

# *Reprocessing and Proliferation*

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Panel on *Toward Nuclear Weapons Capability for All? Proliferation risks of the Global Nuclear Energy Partnership (GNEP) and growing international interest in nuclear technology,*

June 23, 2008, 12:00-1:30pm, Dirksen Senate Office Building 562

## **Some resources**

International Panel on Fissile Materials website

[www.fissilematerials.org](http://www.fissilematerials.org):

*Managing Spent Fuel in the United States: The Illogic of Reprocessing Spent Fuel Reprocessing in France*

*Japan's Spent Fuel and Plutonium Management Challenges*

*The Legacy of Reprocessing in the U.K.* [going up this week]

**“Reprocessing Revisited: The International Dimensions of the Global Nuclear Energy Partnership,”** *Arms Control Today*, April 2008

[www.armscontrol.org](http://www.armscontrol.org)

**“Rethinking Nuclear Fuel Recycling,”** *Scientific American*, May 2008

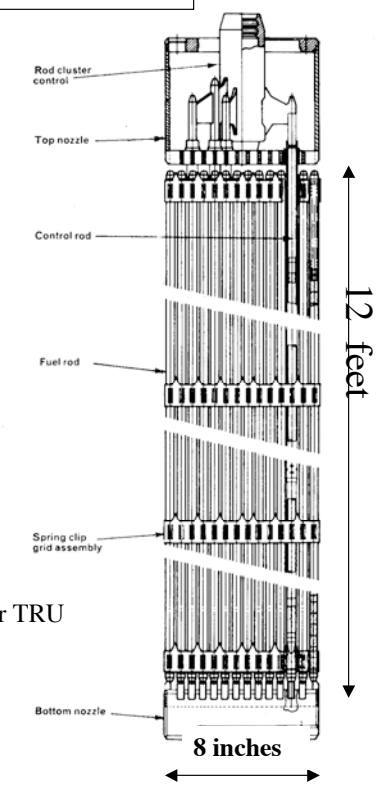
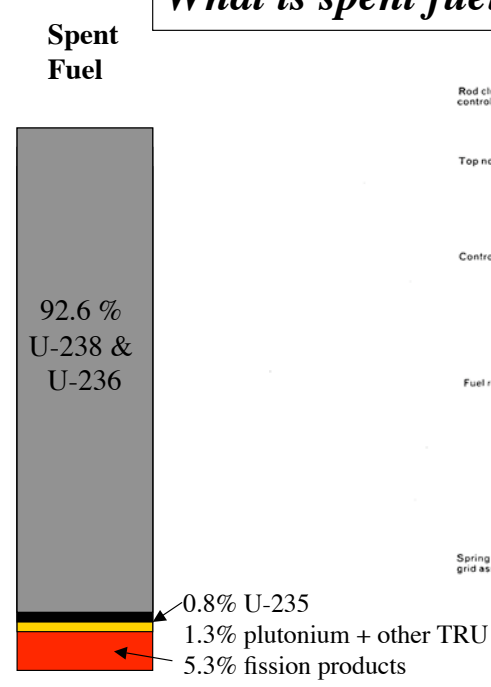
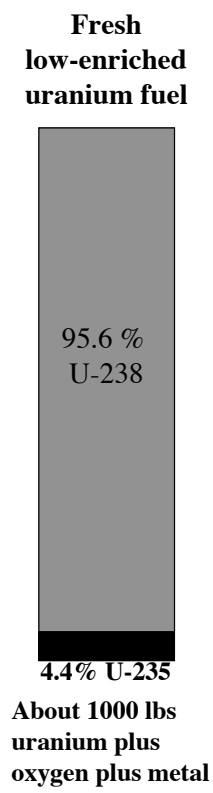
[www.sciam.com](http://www.sciam.com)

**In 75% of countries with nuclear power plants (including the U.S.) spent fuel is stored in cooling ponds for 1-2 decades and then in massive air-cooled dry casks**

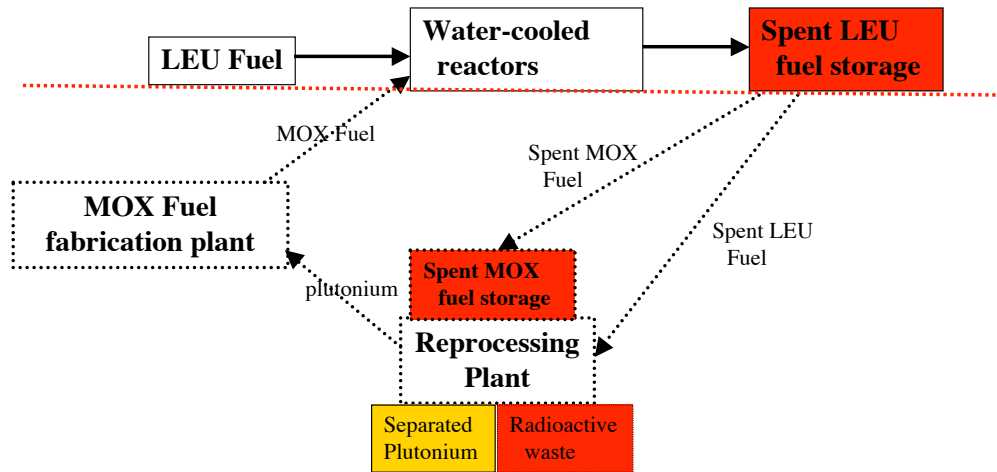


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***What is spent fuel?***



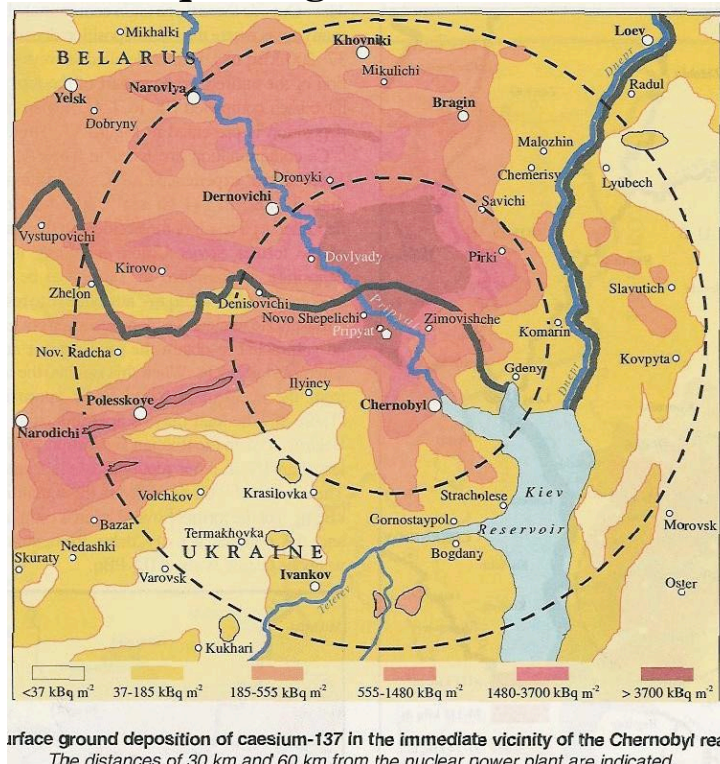
**Reprocessing.** A few countries (France, India, Japan, Russia, the U.K. (and, perhaps in the future, China) reprocess their spent fuel. France recycles its separated plutonium. Japan hopes to soon and India later. Russia does not. The U.K. is ending reprocessing after accumulating a stockpile of 100 tons of separated plutonium (enough for more than 10,000 nuclear weapons)



## Primary Safety Issue: Liquid high-level waste

A reprocessing plant sized to keep up with current U.S. spent-fuel discharges would separate *in two days* the amount of 30-year-halflife cesium-137 that caused the long-term evacuation of an area of more than 1000 square miles around Chernobyl.

In France and the U.K., *years* of liquid high-level waste are stored in tanks that require active cooling to prevent boiling and releases to the atmosphere.



Surface ground deposition of cesium-137 in the immediate vicinity of the Chernobyl reactor. The distances of 30 km and 60 km from the nuclear power plant are indicated.

# Reprocessing and proliferation

Before 1974, the U.S. encouraged other countries to reprocess.

In 1974, India, to which the U.S. had transferred reprocessing technology under the “Atoms for Peace” program, used the first plutonium it separated for a “peaceful nuclear explosion.”

France was about to sell reprocessing plants to South Korea and Pakistan and Germany to Brazil. All three recipient countries wished to acquire plutonium for weapons.

Only one non-weapon state (Japan) reprocesses today.

All other countries that reprocessed, either used it to acquire nuclear weapons or have quit.

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## Reprocessing facilitates proliferation because separated plutonium can be handled easily. Spent fuel is self-protecting.

### Separated plutonium



2.5 kg Pu in light-weight container. Can be processed in a glove box. 3-4 cans enough for Nagasaki-type bomb.

(Mayak Reprocessing Plant, 2004)

### PWR Spent fuel assembly (500 kg and 3.5 m long)

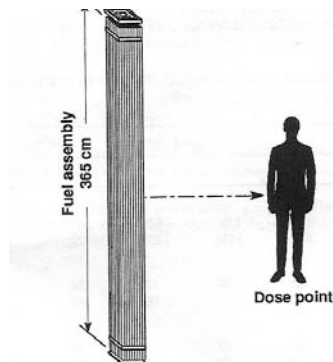


Figure 1. Dose rate from a PWR fuel assembly.

5 kg Pu. Fuel assembly lethal in 20 minutes at 1 meter 50 years after discharge. 20-ton container to transport & reprocessing behind thick walls to recover plutonium

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## U.S. nonproliferation policy on reprocessing

After the 1974 Indian test, U.S. policy became (in effect):

*“We don’t reprocess. You don’t need to either.”*

*No non-weapon state has launched “civilian” reprocessing in the past 30 years and several have stopped.*

In 2004, President Bush proposed a new policy (in effect):

*“The weapon states and Germany, Japan and the Netherlands will enrich your fresh fuel.”*

*The weapon states and Japan will reprocess your spent fuel.”*

### The result: exploding interest in national enrichment & reprocessing:

- Argentina, Australia, Canada and Ukraine joined Brazil and Iran in announcing that they planned to build national enrichment plants.
- South Korea’s nuclear R&D establishment began to push for reprocessing.

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**Selling Reprocessing services has failed in any case.  
Customer countries with one third of global nuclear  
capacity have not renewed their contracts.**

| Customer Country            | Nuclear Generating Capacity end 2006 (Gigawatts ) | Country Supplying the Reprocessing Service |
|-----------------------------|---|--|
| Armenia                     | 0.4   | Russia                                     |
| Belgium                     | 5.8   | France                                     |
| Bulgaria                    | 1.9   | Russia                                     |
| Czech Republic              | 3.5   | Russia                                     |
| Finland                     | 2.7   | Russia                                     |
| Germany                     | 20.3  | France and UK                              |
| Hungary                     | 1.7   | Russia                                     |
| Japan (reprocesses at home) | 47.8  | France and UK                              |
| Slovakia                    | 2.0   | Russia                                     |
| Spain                       | 7.5   | France and UK                              |
| Sweden                      | 9.1   | France and UK                              |
| Switzerland                 | 3.2   | France and UK                              |
| <u>Ukraine</u>              | <u>13.1</u>                                       | Russia                                     |
| <b>Total</b>                | <b>119.0</b>                                      |  |

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***In France: Changing spent LEU fuel into spent MOX fuel  
doubles the estimated cost of spent-fuel disposal***

*[Report to the Prime Minister [of France]: Economic Forecast Study of the  
Nuclear Power Option, (2000)]*

France's electric utility has refused to renew its reprocessing contract with *Areva* unless the price comes down.

Even with its reprocessing plants paid for, *Areva* says that it can't bring the price down now that its foreign customers are no longer subsidizing domestic reprocessing.

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## **South Korea's Interest in Reprocessing**

Dates back to the early 1970s when it was to be the basis of a nuclear-weapon program, which was terminated under U.S. pressure.

In 1992, South and North Korea agreed that neither would reprocess or enrich (Korean Peninsula Denuclearization Agreement).

In 2006, following the launch of its Global Nuclear Energy Partnership, the US DOE began to collaborate with the Korean Atomic Energy Research Institute (KAERI) in pyroprocessing R&D under DOE's International Nuclear Energy Research Initiative.

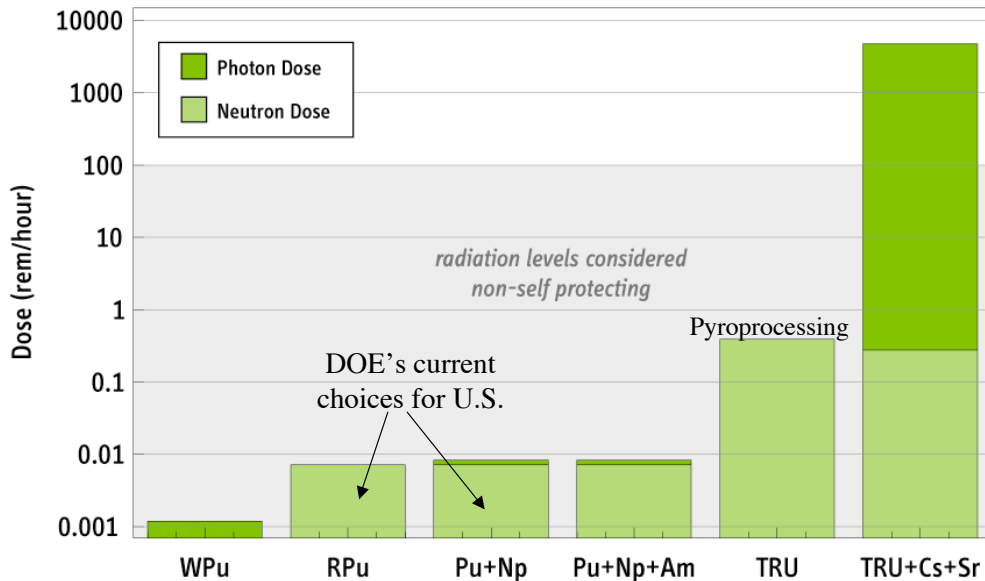
When asked about the compatibility of this R&D with the Korean Peninsula Denuclearization Agreement, the responsible DOE, KAERI and State Dept. officials responded in chorus, "*pyroprocessing is not reprocessing.*"

Recently, DOE has begun to back away from this statement.

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## “Proliferation-resistant” mixes of transuranics not much more self protecting than separated plutonium

(Dose rate from 4.4 kg of transuranics through a canister)



Robert Hill, Argonne National Laboratory, "Advanced Fuel Cycle Systems: Recycle/Refabrication Technology Status," September 7, 2005 <sup>13</sup>

## Where does pyroprocessing stand today?

KAERI is awaiting U.S. permission to pre-treat 44 kilograms of spent fuel to prepare it for pyroprocessing.

In its FY09 budget proposal to Congress, DOE proposes to "Conduct collaborative electrochemical processing [aka pyroprocessing] R&D with South Korea, Japan, and possibly Canada and Russia..."

DOE also proposes to conduct R&D on fast-neutron reactors with France, Japan and South Korea. Fast-reactor fuel cycles *always* include reprocessing.

In its desperation to get foreign support for GNEP to offset the loss of domestic support, DOE appears to have forgotten that GNEP's original purpose was to *prevent* the spread of reprocessing technology to non-weapon states.

## Summary

Reprocessing:

- Exchanges interim storage of self-protecting spent-fuel for interim stockpiling of separated plutonium.
- Costs much more than dry-cask storage.
- Is more dangerous than dry-cask storage.
- Does not reduce the radioactive waste problem in the absence of fast-neutron reactors (which are not economic).
- Provides cover for countries to develop nuclear-weapon options.