's. Russia operates the remaining fast reactor, but it has experienced 15 serious fires in 23 years[11]

The failure of fast reactors has created a plutonium legacy of major proportions. Of the 370 metric tons of plutonium extracted at reprocessing plants over the past 30 years, about one third has been used. There is about 200 tons of plutonium sitting at reprocessing plants around the world – equivalent to the amount in some 30,000 nuclear weapons in global arsenals.[12]

Plutonium is currently used in a limited fashion in European power plants by blending it with uranium. Known as mixed oxide fuel (MOX), it can only be recycled once or twice in a commercial nuclear power plant because of the buildup of radioactive contaminants. According to a report to the French government in 2000 the use of plutonium in existing reactors doubles the cost of disposal. [13]

In 1996, the National Academy of Sciences studied the potential for reprocessing plutonium for recycle in the United States and concluded that it was supremely impractical. It could cost up to $500 billion in 1996 dollars and take 150 years to accomplish the transmutation of plutonium and other dangerous long-lived radioactive toxins.[14] In 2007 the Academy once again tossed cold water in this effort, concluding that “there is no economic justification for going forward with this program at anything approaching a commercial scale.”[15]

Meanwhile, the client base for Areva the French nuclear recycling company has shrunk to one new contract for a relatively small amount of spent fuel from the Netherlands. Most revealing is that its main customer, the French utility, Electricité de France, is balking at doing further business unless the price goes down--something that Areva says it can’t do. It appears that even the French are starting to say no instead of oui.

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