Union of Concerned Scientists
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fact sheet

U.S. Nuclear Fuel Reprocessing Initiative

DOE Research Shows Technology Does Not Reduce Risks of Nuclear Proliferation and Terrorism

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Background

The Bush Administration requested $250 million in its fiscal year 2007 budget as a first installment for a program to "reprocess" spent fuel from nuclear power reactors. Spent fuel is intensely radioactive, and reprocessing is a complex chemical operation that separates plutonium from those elements in spent fuel that make it highly radioactive. At that point the plutonium can be used to make new reactor fuel or nuclear weapons. For this reason, there has been a long-standing concern that reprocessing facilities anywhere would be potential sources for terrorists seeking the materials required to make nuclear weapons, and that such facilities could ease the path for nations beginning nuclear weapons programs. These concerns led the United States to abandon its reprocessing program in the 1970's.

The administration claims that the reprocessing technology it will use will only produce material that is "proliferation-resistant," making the plutonium inaccessible and undesirable to terrorists and states pursuing nuclear weapons. As we discuss below, this claim is not true.

Direct Disposal: The Standard for Proliferation Resistance

It is important to understand that DOE claims these technologies are "proliferation resistant" compared to the reprocessing technology in use today in some other countries—the so-called PUREX process, which separates the plutonium from all the other elements in the spent fuel. DOE is *not* comparing it to the current practice in the U.S. of direct disposal of spent fuel. None of DOE's proposed reprocessing technologies would be nearly as resistant to proliferation or terrorist theft as a fuel cycle in which the spent fuel is stored without reprocessing and disposed of in a geologic repository.

The plutonium in spent fuel is bound up in the large, heavy and highly radioactive "assemblies" of used fuel, making it essentially impossible to steal. Moreover, even decades after being discharged from a reactor, spent fuel would deliver a lethal dose of radiation to someone standing a few feet away in less than an hour unless is surrounded by heavy shielding. Spent fuel is considered radioactive enough to be "self protecting" if it emits more than 100 rads per hour at a one meter distance—which it does for at least 100 years. Eventually, the used fuel assemblies would be placed in a deep underground "geologic" repository where they would remain isolated from the environment for tens of thousands of years. This would keep the plutonium in a highly inaccessible state, even after the radiation barrier of spent fuel decays.

DOE Research on Proliferation Resistance

The Department of Energy claims that the reprocessing technology it will pursue, "UREX+1a," will not be as proliferation-prone as conventional reprocessing (PUREX), for two reasons. First, the plutonium would be mixed with other "transuranic" elements (neptunium, americium and curium) that are more radioactive than plutonium. Second, this plutonium mixture would not be suitable to make nuclear weapons. Both claims are contradicted by DOE research.

A recent presentation by Dr. E. D. Collins, of DOE's Advanced Fuel Cycle Initiative program, shows that the radiation emissions produced by these transuranic (TRU) elements generate a dose rate of less than 1 rad per hour at one meter. This is 100 times less than the accepted standard for self-protection of

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100 rads per hour at a distance of one meter, and a thousand times lower than the dose rate from spent fuel fifty years after reactor discharge.[1] Dr. Collins' research demonstrates that the radiation emitted by this plutonium mixture would be so low that it would cause no immediate harm to the terrorist who stole it, as is the case with pure plutonium produced by PUREX reprocessing.

Dr. Collins' presentation also notes that the plutonium would need to be mixed with fission products from the spent fuel to increase its radioactivity to the point where it mattered, but that doing so would "increase significantly the costs of fuel fabrication and transportation." An important implication of this research is that because the plutonium mixture can be processed without the need for heavy shielding and remote handling by robotic tools, the plutonium could readily be stolen and later separated from the other elements in the mixture using conventional and widely known techniques, and used to make nuclear weapons.

Moreover, a presentation by Dr. Bruce Goodwin, described in the summary of a 1999 workshop, concludes that the transuranic elements or other actinides in spent fuel could be used to build nuclear weapons: "Examination of various cycles and the opinions of weapons-design experts lead to the conclusion that there is no 'proliferation-proof' nuclear power cycle. Explosive Fissionable Material (EFM) [any fissionable material that can generate a nuclear explosion] includes most of the actinides and their oxides…"[2] Dr. Goodwin stated that "As nuclear weapons design and engineering expertise combined with sufficient technical capability become more common in the world, it becomes possible to make nuclear weapons out of an increasing number of technically challenging explosive fissionable materials."[3] In other words, it is unwarranted to assume that terrorists would not acquire the capability to build nuclear weapons with the mixture of plutonium and other actinides that is produced by UREX+.

Terrorist Access to Nuclear Weapons Materials

As the research of DOE scientists makes clear, the reprocessing technologies under consideration would still produce a material that is not radioactive enough to deter theft, and that could be used to make nuclear weapons. One remaining issue is: how difficult would it be for someone working on the inside to steal this material? A commercial reprocessing plant would handle about 10 tons of this plutonium mixture annually—enough for more than 1,000 crude nuclear weapons. Because it would be converted to liquid and powder forms, it is difficult to precisely measure this material and keep track of it in a reprocessing plant. There are several instances in which foreign reprocessing plants have been unable to account for enough plutonium to make ten or more nuclear weapons for over a period of months or years, during which time it was impossible to determine if a theft had occurred.

The modified reprocessing technologies in DOE's proposal would make this problem even worse, because the mixture of plutonium and other elements would be even harder to precisely measure. According to work by Los Alamos scientists, "Even small concentrations of MAs (minor actinides) in plutonium mixes could complicate the accuracy of the plutonium measurement if not properly taken into account: consequently, safeguards of plutonium could be affected."[4]

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[1] E.D. Collins, Oak Ridge National Laboratory, "Closing the Fuel Cycle Can Extend the Lifetime of the High-Level-Waste Repository," American Nuclear Society 2005 Winter Meeting, November 17, 2005, Washington, D.C., p. 13. See http://www.ornl.gov/~webworks/cppr/y2005/pres/124397.pdf

[2] "Proliferation-Resistant Nuclear Power Systems: A Workshop on New Ideas," Center for Global Security Research, Lawrence Livermore National Laboratory, March 2000, p.7. See http://www.llnl.gov/tid/lof/documents/pdf/238172.pdf

[3] ibid, p. 15.

[4] J.E. Stewart et al., "Measurement and Accounting of the Minor Actinides Produced in Nuclear Power Reactors," Los Alamos, LA-13054-MS, January 1996, p. 21. See http://www.sciencemadness.org/lanl2_a/lib-www/la-pubs/00255561.pdf