Fuel Cycle Research & Development

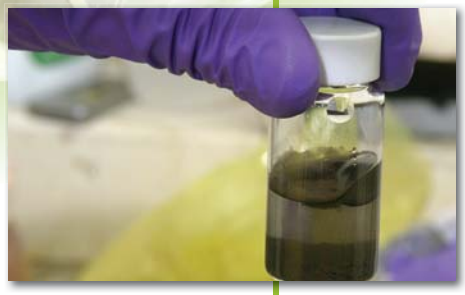
The U.S. Department of Energy's Office of Nuclear Energy

Scientists collaborate to find ways to maximize this economical energy source while minimizing the risks of used nuclear fuel.

The Fuel Cycle Research and Development (FCRD) program works with American industry, the National Laboratories, universities, and international partners to research and develop options for tomorrow's nuclear fuel cycle. This collaboration aims to create technical solutions that will improve safety and reduce long-term environmental and proliferation risks.

MISSION

The mission of the FCRD Program is to develop nuclear fuel and waste management technologies that will enable the safe, secure, economic, and sustainable expansion of nuclear energy, while reducing the risk of proliferation. The program's focus is on long-term, science-based research and development of technologies with the potential to dramatically improve the nuclear fuel cycle.



PROGRAM OBJECTIVES

FCRD seeks to develop technologies and policy options to:

- Improve waste storage and disposal options,
- Promote the safe and secure management of nuclear fuel and waste products,
- Minimize the proliferation risk of the civilian nuclear fuel cycle, and
- Reduce the time-scale for managing high-level nuclear waste from many hundred thousand years (geologic time-scales) to centuries (engineering time-scales).

SOLVING THE GRAND CHALLENGES

A science-based approach will provide the opportunity to focus on solving the grand challenges for the sustainable expansion of nuclear energy and provide truly transformational technologies including:

- Separations technologies with improved proliferation resistance, "near-zero" process losses and minimal undesirable waste streams;
- Nuclear fuels and targets with multi-fold increases in performance over previous generation fuels and very low fabrication losses, that permit high transmutation of radiotoxic elements;

Program Budget

Fuel Cycle Research & Development Program ($ in Millions)

	FY 2009 Actual	FY 2010 Request
	$145.0*	$192.0

** Previously the Advanced Fuel Cycle Initiative*

- Process control and accountability instruments and techniques that permit an order of magnitude improvement in the ability to detect fissile materials in fuel cycle systems; and
- Waste forms with predictable, long-term behavior, and enhanced resistance to long-term degradation suitable for a variety of potential geologic repository environments.

While an incremental approach, based on improving existing technologies, might provide partial solutions to these challenges, a science-based program that involves small-scale experiments coupled with theory development and advanced modeling and simulation is more appropriate for providing the transformational changes needed.

Successful execution of the program will improve the way the nuclear fuel cycle, particularly nuclear waste, is managed, and will facilitate a sustainable expansion of civilian nuclear power in the United States. This new, long-term, science-based R&D program will provide a more complete understanding of the underlying science supporting the development of advanced fuel cycle technologies. The program will also include a more expanded waste-management focus on R&D storage technologies, security systems, and alternative disposal pathways. FCRD will work in conjunction with the Office of Civilian Radioactive Management to begin revisiting the scientific considerations on long-term geologic storage. Therefore, it will provide a sound basis for future decisions on the U.S. nuclear fuel cycle.

PLANNED PROGRAM ACCOMPLISHMENTS

FY 2009

- Continue to research advanced aqueous separations processes with an increasing emphasis on simplification of the process steps.
- Investigate the separation and environmentally safe capture of gaseous release from used fuel during the first stage of the recycle process.
- Investigate the direct transition from waste products (transuranics) in a nitric acid solution to solid oxides capable of effective pellet formation, from which waste is turned into energy.
- Continue R&D to optimize the stability of waste forms and the efficiency of waste form production through laboratory-scale demonstration of solidification processes.
- Initiate post-irradiation examination of Advanced Test Reactor (ATR) fuel pins removed in FY 2008. Continue irradiation and testing of metal and oxide transmutation fuels in the ATR.
- Assess technical options and trade studies for future fuel cycle systems, such as approaches for minor actinide and heat management.

FY 2010

- Initiate a series of fundamental measurements to serve as a basis for expanding the understanding of actinide separations science.
- Develop advanced safeguards instrumentation for materials accountability measurements with increased accuracy and reliability for future separations facilities.
- Initiate the use of advanced experimental techniques and modeling tools to design novel fuel forms with significantly improved performance.
- Continue R&D on advanced alloy and composite cladding materials to support the improved performance goals of advanced fuels.
- Continue R&D activities on high precision measurements of nuclear data, sensitivity analyses to reduce uncertainty, and development of advanced measurement techniques.
- Initiate development of a system capable of capturing and managing all types of fuel cycle R&D knowledge.
- Conduct system studies for a range of possible fuel cycles and geologic repository environments in order to specify technical requirements for each key step of the fuel cycle to achieve a "near-zero" loss cycle.

A bank of centrifugal contactors being tested and evaluated at Idaho National Laboratory. Centrifugal contactors have the potential for higher efficiencies than other aqueous separations techniques.