The Global Nuclear Energy Partnership (GNEP)

GNEP Element: Demonstrate More Proliferation-Resistant Recycling

Under GNEP, the U.S. will work with GNEP partners to demonstrate the capability to safely recycle used nuclear fuel using more proliferation-resistant separation processes. In support of this effort, the U.S and its international partners would conduct an **Engineering-Scale Demonstration** (ESD) of a process that would separate the usable components in used commercial fuel from its waste components, without separating pure plutonium. An **Advanced Fuel Cycle Facility** (AFCF) would be a multi-purpose research and development laboratory that can serve fuel cycle testing needs for 50 years or more.

Fuel recycle separates used fuel

Used nuclear fuel contains uranium, *transuranics elements* (plutonium and other long-lived radioactive material), and fission products. The fission products are waste and make up less than five percent of the used fuel. The buildup of the fission products inhibits the nuclear fission reaction, so used fuel must be removed from a nuclear power plant.

To consume transuranic elements and uranium, while recovering their energy content, they must be separated from the fission products and then be fabricated into new fuel. These recycling plants would only be located in countries that are "fuel supplier nations," thus reducing the proliferation risk.

The current international separation process, PUREX, creates a pure plutonium product. GNEP will instead encourage the use of advanced separation processes (such as

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High purity uranium oxide product recovered from used nuclear fuel using the UREX+ process

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Uranium Extraction plus, or UREX+) aimed at keeping the transuranic elements together – neptunium, plutonium, americium, and curium. This enables the reuse of the transuranics, minimizes waste, and makes the separation more proliferation-resistant than PUREX in that it does not separate out pure plutonium.

GNEP will pursue advanced recycling technologies generally, not just UREX+. However, the UREX+ separations process has been tested successfully on a laboratory scale to isolate pure uranium (see picture) and collect all transuranic elements together. The next step in the development process is to conduct an Engineering-Scale Demonstration (ESD) to obtain cost and performance data that can guide future industrial plant design and operation. ESD will also provide separated transuranics to support fuel requirements for *Advanced Burner Reactor* fuel testing.

The *Advanced Fuel Cycle Facility (AFCF)* would be a multi-purpose research and development laboratory that can serve the fuel cycle testing needs for 50 years or more. It would use modular, flexible construction techniques with near-term priority given to the fabrication and qualification of fuels to be used in the *Advanced Burner Reactor*.

The Advanced Simulation Laboratory (ASL) would support robust research through computer simulation and visualization, thereby decreasing testing costs by advancing computer simulation.

Demonstrating the technology path forward

The technology path forward includes operation of the Advanced Simulation Laboratory in 2008; the computer simulations will help in the other steps of the effort, e.g., the design of the AFCF by 2010. The advanced ESD recycling plant is targeted for operation by 2011. Thereafter, the first AFCF laboratory modules should begin operation in 2016.

Upon successful operation of the ESD, recycling will proceed to a commercial-scale plant capable of separating over 2000 metric tons of used fuel per year, at least as much as is generated annually by the 103 operating U.S. nuclear power plants.

The U.S. will explore collaboration with fuel supplier nations on the development of these technologies.

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