Nuclear Energy

Nuclear Energy

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Nuclear Energy
(including transfer of funds)

Proposed Appropriation Language

For Department of Energy expenses including the purchase, construction, and acquisition of plant and capital equipment, and other expenses necessary for nuclear energy activities in carrying out the purposes of the Department of Energy Organization Act (42 U.S.C. 7101 et seq.), including the acquisition or condemnation of any real property or any facility or for plant or facility acquisition, construction, or expansion, and the purchase of not to exceed **[**20**]***29* passenger motor vehicles**[** for**]**, *including three new buses and 26* replacement **[**only**]***vehicles*, including one ambulance, **[**$970,525,000**]***$853,644,000*, to remain available until expended**[**:**]** **[***Provided*, That**]** **[**$233,849,000 is authorized to be appropriated for Project 99-D-143 Mixed Oxide (MOX) Fuel Fabrication Facility, Savannah River Site, South Carolina: *Provided further*, That the Department of Energy adhere strictly to Department of Energy Order 413.3A for Project 99-D- 143**]**. *(Energy and Water Development and Related Agencies Appropriations Act, 2008.)*

Nuclear Energy
Office of Nuclear Energy

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2007 Current Appropriation	FY 2008 Original Appropriation	FY 2008 Adjustments	FY 2008 Current Appropriation	FY 2009 Request
Energy Supply and Conservation					
University Reactor Infrastructure and Education Assistance	16,547	0	0	0	0
Research and Development					
Nuclear Power 2010	80,291	0	0	0	0
Generation IV Nuclear Energy Systems Initiative	35,214	0	0	0	0
Nuclear Hydrogen Initiative	18,855	0	0	0	0
Advanced Fuel Cycle Initiative	166,092	0	0	0	0
Total, Research and Development	300,452	0	0	0	0
Infrastructure					
Radiological Facilities Management	46,775	0	0	0	0
Idaho Facilities Management	113,723	0	0	0	0
Idaho Sitewide Safeguards and Security	75,919	0	0	0	0
Total, Infrastructure	236,417	0	0	0	0
Program Direction	62,600	0	0	0	0
Transfer from State Department	12,500	0	0	0	0
Subtotal, Energy Supply and Conservation	628,516	0	0	0	0
Funding from Other Defense Activities	-122,634	0	0	0	0
Funding from Naval Reactors	-13,365	0	0	0	0
Total, Energy Supply and Conservation	492,517	0	0	0	0

(dollars in thousands)

	FY 2007 Current Appropriation	FY 2008 Original Appropriation	FY 2008 Adjustments	FY 2008 Current Appropriation	FY 2009 Request
Nuclear Energy Appropriation					
Research and Development					
Nuclear Power 2010	0	135,000	-1,229	133,771	241,600
Generation IV Nuclear Energy Systems Initiative	0	116,000	-1,083	114,917	70,000
Nuclear Hydrogen Initiative	0	10,000	-91	9,909	16,600
Advanced Fuel Cycle Initiative	0	0	0	0	301,500
Total, Research and Development	0	261,000	-2,403	258,597	629,700
Fuel Cycle Research and Facilities					
Advanced Fuel Cycle Initiative	0	181,000	-1,647	179,353	0
Mixed Oxide Fuel Fabrication Facilities	0	281,349	-2,560	278,789	0
Total, Fuel Cycle Research and Facilities	0	462,349	-4,207	458,142	0
Infrastructure					
Radiological Facilities Management	0	48,561	-442	48,119	38,700
Idaho Facilities Management	0	117,000	-1,065	115,935	104,700
Idaho Sitewide Safeguards and Security	0	75,949	-688	75,261	0
Total, Infrastructure	0	241,510	-2,195	239,315	143,400
Program Direction	0	81,615	-743	80,872	80,544
Transfer from State Department	0	0	0	0	0
Subtotal, Nuclear Energy Appropriation	0	1,046,474	-9,548	1,036,926	853,644
Funding from Other Defense Activities	0	-75,949	688	-75,261	0
Total, Nuclear Energy Appropriation	492,517	970,525	-8,860	961,665	853,644

(dollars in thousands)

	FY 2007 Current Appropriation	FY 2008 Original Appropriation	FY 2008 Adjustments	FY 2008 Current Appropriation	FY 2009 Request
Other Defense Activities (NE) Appropriation[a]					
Infrastructure					
Idaho Facilities Management	15,923	0	0	0	0
Idaho Sitewide Safeguards and Security	75,949	75,949	-688	75,261	78,811
Subtotal Infrastructure	91,872	75,949	-688	75,261	78,811
Mixed Oxide Fuel Fabrication Facility	0	0	0	0	487,008
Program Direction	30,844	0	0	0	0
Subtotal, Other Defense Activities Appropriation	122,716	75,949	-688	75,261	565,819
Less Security Charge for Reimbursable Work	-3,003	-3,003	0	-3,003	0
Total Other Defense Activities Appropriation	119,713	72,946	-688	72,258	565,819
Total, All Appropriations	612,230	1,043,471	-9,548	1,033,923	1,419,463

Preface

The Office of Nuclear Energy (NE) leads the U.S. Government's efforts to develop new nuclear energy generation technologies to meet energy and climate goals, to develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy from nuclear fuel, and to maintain and enhance the national nuclear technology infrastructure. NE helps serve the present and future energy needs of the United States by managing the safe operation and maintenance of the DOE critical nuclear infrastructure that provides nuclear technology goods and services. Beginning in FY 2008, NE funds the Mixed Oxide (MOX) Fuel Fabrication Facility activities, which were previously funded by the National Nuclear Security Administration (NNSA).

NE has nine programs; funds for seven of those programs are requested within the Nuclear Energy appropriation in FY 2009: Nuclear Power 2010 (NP 2010), Generation IV Nuclear Energy Systems Initiative (Gen IV), Nuclear Hydrogen Initiative (NHI), Advanced Fuel Cycle Initiative (AFCI), Radiological Facilities Management (RAD), Idaho Facilities Management (IFM), and Program Direction. Prior to FY 2008, NE had two programs that were partially funded within the Other Defense Activities appropriation—Idaho Facilities Management and Program Direction. Beginning in FY 2008, these programs are funded solely in the Nuclear Energy appropriation. Funds are requested for the remaining two programs, Idaho Sitewide Safeguards and Security and the Mixed Oxide Fuel Fabrication Facility, under the Other Defense Activities appropriation.

[a] Includes only the NE portion of the Other Defense Activities appropriation.

Mission

NE supports the diverse nuclear energy programs of the United States. NE is responsible for leading the Federal government's investment in nuclear science and technology to support the diversity and security of the United States energy supply, and advance United States (U.S.) energy competitiveness.

Nuclear power is a greenhouse gas emissions-free, reliable, and safe source of energy are an essential element in the Nation's energy and environment future. Nuclear power is the second most abundant source of electric energy in the United States, and existing plants are among the most economic sources of electricity on the grid today. NE focuses on the development of advanced nuclear technologies to assure diversity in the U.S. energy supply. This budget request responds to the Energy Security goal to develop new generation capacity to fortify U.S. energy independence and security while making improvements in environmental quality by reducing greenhouse gas emissions. It builds on important work started over the last three years to deploy new nuclear plants in the United States by early in the next decade, and to develop advanced, next generation nuclear technology.

To facilitate the construction of new nuclear power plants in the U.S., the budget provides funds in the NP 2010 program to continue licensing demonstration activities started in previous years, and to develop regulations for nuclear power plant standby support, a program authorized by the Energy Policy Act of 2005. Under this authority, the Department will be able to offer risk insurance that will protect sponsors of new nuclear power plants against the financial impact of certain delays during construction or in gaining approval for operation that are beyond the sponsors' control.

Through NE programs and initiatives, NE seeks to develop advanced, proliferation-resistant nuclear fuel technologies that maximize energy output, minimize wastes, and operate in a safe and environmentally sound manner. The AFCI develops technologies that would enable the reduction of spent nuclear fuel waste requiring geologic disposal. Over the last five years, the U.S. has joined several countries in an international effort to pursue advanced technologies that could treat and transmute spent nuclear fuel from nuclear power plants, while reducing overall proliferation risk. These efforts are continued under the AFCI program through the Global Nuclear Energy Partnership (GNEP). Beginning in FY 2008, NE funds the Mixed Oxide (MOX) Fuel Fabrication Facility activities, which are focused on producing fuel for nuclear reactors from surplus weapon-grade plutonium.

The NE budget request also supports development of new nuclear generation technologies that provide significant improvements in sustainability, economics, safety and reliability, and non-proliferation and resistance to attack. Specifically, the NHI will develop advanced technologies that can be used in tandem with next generation nuclear energy plants to generate economic, commercial quantities of hydrogen to support a sustainable, clean energy future for the U.S. The Gen IV establishes a basis for expansive cooperation with international partners to develop next generation reactor and fuel cycle systems that represent a significant leap in economic performance, safety, and proliferation resistance.

Strategic Themes and Goals and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for energy security, nuclear security, scientific discovery, environmental responsibility, and management excellence) plus 16 Strategic Goals that tie to the Strategic Themes. This Nuclear Energy appropriation supports the following goals:

Strategic Theme 1, Energy Security: Promoting America's energy security through reliable, clean, and affordable energy.

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

Strategic Theme 2, Nuclear Security: Ensuring America's nuclear security

Strategic Goal 2.2, Weapons of Mass Destruction: Prevent the acquisition of nuclear and radiological materials for use in weapons of mass destruction and other acts of terrorism.

The programs funded within the Nuclear Energy appropriation have three GPRA Unit Program Goals that contributes to the Strategic Goals in the "goal cascade". These goals are:

GPRA Unit Program Goal 1.2.14.00: Develop New Nuclear Generation Technologies - By 2015, enable industry to construct and operate new nuclear power plants, promoting safe, reliable and carbon-free energy production, through the standardization of Generation III+ plant designs, the successful demonstration of nuclear plant permitting and licensing processes, the advancement of Gen IV plant technologies, the construction of pilot-scale hydrogen production experiments, and the commencement of proliferation-resistant spent nuclear fuel recycling technology demonstration activities.

GPRA Unit Program Goal 1.2.15.00: Maintain and Enhance National Nuclear Infrastructure - Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability to meet the Nation's energy, medical research, space exploration, and national security needs.

GPRA Unit Program Goal 2.2.43: Fissile Materials Disposition – Eliminate surplus Russian plutonium and surplus United States plutonium and highly enriched uranium.

Contribution to Strategic Goal

As the U.S. considers the expansion of nuclear energy, it is clear that the Nation must optimize its approach to managing spent nuclear fuel. While the planned geologic repository at Yucca Mountain would be sufficient for all commercial spent fuel generated in the U.S. through 2015, the current "once-through" approach to spent fuel will require the U.S. to consider additional repository space to assure the continued, safe management of spent fuel from currently operating plants and a new generation of nuclear plants. Further, long-term issues associated with the toxicity of nuclear waste and the eventual proliferation risks posed by plutonium in spent fuel remain.

The AFCI is focused on developing technologies which can reduce the volume and long-term toxicity of high level waste from spent nuclear fuel, reduce the long-term proliferation threat posed by civilian inventories of plutonium in spent fuel, and provide for proliferation-resistant technologies to recover the energy content in spent nuclear fuel.

Improving the way spent nuclear fuel is managed will facilitate the expansion of civilian nuclear power in the U.S. and encourage civilian nuclear power in foreign countries to evolve in a more proliferation-

resistant manner. Once these recycling technologies are proven, the U.S. and other countries, having the established infrastructure, could arrange to supply nuclear fuel to countries seeking the energy benefits of civilian nuclear power, and the spent nuclear fuel could be returned to partner countries for eventual disposal in international repositories. In this way, foreign countries could obtain the benefits of nuclear energy without needing to design, build, and operate uranium enrichment or recycling technologies. Related contributions are described within the Department's request for the AFCI program in support of GNEP.

The NP 2010 program is focused on resolving the technical, institutional, and regulatory barriers to the deployment of new nuclear power plants, consistent with the recommendations of the Nuclear Energy Advisory Committee (NEAC) report, "A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010." In support of the "National Energy Policy" and the President's goal of reducing greenhouse gas intensity by 18 percent by 2012, the NP 2010 program will help enable industry to deploy up to 30 new advanced nuclear power plants in the U.S. over the next decade.

To help facilitate the deployment of new nuclear power plants, the Department is authorized to develop regulations for nuclear power plant standby support through the Energy Policy Act of 2005. Under these regulations, the Department would, with appropriated funds, be able to offer risk insurance that will protect sponsors of new nuclear power plants against the financial impact of certain delays during construction or in gaining approval for operation that are beyond the sponsors' control. This insurance will provide additional certainty to the builders of new nuclear power plants and help lead to the construction of new nuclear power plants by the 2014 timeframe.

For the longer-term future, the Department is pursuing new, next-generation technologies considered to enhance the prospects for a significant expansion in the use of nuclear energy in the U.S. and globally. These technologies are the types of long-term, high-risk, high-pay-off research that only Government-sponsored research can address. As an example, the future energy picture of the U.S. could include a large role for hydrogen as a fuel for automobiles and other elements of the vast U.S. transportation infrastructure. The use of hydrogen would make it possible for the Nation to realize a primary objective of the "National Energy Policy"—to enhance the energy independence and security of the U.S. while making significant improvements in environmental quality. Hydrogen could someday be used to power the nation's transportation system, reducing our reliance on imported oil, and dramatically reducing the harmful emissions associated with the combustion of fossil fuels.

The Department is working with industry and overseas governments to establish the technological infrastructure for nuclear energy-produced hydrogen. Applying advanced thermochemical processes, it may be possible to develop a new generation of nuclear energy plants to produce very large amounts of hydrogen without emitting carbon dioxide or other greenhouse gases—and do so at a cost that is very competitive with imported fossil fuels. NHI will develop new technologies to generate hydrogen on a commercial scale in an economic and environmentally-benign manner. The Department's Offices of Nuclear Energy; Fossil Energy; and Energy Efficiency and Renewable Energy are working in coordination to provide the technological underpinnings of the President's National Hydrogen Fuel Initiative.

Developing the next-generation nuclear systems to make hydrogen possible is one aspect of the Gen IV program. Through this effort, the U.S. will lead multi-national research and development (R&D) projects to develop next-generation nuclear reactors and fuel cycles. This international approach allows

for the development of technologies that are widely acceptable; enables the Department to access the best expertise in the world to develop complex new technologies; and allows us to leverage our scarce nuclear R&D resources.

In addition to nuclear R&D programs, the Department has the responsibility to maintain and enhance the Nation's existing nuclear research infrastructure.

The Radiological Facilities Management program maintains DOE nuclear technology facilities in a safe, secure, environmentally compliant, and cost-effective manner to support national priorities. NE maintains the Department's vital nuclear energy research resources and capabilities at Idaho National Laboratory (INL), Oak Ridge National Laboratory (ORNL), and Los Alamos National Laboratory (LANL). The RAD program also supplies new research reactor fuel to universities and disposes of spent fuel from university research reactors.

The Idaho Facilities Management (IFM) program maintains the Department's facilities at Idaho in a safe, secure, and environmentally compliant condition for a range of vital Federal missions. Central to this infrastructure is the Nation's nuclear technology laboratory, INL. The Department is proceeding with plans to establish INL as a world-class nuclear technology laboratory within 10 years.

Beginning in FY 2008, NE funds the Mixed Oxide (MOX) Fuel Fabrication Facility program which converts surplus U.S. weapon-grade plutonium into fuel for commercial light-water reactors. After irradiation, the plutonium would no longer be directly usable. Beginning in FY 2009, the funding for this program is requested in the Other Defense Activities appropriation.

The Program Direction account funds expenses associated with the technical direction and administrative support of NE programs. NE is responsible for leading the Federal government's investment in nuclear science and technology by investing in innovative science and preserving the national research and development infrastructure. This program supports NE's Headquarters, Idaho, and Oak Ridge offices, U.S. mission to International Organization in Vienna, the U.S. mission to the Organization for Economic Cooperation and Development, and the Department of Energy Tokyo Office. NE plans to perform its mission, goals, and activities with excellence in accordance with the President's Management Agenda by: creating an organization that will more effectively implement the Secretary's priorities; updating and expanding the independently created Office of Nuclear Energy Workforce Plan; and continuing to recruit a well-qualified, diverse workforce.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Strategic Goal 1.2, Environmental Impacts of Energy			
GPRA Unit Program Goal 1.2.14.00, Develop New Nuclear Generation Technologies	300,452	437,950	629,700
GPRA Unit Program Goal 1.2.15.00, Maintain and Enhance National Nuclear Infrastructure	147,757	164,054	143,400

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Total, Strategic Goal 1.2, Environmental Impacts of Energy	448,209	602,004	773,100
Strategic Goal 2.2, Weapons of Mass Destruction			
GPRA Unit Program Goal 2.2.43.00, Fissile Materials Disposition	0	278,789	0
Subtotal, Strategic Goals 1.2 and 2.2 (Nuclear Energy)	448,209	880,793	773,100
All Other			
Program Direction	31,808	80,872	80,544
Total, Strategic Goal 1.2 and 2.2 (Nuclear Energy)	480,017	961,665	853,644

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by the Office of Management and Budget (OMB) to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews.

The current focus is to establish outcome- and output-oriented goals, the successful completion of which will lead to benefits to the public, such as increased national security and energy security, and improved environmental conditions. DOE has incorporated feedback from OMB into the FY 2008 Budget Request, and the Department will take the necessary steps to continue to improve performance.

The results of the FY 2005 review for the R&D programs, the FY 2006 review for the Infrastructure program, and the FY 2007 review for the University program are reflected in the FY 2009 Budget Request as follows:

NP 2010 received a rating of Adequate; Gen IV and AFCI received a rating of Moderately Effective; and National Nuclear Infrastructure and University Reactor Infrastructure and Education Assistance received a rating of Results Not Demonstrated.

Four of the five programs were assessed top scores for clarity of program purpose and soundness of program design. In the planning area, the PART assessment revealed a need for stronger links between budget and performance data for several of the programs. To address these findings, stronger links between program goals and funding requests are shown in this budget submission.

In the program management area, it was determined that the R&D programs needed to improve their methods for measuring and achieving cost effectiveness in program execution. The FY 2009 budget submission includes an efficiency measure that tracks program overhead against total R&D program costs, following a common methodology adopted by all applied energy R&D programs within the Department.

In addition, the AFCI and Gen IV programs were found to rely upon process oriented, output based metrics that do not indicate whether the programs are successful or demonstrating meaningful progress.

For example, it was determined that AFCI should have metrics in place that demonstrate annual progress on its various components, such as separations, fuels, and transmutation. For the Gen IV program, metrics were needed to compare the key attributes of the various reactor designs (sustainability, proliferation resistance and security, safety and reliability, and economics) more objectively. In response to these findings, NE has developed meaningful, measurable outcome based performance metrics.

The National Nuclear Infrastructure assessment found that the program is effectively targeted through the formal Idaho National Laboratory Ten Year Site Plan, which identifies the mission-essential infrastructure and facilities, planned annual work scope, and performance measures for the laboratory. In FY 2006, as a follow-up action assigned as part of this assessment, NE contracted with the National Academy of Sciences to conduct an extensive, comprehensive, and independent evaluation of R&D and Infrastructure program goals and plans, including the process for establishing program priorities and oversight. The evaluation resulted in a detailed set of policy and research recommendations and associated priorities for an integrated agenda of research activities to support the long-term commercial energy option to provide diversity in energy supply. A pre-publication version of the report was issued in October 2007; the final report is scheduled for publication in January 2008. NE continues to review the report findings, and is working with OMB to develop a viable strategy for implementing the committee's recommendations.

The University Reactor Infrastructure and Education Assistance assessment determined that enrollment target levels of the program have already been met and students no longer need to be encouraged to enter into nuclear related disciplines. In addition, the number of universities offering nuclear-related programs also has increased. These trends reflect renewed interest in nuclear power. Students will continue to be drawn into this course of study and universities, along with nuclear industry societies and utilities, will continue to invest in university research reactors, students, and faculty members. Consequently, Federal assistance was considered no longer necessary, and the FY 2007 Budget Request proposed termination of this program.

Findings from PART assessments are also addressed in the relevant sections of this budget submission.

Basic and Applied R&D Coordination

NE is requesting $55M within the AFCI to support applied research in advanced mathematics for optimization of complex systems, control theory, and risk assessment. This R&D integration focus area was the subject of workshops sponsored by the Office of Science in August 2006 and December 2006. DOE program activities address advanced math for understanding, controlling, and optimizing complex systems such as the electric grid, novel combustion systems and industrial processes and advanced nuclear reactors. Offices within DOE that will benefit from this research integration effort include the Offices of Energy Efficiency and Renewable Energy, Electricity Delivery and Energy Reliability, and Science.

In addition, NE is requesting $59M within AFCI to support applied research in the characterization of radioactive waste. This R&D integration focus area was the subject of workshops sponsored by the Office of Science in September 2005, July 2006 and August 2006. DOE program activities address critical unanswered scientific questions to facilitate the stabilization, long-term storage, treatment, and ultimate disposal of radioactive waste. Offices within DOE that will benefit from this research

integration effort include the Offices of Environmental Management, Civilian Radioactive Waste Management, Legacy Management, and Science.

AFCI R&D is focused on transmutation fuels, separations science and engineering and fast reactor design to support the GNEP vision. As part of its coordination with basic R&D activities conducted by the Office of Science, AFCI R&D is executed as an integrated experimental R&D and simulation effort focused on developing the key capabilities and products required for an advanced fuel cycle.

As part of the advanced mathematics focus area, the program will initiate code groups to develop advanced design and simulation codes in support of the goals of AFCI/GNEP. For example, the work of these groups would include three-dimensional integrated modeling to improve safety, performance, design, and construction costs for an advanced burner reactor.

As part of the characterization of radioactive waste focus area, the program is conducting significant R&D activities in spent fuel separations R&D to develop advanced aqueous and electrochemical separations technology alternatives capable of treating spend nuclear fuel in a safe, efficient and proliferation resistant manner. In addition, the program is conducting transmutation R&D to determine methods for lowering the radiotoxicity of spent nuclear fuel.

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Advanced mathematics for optimization of complex systems, control theory, and risk assessment[a]			
Office of Nuclear Energy	10,000	19,410	55,000
Characterization of Radioactive Waste[b]			
Office of Nuclear Energy	37,190	53,722	59,000

Indirect Costs and Other Items of Interest

Facilities Maintenance and Repair

The Department's Facilities Maintenance and Repair activities are tied to its programmatic missions, goals, and objectives. Facilities Maintenance and Repair activities funded by this budget are displayed below.

Indirect-Funded Maintenance and Repair

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Idaho National Laboratory	9,334	9,670	9,892
Oak Ridge National Laboratory	410	421	430
Total, Indirect-Funded Maintenance and Repair	9,744	10,091	10,322

[a] Includes activities within the Systems Analysis and Integration funding activity within Advanced Fuel Cycle Initiative.
[b] Includes activities within the Separations R&D and Transmutation R&D funding activities within Advanced Fuel Cycle Initiative.

Direct-Funded Maintenance and Repair

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Idaho National Laboratory	8,930	9,000	9,000
Oak Ridge National Laboratory	165	169	173
Other	2,133	2,184	2,236
Total, Direct-Funded Maintenance and Repair	11,228	11,353	11,409

Nuclear Energy
Office of Nuclear Energy

Funding by Site by Program

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Argonne National Laboratory			
Advanced Fuel Cycle Initiative	16,400	19,505	47,860
Generation IV Nuclear Energy Systems Initiative	1,297	2,700	1,860
Nuclear Hydrogen Initiative	1,865	650	700
Nuclear Power 2010	23	0	0
Total, Argonne National Laboratory	19,585	22,855	50,420
Brookhaven National Laboratory			
Advanced Fuel Cycle Initiative	1,041	1,425	3,112
Generation IV Nuclear Energy Systems Initiative	286	167	0
Nuclear Hydrogen Initiative	42	44	0
Nuclear Power 2010	0	67	0
Radiological Facilities Management	2,905	3,200	0
Total, Brookhaven National Laboratory	4,274	4,903	3,112
Chicago Operations Office			
Generation IV Nuclear Energy Systems Initiative	40	40	40
Idaho National Laboratory			
Advanced Fuel Cycle Initiative	50,464	44,495	70,050
Generation IV Nuclear Energy Systems Initiative	20,428	67,063	56,950
Idaho Facilities Management	84,435	113,485	102,250
Nuclear Hydrogen Initiative	4,405	3,520	5,200
Radiological Facilities Management	12,200	13,300	14,430
University Reactor Infrastructure and Education Assistance	5,518	0	0
Total, Idaho National Laboratory	177,450	241,863	248,880
Idaho Operations Office			
Advanced Fuel Cycle Initiative	31,416	75	7,762
Generation IV Nuclear Energy Systems Initiative	8,561	8,979	5,010
Nuclear Hydrogen Initiative	1,563	1,152	2,200

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Nuclear Power 2010	79,873	132,771	241,100
Radiological Facilities Management	0	2,920	3,700
Program Direction	0[a]	32,676[b]	32,676
University Reactor Infrastructure and Education Assistance	10,988	0	0
Total, Idaho Operations Office	132,401	178,573	292,448
Lawrence Berkeley National Laboratory			
Advanced Fuel Cycle Initiative	0	540	6,225
Lawrence Livermore National Laboratory			
Advanced Fuel Cycle Initiative	2,295	3,265	388
Generation IV Nuclear Energy Systems Initiative	180	60	0
Total, Lawrence Berkeley National Laboratory	2,475	3,325	388
Los Alamos National Laboratory			
Advanced Fuel Cycle Initiative	15,750	24,350	31,125
Generation IV Nuclear Energy Systems Initiative	85	1,092	0
Radiological Facilities Management	17,014	15,971	15,410
Total, Los Alamos National Laboratory	32,849	41,413	46,535
National Renewable Energy Laboratory			
Nuclear Hydrogen Initiative	550	221	300
NNSA Service Center			
Generation IV Nuclear Energy Systems Initiative	0	700	0
Oak Ridge National Laboratory			
Advanced Fuel Cycle Initiative	15,220	24,550	31,102
Generation IV Nuclear Energy Systems Initiative	1,910	3,108	2,440
Nuclear Hydrogen Initiative	480	129	0
Radiological Facilities Management	11,815	12,178	5,160

[a] Excludes $30,844,000 for Program Direction expenses at the Idaho Operations Office appropriated under Other Defense Activities.

[b] Beginning in FY 2008, funding for Program Direction expenses and Full Time Equivalents for the Idaho Operations Office is requested in the Nuclear Energy appropriation.

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Total, Oak Ridge National Laboratory	29,425	39,965	38,702
Oak Ridge Operations Office			
Advanced Fuel Cycle Initiative	25	0	0
Program Direction	2,032	2,189	1,290
Radiological Facilities Management	491	0	0
Total, Oak Ridge Operations Office	2,548	2,189	1,290
Pacific Northwest National Laboratory			
Advanced Fuel Cycle Initiative	1,574	2,865	3,112
Radiological and Environmental Sciences Laboratory			
Idaho Facilities Management	0	2,450	2,450
Program Direction	0	2,774	2,899
Total, Radiological and Environmental Sciences Laboratory	0	5,224	5,349
Sandia National Laboratories			
Advanced Fuel Cycle Initiative	1,760	3,640	6,225
Generation IV Nuclear Energy Systems Initiative	575	1,025	100
Nuclear Hydrogen Initiative	5,147	2,661	3,510
Radiological Facilities Management	1,800	0	0
Total, Sandia National Laboratories	9,282	7,326	9,835
Savannah River National Laboratory			
Advanced Fuel Cycle Initiative	7,613	1,943	18,675
Nuclear Hydrogen Initiative	1,479	1,246	2,200
Nuclear Power 2010	109	0	0
Total, Savannah River National Laboratory	9,201	3,189	20,875
Savannah River Operations Office			
Advanced Fuel Cycle Initiative	0	3,300	0
MOX Fuel Fabrication Facility	0	278,789	0
Total, Savannah River Operations Office	0	282,089	0

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
University of Nevada, Las Vegas			
Advanced Fuel Cycle Initiative	0	4,000	3,105
Generation IV Nuclear Energy Systems Initiative	0	1,400	0
Nuclear Hydrogen Initiative	2,000	0	2,000
Total, University of Nevada, Las Vegas	2,000	5,400	5,105
Washington Headquarters			
Advanced Fuel Cycle Initiative	22,534	45,400	72,759
Generation IV Nuclear Energy Systems Initiative	1,852	28,583	3,600
Nuclear Hydrogen Initiative	1,324	286	490
Nuclear Power 2010	286	933	500
Program Direction	29,776	43,233	43,679
Radiological Facilities Management	550	550	0
Transfer from State Department	12,500	0	0
University Reactor Infrastructure and Education Assistance	41	0	0
Total, Washington Headquarters	68,863	118,985	121,028
Total, Nuclear Energy	492,517	961,665	853,644

Site Description

Argonne National Laboratory

Introduction

Argonne National Laboratory (ANL) is one of the Department of Energy's (DOE) scientific research laboratories and is the Nation's first national laboratory, chartered in 1946. ANL is located approximately 25 miles southwest of the Chicago Loop, occupies 1,500 acres, and is surrounded by a forest preserve.

Advanced Fuel Cycle Initiative

ANL staffs the Advanced Fuel Cycle Initiative (AFCI) Campaign manager positions for separations technology development, waste form development, and fast reactor development, providing leadership over multi-laboratory research activities. Furthermore, ANL is the principal laboratory supporting the development of a fast recycling reactor. ANL also supports the AFCI/GNEP program by performing reactor physics calculations, including spent fuel throughput calculations, for existing commercial light water reactors and Generation IV thermal and fast reactor concepts. ANL has the lead for key systems analysis activities, including certain program reports to Congress and their subsequent updates.

Generation IV Nuclear Energy Systems Initiative
ANL continues to play an important role in conducting key R&D in support of the Generation IV Nuclear Energy Systems Initiative. ANL participates in system design and evaluation activities for the Generation IV systems, makes important contributions to Generation IV fuels and materials efforts, and leads or participates in joint projects with France, Korea, Canada, Euratom, and Japan. ANL leads the United States portion of the Generation IV International Forum (GIF) coordinated research and development activities on the Sodium Fast Reactor (SFR), including the staffing of GIF SFR Steering Committee vice-chair and membership on several GIF SFR Project Management Boards. ANL is responsible for staffing the position of Generation IV National Technical Director for Design and Evaluation Methods, who coordinates the United States (U.S.) efforts on method development and validation. ANL provides one of two U.S. experts for the GIF Experts Group.

Nuclear Hydrogen Initiative
ANL supports the program by conducting laboratory analyses of thermochemical hydrogen production methods, specifically alternative cycles other than sulfur-based cycles.

Brookhaven National Laboratory
Introduction
The Brookhaven National Laboratory (BNL) is a multiprogram laboratory located in Upton, New York. The Department of Energy's BNL conducts research in the physical, biomedical, and environmental sciences, as well as in energy technologies. Brookhaven also builds and operates major facilities available to university, industrial, and government scientists. BNL provides expertise in the design of spallation targets and also related work in the design of the subcritical multiplier. BNL also performs a prospective benefits analysis of the Department of Energy's nuclear energy research and development portfolio in support of the Nuclear Power 2010 (NP 2010), Generation IV Nuclear Energy Systems Initiative (Generation IV), Nuclear Hydrogen Initiative (NHI) and the AFCI.

Advanced Fuel Cycle Initiative
BNL supports the AFCI program by conducting transmutation and fuel systems analyses, and advanced fuels performance modeling.

Nuclear Power 2010
BNL supports NP 2010 through the assessment of the benefits of spending research, development, demonstration, and deployment funds that allow or accelerate the market penetration of the new or improved technologies that will offer greater economic, energy security, and environmental benefits. The outcome of the benefit analysis can be used to determine program funding requirements.

Radiological Facilities Management
The Brookhaven Linear Isotope Producer (BLIP) at BNL uses a linear accelerator that injects 200 million-electron-volt protons into the 33 giga-electron-volt Alternating Gradient Synchrotron. Isotopes such as strontium-82, germanium-68, copper-67, and others that are used in medical diagnostic applications are produced at BLIP.

Chicago Operations Office
Generation IV Nuclear Energy Systems Initiative
The Chicago Operations Office distributes the Generation IV funding contribution to the EPSCoR projects.

Idaho National Laboratory

Introduction

The Idaho National Laboratory (INL) is an extensive research and engineering complex that has been the center of nuclear energy research since 1949. It occupies 890 square miles in southeastern Idaho along the western edge of the Snake River Plain, 42 miles northwest of Idaho Falls, Idaho. The INL consists of three main engineering and research campuses: (1) the Reactor Technology Complex (RTC) at the site, (2) the Materials and Fuels Complex (MFC) at the site, and (3) the Science and Technology Complex (STC) in Idaho Falls. As INL Landlord, NE also operates the Central Facilities Area (CFA) at the site that provides support to all the compounds and campuses at the site. The Office of Nuclear Energy (NE) has Lead Program Secretarial Office (LPSO) responsibility for the Idaho Operations Office (ID). INL is the center for NE's strategic nuclear energy research and development enterprise. INL has a central role in Generation IV nuclear energy systems development, advanced fuel cycle development, and space nuclear power and propulsion applications. The INL has transitioned its research and development focus from environmental programs to nuclear energy programs, while maintaining its multi-program national laboratory status to best serve ongoing and future DOE and national needs. While focused on its role as the center for nuclear research and development, as a multi-program national laboratory, INL continues to pursue national security, and homeland security activities.

Advanced Fuel Cycle Initiative

INL serves as the Technical Integration Office for AFCI. INL also staffs the AFCI Campaign manager positions for Fuels and Systems Analysis, leading the efforts of several national laboratories in the Generation IV and transmutation fuels, systems analysis and computer modeling and simulation arenas. INL has the lead role for the design of the Advanced Fuel Cycle Facility (AFCF). The mission of this facility is to establish the feasibility of advanced separations processes for spent nuclear fuel and the fabrication of advanced fuel types. INL is also responsible for qualification of resulting waste forms. INL capabilities also include nuclear fuel development, irradiation of AFCI transmutation and Generation IV test fuels, post-irradiation examinations, waste and nuclear material characterization, and development of dry, interim storage for spent fuel and other radioactive materials.

Generation IV Nuclear Energy Systems Initiative

INL is the lead laboratory for the Generation IV program and conducts the program's technical integration activities. INL provides the R&D leadership for the Very High Temperature Reactor (VHTR), leads or participates in system design and evaluation activities for this system, and makes important contributions to fuel, materials and energy conversion system efforts. As designated by the Energy Policy Act of 2005, INL is the lead laboratory for the Next Generation Nuclear Plant (NGNP) project activities. This includes the integration of NGNP research and development, design, licensing and industrial participation. INL, together with ORNL, is the principal laboratory responsible for the development of advanced gas reactor fuel for the VHTR. INL leads or participates in a number of joint projects with France, Korea, Canada, Euratom, and Japan. INL is responsible for staffing the position of Technical Director of the GIF, and plays a key role in organizing international GIF Policy Group meetings. INL is also responsible for staffing the position of Chair of the GIF Experts Group and for the organization of the GIF Experts Group meetings.

Idaho Facilities Management

The INL is a multi-program national laboratory that employs research and development assets to pursue a wide range of nuclear power research and development and other national energy security activities such as the AFCI, Generation IV, the Space and Defense Power Systems program, and the Navy's

nuclear propulsion research and development program. The purpose of the Idaho Facilities Management (IFM) program is to provide the INL with the infrastructure required to support these efforts and to ensure that the existing infrastructure is maintained and operated in compliance with environment, safety and health rules and regulations.

NE is responsible for 890 square miles of land west of Idaho Falls (the site) and numerous laboratory and administrative facilities located in the town of Idaho Falls. NE operates and maintains buildings, nuclear and radiological facilities and associated support structures; a full complement of site wide utilities, including power, communications and data transmission systems; 800 miles of paved and unpaved roads; 61 miles of high voltage electrical transmission lines; and 14 miles of railroad track.

Nuclear Hydrogen Initiative
INL provides leadership in executing the NHI. INL cooperates with SNL, in its role as Generation IV National Technical Director for Energy Conversion Systems, to ensure efficient integration of Generation IV and NHI activities. INL leads the development of the High Temperature Steam Electrolysis hydrogen production process technology.

Radiological Facilities Management
INL is responsible for the radioisotope power systems heat source and test and assembly operations that were transferred from the Mound Site. Activities also include the transfer of neptunium-237 (Np-237) inventory from the Savannah River Site to the INL during FY 2005. Beginning in FY 2008, INL will provide fuel for university research reactors including fuel for conversions from highly enriched uranium (HEU) to low enriched uranium (LEU), and ship spent fuel from university reactors to DOE's Savannah River site.

University Reactor Infrastructure and Education Assistance
Due to the FY 2007 Continuing Resolution, INL provided fuel for university research reactors including fuel for conversions from HEU to LEU, and to ship spent fuel from university reactors to DOE's Savannah River Site. INL also administered the peer-review of the Nuclear Engineering Education Research (NEER) program to provide competitive investigator-initiated, research grants to nuclear engineering schools; the university reactor upgrade program to provide funding for improvements and maintenance of 20-25 university research reactors; and part of the university programs summer internship program.

Idaho Operations Office
Introduction
The Idaho Operations Office provides procurement, contract, cooperative agreement, and grant support for the Generation IV, Nuclear Hydrogen Initiative, Nuclear Power 2010, and AFCI programs.

University Reactor Infrastructure and Education Assistance
The Idaho Operations Office administered the grants for the NE & HP fellowships and scholarships and the DOE/Industry Matching Grants program, and the NE Education Opportunities program in FY 2007. ID also administers engineering management contracts in support of the AFCI/GNEP initiative.

Lawrence Berkeley National Laboratory

Introduction

Lawrence Berkeley National Laboratory has been a leader in science and engineering research for more then 70 years. Located on a 200 acre site in the hills above the University of California's Berkeley campus, adjacent to the San Francisco Bay, Berkeley Lab holds the distinction of being the oldest of the U.S. Department of Energy's National Laboratories.

Advanced Fuel Cycle Initiative

Lawrence Berkeley National Laboratory provides expertise in waste form research and development, including waste form modeling and simulation.

Lawrence Livermore National Laboratory

Introduction

Lawrence Livermore National Laboratory (LLNL) is a multi-disciplinary research and development laboratory focused on national defense, which has two noncontiguous geographic locations in northern California. LLNL is approximately one square mile and is located 40 miles east of San Francisco. LLNL conducts research in advanced defense technologies, energy, environment, biosciences, and basic science.

Advanced Fuel Cycle Initiative

LLNL provides expertise on the impact of separation technologies on the geologic repository, advanced computer simulations and modeling efforts, and coordination with Office of Science and Civilian Radioactive Waste Management experts from other laboratories.

Generation IV Nuclear Energy Systems Initiative

LLNL is working on the development of the Generation IV lead-cooled fast reactor and associated fuel cycle. LLNL and ANL together serve as the Systems Integration Manager for the lead-cooled fast reactor.

Los Alamos National Laboratory

Introduction

Los Alamos National Laboratory (LANL) is a multi-disciplinary research facility located on approximately 28,000 acres near the town of Los Alamos in northern New Mexico. LANL is engaged in a variety of programs for DOE and other government agencies. LANL's primary mission is to engage in research and technical activities supporting the Nation's defense. LANL also supports DOE missions related to arms control, non-proliferation, nuclear material disposition, energy research, science and technology, and environmental management. Research and development in the basic sciences, mathematics, and computing have a broad range of applications, including: national security, non-nuclear defense, nuclear and non-nuclear energy, atmospheric and space research, geoscience, bioscience, biotechnology, and the environment.

Advanced Fuel Cycle Initiative

LANL supports the AFCI and Generation IV programs through advanced fuels, materials and transmutation engineering research, including accelerator-driven systems. LANL staffs one of the two Deputy Director positions of the AFCI Technical Integration Office. LANL is coordinating several aspects of the GNEP international cooperation initiatives. LANL also supports activities under the

transmutation science education program related to nuclear science and engineering research at U.S. universities.

Radiological Facilities Management
At LANL, a portion of the Plutonium Facility-4 at the Technical Area-55 is dedicated to Pu-238 activities and is used to purify and encapsulate Pu-238 used in radioisotope power sources for the National Aeronautics and Space Administration (NASA) space exploration missions and national security applications. The LANL capabilities were expanded to include establishing a Pu-238 scrap recovery capability to recycle Pu-238 scrap for use in future missions.

At LANL, the 100 MeV Isotope Production Facility (IPF) became fully operable in FY 2005 and produces major isotopes, such as germanium-68, a calibration source for Positron Emission Tomography (PET) scanners; strontium-82, the parent of rubidium-82, used in cardiac PET imaging; and arsenic-73 used as a biomedical tracer.

National Renewable Energy Laboratory
Introduction
The National Renewable Energy Laboratory (NREL) is located in Golden, Colorado.

Nuclear Hydrogen Initiative
NREL coordinates the research in the thermochemical area. Additionally, NREL provides the systems integration function for the DOE Hydrogen program.

Oak Ridge National Laboratory
Introduction
The Oak Ridge National Laboratory (ORNL) is a DOE scientific research laboratory located in Oak Ridge, Tennessee. ORNL also maintains the DOE computer code system, software, and documentation at the Radiation Safety Information Computational Center (RSICC) and serves as a repository for DOE computational research activities, including computer software that is developed by NEER research projects. The RSICC computer software is made available to nuclear engineering departments, NERI and NEER awardees.

Advanced Fuel Cycle Initiative
ORNL conducts research in basic and applied science in support of the AFCI program. ORNL provides materials expertise to develop spallation targets and specific reactor components, conducts research and development on advanced separations technologies, transmutation fuels for advanced recycling reactors and participates in the development and deployment planning of advanced aqueous spent fuel treatment technologies. Specifically, ORNL is performing a Coupled-End-To-End demonstration project of an advance aqueous separations technology supporting the used nuclear fuel recycling objectives of GNEP. AFCI's Campaign manager for Grid-Appropriate Reactors resides at ORNL and integrates and coordinates multi-laboratory research for small reactor design.

Generation IV Nuclear Energy Systems Initiative
ORNL and INL are the principal laboratories responsible for the development of advanced gas reactor fuel for the Very High Temperature Reactor. ORNL will fabricate gas reactor fuel in a laboratory-scale facility to supply demonstration fuel for irradiation testing and fuel performance modeling. ORNL also staffs the Generation IV National Technical Director for Materials, leads the development of the

Generation IV Materials handbook efforts, and conducts much of the materials testing in support of the Generation IV.

Radiological Facilities Management
ORNL provides the unique capabilities for fabricating carbon insulator and iridium heat source components for radioisotope power sources used for NASA space exploration missions. These sophisticated heat source components are necessary for the safe operation of these power systems during normal operation and during launch, reentry or other deployment accidents.

Enriched stable isotopes are processed at two laboratories. The material laboratory performs a wide variety of metallurgical, ceramic, and high vacuum processing techniques; the chemical laboratory performs scraping, leaching, dissolving, oxidizing processes to remove unwanted materials and place the isotope into a "chemically stable" form. Radioactive isotopes are chemically processed and packaged in hot cells in Buildings 4501 and 7920.

Oak Ridge Operations Office
Radiological Facilities Management
Funding provides for oversight and monitoring of the maintenance of DOE leased assets at the Paducah Gaseous Diffusion Plant site. This program assures that USEC Inc. meets its MOA commitments and that the Government's rights and options are preserved. Beginning in FY 2008, the DOE will assume direct responsibility for these oversight and monitoring activities.

Pacific Northwest Laboratory
Introduction
Pacific Northwest Laboratory (PNL) is a multi-program laboratory located on approximately 640 acres of the Department's Hanford site. PNL also monitors a marine science lab in Sequim, Washington.

Advanced Fuel Cycle Initiative
PNL provides technical support to the AFCI in the areas of advanced separations, fuels, materials, nonproliferation analysis, and systems analysis.

Radiological and Environmental Sciences Laboratory (RESL)
Idaho Facilities Management
RESL is a DOE-owned and operated Federal reference laboratory with core mission capabilities in radiation measurement and calibrations, and analytical chemistry. The laboratory conducts measurement quality assurance programs to assure that key DOE missions are completed in a safe and environmentally responsible manner.

Sandia National Laboratories
Introduction
Sandia National Laboratories (SNL) is a research development facility located on approximately 18,000 acres on the Kirtland Air Force Base reservation near Albuquerque, New Mexico and has smaller facilities in Livermore, California and Tonopah, Nevada. The mission of SNL is to meet national needs in the nuclear weapons and related defense systems, energy security, and environmental integrity.

Advanced Fuel Cycle Initiative
SNL staff includes the Manager for the Regulation and Safety crosscut campaign. SNL is also an integral part of the AFCI systems analysis effort. SNL also has the lead for nuclear safeguards, security and regulatory requirements for GNEP proposed facilities.

Generation IV Nuclear Energy Systems Initiative
SNL is responsible for staffing the position of National Technical Director for Energy Conversion, who coordinates the U.S. R&D on advanced systems for converting nuclear-generated heat into marketable energy products. This R&D is focused on advanced gas turbo-machinery with helium or supercritical carbon dioxide as the working fluids.

Nuclear Hydrogen Initiative
SNL serves as the technical integrator for NHI, responsible for coordinating the participation of all laboratories in the development and conduct of the Nuclear Hydrogen Initiative R&D program. SNL is conducting research and development on the sulfur-iodine thermochemical process to operate an integrated demonstration in FY 2008.

Radiological Facilities Management
The Annular Core Research Reactor (ACRR) is a highly flexible facility that has been applied to the mission requirements of the Department in both isotope and national security applications. National security programs use the ACRR's short duration high-power pulse capabilities for component testing. The Isotope Program no longer has a programmatic need for the ACRR. NNSA is currently the only user. The transfer to NNSA of the ACRR and hot cells that have been maintained in a non-nuclear status will be completed by the end of FY 2007.

Savannah River National Laboratory
Introduction
The Savannah River Site (SRS) is an extensive material production and engineering complex that has been a nuclear site since 1951 when construction began supporting the U.S. strategic weapons program. SRS is now a multiprogram operational site covering 310 square mile site near Aiken, South Carolina. Because of its Cold War nuclear legacy, there is a significant level of environmental management cleanup work being performed at the site. In addition to supporting NE programs, the SRS workforce continues to support the National Nuclear Security Administration's weapons disposition program. Savannah River National Laboratory (SRNL) is a multiprogram laboratory located on approximately 34 acres within the Savannah River Site.

Advanced Fuel Cycle Initiative
SRNL conducts research on advanced aqueous separations, systems analysis, advanced safeguards, and waste form development. Building on years of experience operating separations processes and managing waste from nuclear processes, SRS provides engineering analyses in support of AFCI and participates in the development and deployment planning of advanced aqueous spent fuel treatment technologies. Based on it history and current work of stabilizing nuclear material, SRS possesses the most operational experience in spent nuclear fuel separations in the U.S.

Nuclear Hydrogen Initiative
Savannah River assists with hybrid sulfur thermochemical cycle activities.

Nuclear Power 2010
Savannah River provides consultation and expertise on seismic issues.

Savannah River Operations
Introduction
The SRS is an extensive material production and engineering complex that has been a nuclear site since 1951 when construction began supporting the U.S. strategic weapons program. SRS is now a multiprogram operational site covering 310 square mile site near Aiken, South Carolina. Because of its Cold War nuclear legacy, there is a significant level of environmental management cleanup work being performed at the site.

Advanced Fuel Cycle Initiative
SRS performs engineering studies on various process alternatives for the Consolidated Fuel Treatment Center project and prepared several reports for the input into the Programmatic Environmental Impact Statement.

MOX Fuel Cycle Fabrication Facility
NE will oversee the design, construction, and operation of the MFFF to be built at the Department's SRS.

University of Las Vegas, Nevada
Advanced Fuel Cycle Initiative
UNLV is actively engaged in experiments on lead alloy coolants and targets in accelerator-based systems and fast reactor systems. UNLV conducts systems analysis on AFCI/GNEP activities, including the potential for deep burn gas reactor transmutation. UNLV also conducts research using student participation.

Nuclear Hydrogen Initiative
UNLV is working with the Department to perform research and development on candidate heat exchanger designs. UNLV's scope includes complimentary materials testing activities.

Washington Headquarters
FY 2007, FY 2008, and FY 2009 include funding for SBIR and other small business initiatives. For AFCI/GNEP, this account will also fund potential industry contracts for design studies on advanced spent nuclear fuel recycling facilities and advanced recycling reactors.

Nuclear Power 2010
Includes funding for activities conducted in support of the combined Construction and Operating License (COL) demonstration projects. Also, includes funding to develop the regulations, criteria, and process under which the Department would accept, evaluate, and approve applications for standby support contracts from sponsors of new nuclear power plants.

Radiological Facilities Management
Includes funding for certification of isotope shipping casks, independent financial audits of the revolving fund, and other related expenses. Starting in FY 2009, limited investments will be made in

university infrastructure that can achieve production of small quantities of medical research isotopes at lower cost than the national laboratories.

University Reactor Infrastructure and Education Assistance

Funding Profile by Subprogram

(dollars in thousands)

	FY 2007 Current Appropriation	FY 2008 Original Appropriation	FY 2008 Adjustments	FY 2008 Current Appropriation	FY 2009 Request
University Reactor Infrastructure & Education Assistance	16,547	0	0	0	0

Public Law Authorizations:
P.L. 110-5, Revised Continuing Appropriations Resolution, 2007
P.L. 110-161, The Consolidated Appropriations Act, 2008

Mission

The mission of the University Reactor Infrastructure and Education Assistance program has been to enhance the national nuclear educational infrastructure to meet the manpower requirements of the Nation's energy, environmental, health care, and national security sectors. Enrollment levels of the University Reactor Infrastructure and Education Assistance program have increased and the program is no longer considered essential to encourage students to enter into nuclear related disciplines.

The United States (U.S.) has led the world in the development and application of nuclear technology for many decades. This leadership, which spans energy, national security, environmental, medical, and other applications, has been possible because the Government has helped foster advanced nuclear technology education at many universities and colleges across the Nation. The Government has aided these programs to maintain the educational and training infrastructure necessary to develop the next generation of nuclear scientists and engineers. During the 1980s and 1990s, the number of students entering nuclear engineering programs in the U.S. declined causing a corresponding decline in nuclear engineering programs and research reactors. As the decline continued, the existing expertise in the nuclear field was reaching retirement age. Thus, the demand for nuclear scientists and engineers exceeded supply. The University Reactor Infrastructure and Education Assistance program was designed to address these issues by providing support to university nuclear engineering programs and the university research reactor community.

Beginning in FY 2008, funding to continue Federal support for fuel for universities is requested in the Radiological Facilities Management budget under Research Reactor Infrastructure.

In FY 2009, NE will continue to support R&D activities at university and research institutions through competitive awards focused on advancing nuclear energy technologies. Through its Nuclear Energy Research Initiative process, NE will designate at least 20 percent of funds appropriated to its R&D programs for work to be performed at university and research institutions. This commitment to strengthening the nation's nuclear education infrastructure directly supports the goals of the America Competes Act of 2007, which specifically highlighted the need for increased support of the U.S. nuclear science and engineering education enterprise, as well as the President's American Competitiveness Initiative. These funds will support investigator-initiated basic research and mission-specific applied R&D activities; human capital development activities such as fellowships and young faculty awards;

and, infrastructure and equipment upgrades for university-based research reactors and laboratories. This mutually beneficial arrangement will help university and research institutions bolster their R&D capabilities and help strengthen the U.S. educational infrastructure necessary to support the nuclear renaissance envisioned by this budget request.

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for energy security, nuclear security, scientific discovery, environmental responsibility, and management excellence), plus 16 Strategic Goals that tie to the Strategic Themes. The University Reactor Infrastructure and Education Assistance program supported the following goals:

Strategic Theme 1, Energy Security
Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

The University Reactor Infrastructure and Education Assistance program has one GPRA Unit Program goal which contributed to Strategic Goals 1.2 in the "goal cascade":

GPRA Unit Program Goal 1.2.15.00*: Maintain and Enhance National Nuclear Infrastructure - Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability to meet the Nation's energy, medical research, space exploration, and national security needs.*

Contribution to GPRA Unit Program Goal 1.2.15.00 (Maintain and Enhance National Nuclear Infrastructure)

The University Reactor Infrastructure and Education Assistance Program was designed to address declining infrastructure support for U.S. nuclear engineering programs. Since the late 1990s, enrollment levels in nuclear education programs have increased dramatically. In fact, enrollment levels for 2005 reached upwards of 1,500 students. In addition, the number of universities offering nuclear-related programs also has increased. These trends reflect renewed interest in nuclear power. Students will continue to be drawn into this course of study, and universities, along with nuclear industry societies and utilities, will continue to invest in university research reactors, students, and faculty members. Consequently, Federal assistance is no longer necessary, and the FY 2009 Budget proposed termination of the University Reactor Infrastructure and Education Assistance Program. Under the FY 2007 Continuing Resolution, funding was provided to fully fund existing mortgages and close out all activities under the University Reactor Infrastructure and Education Program.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

FY 2007	FY 2008	FY 2009

Strategic Goal 1.2, Environmental Impacts of Energy

GPRA Unit Program Goal 1.2.15.00, Maintain and Enhance National Nuclear

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Infrastructure			
University Reactor Infrastructure and Education Assistance	16,547	0	0
Total, Strategic Goal 1.2 (University Reactor Infrastructure and Education Assistance)	16,547	0	0

Means and Strategies

The University Reactor Infrastructure and Education Assistance program used various means and strategies to achieve its program goals. The program also performed collaborative activities to help meet its goals.

The Department implemented the following means:

- Used educational incentives, including fellowships, scholarships, research funding, faculty support and private sector funding support from our Matching Grant program, which was aimed at increasing enrollments and graduates in nuclear engineering.
- Pursued programs that were geared towards increasing minority participation and support by pairing nuclear engineering schools with minority institutions enabling students from minority universities to achieve degrees in both nuclear engineering and their chosen technical field.

The Department implemented the following strategies:

- Worked to develop a pipeline of qualified and interested students in the area of nuclear science by training and educating middle and high school science teachers through the funding of the American Nuclear Society (ANS) Workshops.
- Improved the tools available to present and future students by upgrading university reactors and enabling others to share reactor time creating a stronger infrastructure by improving reactor operations and broadening the reach of the reactor facilities to those who would not otherwise have access to such sophisticated facilities.
- Met periodically throughout the year with stakeholder organizations such as the Nuclear Engineering Department Heads Organization (NEDHO); the University Working Group; the Test, Research, and Training Reactor Management Group (TRTR); and other committees of professional organizations such as the ANS to review program activities; discuss program issues; and solicit input, advice, and guidance.

Validation and Verification

All peer-reviewed university activities grantees are required to submit annual reports to DOE outlining the progress achieved. Once annual reports are submitted, they are logged in the NE database and reviewed by the NE Program Manager for compliance with the Program's stated goals and objectives. Nuclear Engineering Education Research (NEER) annual and final reports are posted to the NEER web page at http://neer.inel.gov/. These annual reports provide an opportunity to verify and validate

performance. Also, quarterly, semi-annual, and annual reviews of financial reports consistent with program plans are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.

Program evaluations of Innovations in Nuclear Infrastructure and Education (INIE) grant activities are typically conducted twice a year. In addition, comprehensive reviews are held with each INIE consortium to go over performance and cost. Each consortium member has an opportunity to provide progress information and input into upcoming performance. Further, INIE awardees are required to submit annual progress reports to NE on activities conducted during the year. The report was revised in FY 2005 to make the report more standardized. They are logged in the NE database and reviewed by the NE Program Manager for compliance with program goals.

NE conducts annual reviews of existing fellowship and scholarship recipients prior to renewing any awards.

All three-year radiochemistry grants are reviewed annually through site visits by the program manager.

Program Assessment Rating Tool (PART)

The Department has implemented a tool to evaluate selected programs. PART was developed by the Office of Management and Budget to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews.

A PART was completed for the University Reactor Infrastructure and Education Assistance program during the FY 2007 budget formulation cycle. The assessment determined that enrollment levels of the program have increased and that students no longer need to be encouraged to enter into nuclear related disciplines. In addition, the number of universities offering nuclear-related programs also has increased. These trends reflect renewed interest in nuclear power. Students will continue to be drawn into this course of study and universities, along with nuclear industry societies and utilities, will continue to invest in university research reactors, students, and faculty members. Consequently, Federal assistance is no longer necessary, and the 2007 Budget proposed termination of this program.

Funding Schedule by Activity

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
University Reactor Infrastructure and Education Assistance			
University Nuclear Infrastructure	5,559	0[a]	0
Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities	4,413	0	0
Health Physics Fellowships & Scholarships	300	0	0

[a] $2,947,000 for fuel is requested in the Radiological Facilities Management Budget under Research Reactor Infrastructure.

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Nuclear Engineering Education Research (NEER) Grants	5,000	0	0
Radiochemistry Awards	1,275	0	0
Total, University Reactor Infrastructure and Education Assistance	16,547	0	0

Detailed Justification

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
University Nuclear Infrastructure	**5,559**	**0**[a]	**0**

The UNI program provided fuel for the universities; instrumentation, electronics, hardware, and software upgrades for the research reactors; and reactor sharing and research support for educational institutions to facilitate the development of the Nation's next generation of nuclear scientists and engineers.

Under the FY 2007 Continuing Resolution, funding was provided to purchase of a new shipping cask to enable continuation of spent fuel shipments from reactors at the Massachusetts Institute of Technology, the University of Missouri and various other university reactors, and for the fabrication and shipment of fresh fuel to and spent fuel from university research reactors.

No funding is requested for these activities in FY 2008 or FY 2009. Funding to provide fresh reactor fuel for universities is requested in the Radiological Facilities Management budget under Research Reactor Infrastructure.

Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities	**4,413**	**0**	**0**

The University Partnership program encouraged students enrolled at minority-serving institutions to pursue a nuclear engineering degree in cooperation with universities that grant those degrees.

Under the FY 2007 Continuing Resolution, funding was provided to fully fund and close out all existing fellowships, scholarships, and partnerships. No new awards were funded.
No funding is requested for this activity in FY 2008 or FY 2009.

Health Physics Fellowships & Scholarships	**300**	**0**	**0**

Under the FY 2007 Continuing Resolution, funding was provided to fully fund and close out all existing Health Physics fellowships and scholarships.

No funding is requested for this activity in FY 2008 or FY 2009.

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Nuclear Engineering Education Research (NEER) Grants	**5,000**	**0**	**0**

The NEER program provided grants allowing nuclear engineering faculty and students to conduct innovative research in nuclear engineering and related areas.

Under the FY 2007 Continuing Resolution, funding was provided to fully fund and close out all NEER grants.

No funding is requested for this activity in FY 2008 or FY 2009.

Radiochemistry Awards	**1,275**	**0**	**0**

The Department provided grants every three years to support faculty and graduate/post doctorate students in radiochemistry.

Under the FY 2007 Continuing Resolution, funding was provided to fully fund and close out all existing radiochemistry awards.

No funding is requested for this activity in FY 2008 or FY 2009.

Total, University Reactor Infrastructure and Education Assistance	**16,547**	**0**	**0**

Research and Development

Funding Profile by Subprogram

(dollars in thousands)

	FY 2007 Current Appropriation	FY 2008 Original Appropriation	FY 2008 Adjustments	FY 2008 Current Appropriation	FY 2009 Request
Research and Development					
Nuclear Power 2010	80,291	135,000	-1,229	133,771	241,600
Generation IV Nuclear Energy Systems Initiative	35,214	116,000	-1,083	114,917	70,000
Nuclear Hydrogen Initiative	18,855	10,000	-91	9,909	16,600
Advanced Fuel Cycle Initiative	166,092	0	0	0	301,500
Total, Research and Development	300,452	261,000	-2,403	258,597	629,700

Public Law Authorizations:
P.L. 110-5, Revised Continuing Appropriations Resolution, 2007
P.L. 110-161, The Consolidated Appropriations Act, 2008

Mission

The mission of the Office of Nuclear Energy's (NE) Research and Development (R&D) program is to secure nuclear energy as a viable, long-term commercial energy option, providing diversity in the energy supply. In the short term, government and institutional barriers will be addressed to enable new plant deployment decisions by nuclear power plant owners and operators who wish to be among the first to license and build new nuclear facilities in the United States (U.S.). In the longer term, new nuclear technologies that can compete with advanced fossil and renewable technologies will be developed, enabling power providers to select from a diverse group of generation options that are economical, reliable, safe, secure, and environmentally acceptable. In FY 2008, the Advanced Fuel Cycle Initiative (AFCI) is included in the Fuel Cycle Research and Facilities program.

Nuclear energy has the potential to safely and reliably generate electricity for our 21st century economy, to produce economical hydrogen for transportation use without emitting greenhouse gases, and to produce heat and clean water to support growing industry and populations worldwide. NE is a key participant in on-going integrated benefits assessment activities conducted for applied R&D programs in the Department. Analyses to measure the benefits of the NE R&D portfolio compared its programs' contributions to nuclear technologies against other electricity-generating and hydrogen-producing fossil and energy efficiency and renewable energy technologies. These analyses showed that the economic benefit of the NE R&D portfolio, in terms of energy system cost saving, potentially could total $45 billion per year by 2050, many times the cost of the government's cumulative investment. Moreover, the additional reduction in carbon dioxide emissions from nuclear technologies influenced by NE R&D could be 246 million tons of carbon equivalents per year by 2050. These projected savings show that NE R&D plays a significant role in the Energy, Science, and Environment portfolio, which, taken together, is estimated to save $256 billion and 730 million tons of carbon equivalent per year. These results indicate substantial benefit can be derived from the Department's applied R&D portfolio investments.

At the same time the expanded use of nuclear energy domestically and globally presents challenges that must be met. Some of these challenges will be met through excellence in the use of nuclear power (e.g., nuclear safety). Others, such as nuclear waste and economic issues, can be addressed in part through advances in technology. Investment in long-term R&D could help expand the use of nuclear energy worldwide. NE focuses on much of its research on long-term, highrisk R&D that industry does not have the incentive to undertake on their own.

For the Nuclear Power 2010 (NP 2010) program, the FY 2009 budget request continues new nuclear plant licensing and reactor engineering and design activities started in previous years. In FY 2009, the NP 2010 program will cost share the work being performed by industry partners to respond to information requests from the Nuclear Regulatory Commission (NRC) as they advance their review of the two combined Construction and Operating License (COL) applications. Additionally, NP 2010 will continue to cost share the engineering and design activities of the reactor vendors for two Generation III+ advanced, light water reactors including issues related to design certification requests being reviewed by NRC. The scope of work being executed in FY 2009 will achieve progress necessary to maintain the goal of licensing and design certification decisions by NRC in FY 2010 and FY 2011, an industry decision to build in FY 2010, and completion of standardized reactor designs in FY 2011. Successful completion of these activities will lead to deployment of new nuclear plants in the next decade.

For the Generation IV Nuclear Energy Systems Initiative (Gen IV) program, the FY 2009 budget request continues critical gas reactor R&D that will help achieve desired goals of sustainability, economics, and proliferation resistance to ready the technology for commercial deployment in the 2030 timeframe. In FY 2009, Gen IV R&D focuses specifically on component and material aging and degradation where results will directly benefit existing nuclear plants by extending their current operating licensing period and designing advanced reactor concept plants with a longer operating life. Continued investigation of technical and economical challenges and risks are needed to support NGNP design and licensing basis development. In FY 2009, NGNP R&D includes broader activities conducted in support of the VHTR concept and benchmarking methodologies in conjunction with the Generation IV International Forum (GIF). Successful completion of these activities is necessary to support the 2011 decision to proceed with the demonstration of an NGNP by 2021, as directed by EPAct. Key to the strategy for conducting R&D under the Gen IV Nuclear Energy Systems Initiative is the multiplication effect on investment derived from international collaboration. By coordinating U.S. efforts with those of the GIF partner nations, our funding is leveraged by a factor of two to ten, depending on the reactor concept involved.

For the Nuclear Hydrogen Initiative (NHI) program, the FY 2009 budget request continues integrated laboratory-scale (ILS) experiments begun in FY 2008 on two baseline nuclear hydrogen production technologies. It also completes the design of an ILS experiment for the Hybrid Sulfur thermochemical cycle. These experiments are being conducted in order to provide the necessary information needed to make a recommendation of the hydrogen production technology to be coupled with the NGNP as required by the Energy Policy Act of 2005 (EPAct 2005). Additional NHI activities planned in FY 2009 are targeted at improving the efficiency and economics of advanced, high temperature hydrogen production technologies. Successful completion of these activities will represent tangible progress toward demonstrating nuclear hydrogen production at a cost competitive with other hydrogen production technologies.

For the Advanced Fuel Cycle Initiative (AFCI) program, which is focused on implementing the Global Nuclear Energy Partnership (GNEP), the FY 2009 budget request continues to develop methods to reduce the volume and long-term toxicity of high-level waste from spent nuclear fuel, reduce the long-term proliferation threat posed by civilian inventories of plutonium in spent fuel, and provide for proliferation-resistant technologies to recover the energy content in spent nuclear fuel. These activities continue R&D to develop advanced recycling technologies capable of extracting highly radioactive elements from commercial spent nuclear fuel and using that material as fuel in nuclear reactors to generate additional electricity. The FY 2009 request also supports continuation of conceptual design activities for the AFCF, ABR and CFTC, necessary to support the GNEP vision of a closed fuel cycle. Successful achievement of these activities will improve the way spent nuclear fuel is managed, and will facilitate the expansion of civilian nuclear power in the United States and encourage civilian nuclear power internationally to evolve in a more proliferation-resistant manner.

In FY 2009, NE will continue to support R&D activities at university and research institutions through competitive awards focused on advancing nuclear energy technologies. Through its Nuclear Energy Research Initiative process, NE will designate at least 20 percent of funds appropriated to its R&D programs for work to be performed at university and research institutions. This commitment to strengthening the nation's nuclear education infrastructure directly supports the goals of the America Competes Act of 2007, which specifically highlighted the need for increased support of the U.S. nuclear science and engineering education enterprise, as well as the President's American Competitiveness Initiative. These funds will support investigator-initiated basic research and mission-specific applied R&D activities; human capital development activities such as fellowships and young faculty awards; and, infrastructure and equipment upgrades for university-based research reactors and laboratories. This mutually beneficial arrangement will help university and research institutions bolster their R&D capabilities and help strengthen the U.S. educational infrastructure necessary to support the nuclear renaissance envisioned by this budget request.

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for energy security, nuclear security, scientific discovery, environmental responsibility and management excellence), plus 16 Strategic Goals that tie to the Strategic Themes. The NE R&D program supports the following goals:

Strategic Theme 1, Energy Security: Promoting America's energy security through reliable, clean, and affordable energy

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

The NE R&D program has one GPRA Unit Program goal which contributes to Strategic Goal 1.2 in the "goal cascade":

GPRA Unit Program Goal 1.2.14.00: Develop New Nuclear Generation Technologies - By 2015, enable industry to construct and operate new nuclear power plants, promoting safe, reliable and carbon-free energy production, through the standardization of Generation III+ plant designs, the successful demonstration of nuclear plant permitting and licensing processes, the advancement of Gen IV plant

technologies, the construction of pilot-scale hydrogen production experiments, and the commencement of proliferation-resistant spent nuclear fuel recycling technology demonstration activities.

Contribution to GPRA Unit Program Goal 1.2.14.00 (Develop New Nuclear Generation Technologies)

The NE R&D program supports near-term technology development and demonstration activities that advance the goals of the National Energy Policy and Energy Policy Act of 2005 to enhance long-term U.S. energy independence and reliability and expand the contribution of nuclear power to the Nation's energy portfolio. The NP 2010 program supports this program goal by identifying sites for new nuclear power plants, developing and bringing to market advanced standardized nuclear plant designs, evaluating the business case for building new nuclear power plants, demonstrating untested regulatory processes through submission of combined Construction and Operating License applications to seek Nuclear Regulatory Commission (NRC) approval for building and operating new advanced light water reactor (LWR) nuclear plants in the U.S. leading to an industry decision to build in the next few years.

Gen IV supports this program goal through the development of innovative, next-generation reactor and fuel cycle technologies. The Gen IV program supports R&D that could help achieve the desired goals of sustainability, economics, and proliferation resistance. Further examination of materials, and fuels and the development of advanced computer modeling tools will support the design processes needed to proceed with a demonstration of the Very-High-Temperature Reactor as the reactor technology for the NGNP. The NGNP is being developed for economical production of electricity, hydrogen gas and other desirable products derived from high quality heat. The Gen IV program will implement research and development activities on component and material aging and degradation that will directly benefit existing nuclear plants by extending their current operating licensing period and designing future plants with a longer operating life.

NHI contributes to this program goal by researching, developing, and demonstrating economical hydrogen production technologies using high temperature heat from advanced nuclear energy systems. The initiative will develop hydrogen production technologies that are compatible with nuclear energy systems through scaled experiments.

The AFCI supports near-term technology development and demonstration activities that advance the goals of the National Energy Policy and Energy Policy Act of 2005 by developing the enabling technologies needed to reduce high level waste volume and separate and transmute long-lived, highly radiotoxic elements. These activities directly support the vision and goals of GNEP. In addition to advanced fuel cycle R&D activities, the program will develop an Advanced Burner Reactor, which will be a prototype for future commercial plants and incorporate advanced design features to improve performance, reduce cost and improve safeguards. A nuclear fuel recycling center will employ state-of-the-art technologies to provide proliferation-resistant LWR separations capability. Finally, AFCF will provide technology development capability to support fast reactor design and development of transmutation fuel and/or transmutation targets.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Strategic Goal 1.2, Environmental Impacts of Energy			
GPRA Unit Program Goal 1.2.14.00, Develop New Nuclear Generation Technologies			
Nuclear Power 2010	80,291	133,771	241,600
Generation IV Nuclear Energy Systems Initiative	35,214	114,917	70,000
Nuclear Hydrogen Initiative	18,855	9,909	16,600
Advanced Fuel Cycle Initiative	166,092	0	301,500
Total, Strategic Goal 1.2 (Research and Development)	300,452	258,597	629,700

Annual Performance Results and Target

FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008 Targets	FY 2009 Targets
GPRA Unit Program Goal 1.2.14.00 (Develop New Nuclear Generation Technologies)					
Research and Development					
	Achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Advanced Fuel Cycle, Generation IV Nuclear Energy Systems and Nuclear Hydrogen Initiatives. (MET TARGET)	*Maintain total administrative overhead costs in relation to total program costs of less than 8 percent. (Baseline for administrative overhead rate is currently being validated) (MET TARGET)*	*Maintain total administrative overhead costs in relation to total program costs of less than 8 percent. (MET TARGET)*	*Maintain total administrative overhead costs in relation to total R&D program costs of less than 8 percent.*	*Maintain total administrative overhead costs in relation to total R&D program costs of less than 8 percent.*
Nuclear Power 2010					
Select for award at least one cost-shared project with a power generating company-led team for activities required to demonstrate for the first time the combined Construction and Operating License (COL) process. (MET TARGET)	Issue project implementation plans for two COL Demonstration Projects. (MET TARGET)	Complete engineering and licensing demonstration activities necessary to implement the NP 2010 program in accordance with the principles of project management, to help ensure that program performance goals are achieved on schedule and within budget. (MET TARGET)	Complete NP 2010 engineering and licensing activities, focusing on the resolution of reactor certification and design issues and the preparation and review of COL applications, to enable an industry decision in 2010 to build a new nuclear power plant. (MET TARGET)	Enable industry to make a decision to build a new nuclear power plant by 2010 by supporting New Nuclear Plant Licensing Demonstration Projects and by administering the Department's standby support program.	Enable industry to make a decision to build a new nuclear power plant by 2010 by supporting New Nuclear Plant Licensing Demonstration Projects and by administering the Department's standby support program.
Generation IV Nuclear Energy Systems Initiative					
Award one or more contracts for the Next Generation Nuclear Plant pre-conceptual design. (NOT MET)	Issue the final design documents for the fuel capsule, test train, fission product monitoring system, and control system for the fuel irradiation shakedown test (AGR-1). (MET TARGET)	Complete Generation IV research and development activities to inform a design selection for the next generation nuclear power plant by FY 2011. (MET TARGET)	Complete Generation IV research and development activities, focusing on fuels and materials testing and plant system optimization, to inform the functional and operational design requirements of a next generation of nuclear power plant by FY 2011. (MET TARGET)	Determine a path forward for the design and construction of a next Generation nuclear power plant by 2011 by submitting an NGNP licensing strategy to Congress and completing NGNP conceptual design technology selection studies.	Determine a path forward for the design and construction of a next generation nuclear power plant by 2011 by partnering with private industry on the development of NGNP, performing environmental assessment activities, and continuing with the research, analysis and conceptual design activities needed to identify the preferred and alternative technologies for the reactor system, including examination of fuel and graphite materials.

FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008 Targets	FY 2009 Targets
Nuclear Hydrogen Initiative					
Complete final designs for the baseline thermochemical and high-temperature electrolysis laboratory-scale experiments. (MET TARGET)	Issue conceptual design documents for the thermochemical and high-temperature electrolysis pilot scale experiments. (MET TARGET)	Complete development of key technologies and infrastructure requirements in preparation for the thermochemical and high-temperature electrolysis integrated laboratory-scale experiments. (MET TARGET)	Complete NHI research and development activities focused on thermochemical and high temperature electrolysis (HTE) processes to support the Department's selection of a hydrogen production technology in 2011. (MET TARGET)	Select a hydrogen production technology by 2011 that will be demonstrated in a pilot scale experiment by conducting integrated laboratory-scale experiments on sulfur-iodine, thermochemical and HTE processes, and by developing advanced interface components to connect a nuclear heat source to a hydrogen production plant.	Select a hydrogen production technology by 2011 that will be demonstrated in a pilot scale experiment by conducting integrated laboratory-scale experiments on sulfur-iodine, thermochemical and HTE processes, and by developing advanced interface components to connect a nuclear heat source to a hydrogen production plant.
Advanced Fuel Cycle Initiative					
Complete fabrication and irradiation of advanced LWR proliferation-resistant transmutation fuel samples, and initiate post-irradiation examination of the samples. (MET TARGET)	Issue preliminary report on the post-irradiation examination (PIE) of actinide-bearing metal and nitride transmutation fuels in the Advanced Test Reactor (ATR). (MET TARGET)	Complete research and development activities that allow the AFCI program to support the Secretary of Energy's determination of the need for a second geologic repository for spent nuclear fuel by FY 2008. (MET TARGET)	Complete research and development activities, focused on advanced fuel separations technology development and demonstration, to support the Secretary of Energy's determination of the need for a second geologic repository for spent nuclear fuel by FY 2008. (MET TARGET)		Support the Secretary of Energy's path forward for achieving the GNEP vision by completing advanced separations and fuels research and development and associated technology development activities, and economic evaluations to support the deployment of GNEP facilities.
Achieve variance of less than 10 percent from cost and schedule baselines for AFCI activities. (MET TARGET)	Conduct laboratory-scale test of group actinide separation process (plutonium, neptunium, americium and curium extracted together) with actual LWR spent fuel and report preliminary results. (MET TARGET)				Support the Secretary of Energy's path forward for achieving the GNEP vision by continuing conceptual design activities, including economic evaluations, for the Advanced Fuel Cycle Facility.
Issue the report on the demonstration of a laboratory-scale separation of americium/curium from spent nuclear fuel to support the development of advanced fuel cycles for enhanced repository performance. (MET TARGET)					Support the Secretary of Energy's path forward for achieving the GNEP vision by initiating conceptual design activities, including preliminary economic evaluations of various alternatives for an Advanced Burner Reactor prototype.

FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008 Targets	FY 2009 Targets
					Support the Secretary of Energy's path forward for achieving the GNEP vision by completing technical, economic and policy analyses, including cooperative agreements with industry, which inform conceptual design alternatives for a nuclear fuel recycling center.

Means and Strategies

The R&D program will use various means and strategies to achieve its GPRA Unit Program goals. However, various external factors may impact the ability to achieve these goals. The program also performs collaborative activities to help meet its goals.

The Department will implement the following means:

- A joint government/industry cost-shared effort to identify sites for new nuclear power plants, develop advanced standardized Generation III+ nuclear plant designs, evaluate the business case for building new nuclear power plants, and demonstrate untested regulatory processes through submission of combined Construction and Operating License applications to seek the NRC's approval to build and operate new advanced nuclear power plants in the U.S. leading to an industry decision to build in the next few years.

- Hydrogen production technologies compatible with nuclear energy systems are being developed by NHI. This program includes participation of the national laboratories, industry, and university research communities as well as international research partners. While these technologies are not sufficiently mature to require industry cost sharing at this time, cost sharing will be required for the final engineering-scale demonstration. The initiative will employ competitive selection processes for design, construction, and operation activities.

- Advanced, next-generation reactor systems that offer the most sustainable, cost-competitive, reliable, and secure means of generating electricity and hydrogen are being developed by the Gen IV. The program includes participation by the national laboratories, industry, and university research communities as well as the international research community represented by the Generation IV International Forum (GIF). Industrial and international cost sharing will be pursued where practical during the R&D on these intermediate- and long-term reactor technologies and the construction of the NGNP at the Idaho National Laboratory.

- Joint government/industry cost-shared R&D activities to establish the technical and licensing basis to extend the safe and economical operation of the existing nuclear plants to at least 80 years. Laboratory R&D will be conducted to research, develop, test, and license high-performance LWR reactor fuel and clad materials to extend the operating cycles and enhance safety and productivity of existing nuclear plants. The reactor fuel R&D initiative will include participation of colleges and universities, industry, and national laboratories.

- Collaborate with industry to: 1) define the most commercially viable designs and business models under which advanced fuel cycle technologies could be deployed, 2) provide industry representation on appropriate expert review panels and 3) ultimately construct AFCI/GNEP facilities.

The Department will implement the following strategies:

- Partnering with the private sector, national laboratories, universities, and international partners to develop and deploy advanced nuclear technologies to increase the use of nuclear energy in the U.S.

- Leading the international community in pursuit of advanced nuclear technology that will benefit the U.S. with enhanced safety, improved economics, and reduced production of wastes.

- Conducting international cost-shared R&D in the Gen IV, NHI and AFCI/GNEP programs.

These strategies will result in the efficient and effective management of NE programs - thus putting the taxpayer's dollars to more productive use.

The following external factors could affect NE's ability to achieve its strategic goal:

- Whether new nuclear plant technology is deployed depends to a large extent on power demand and economic and environmental factors beyond the scope of DOE R&D programs. In the near term, it depends on complex economic decisions made by industrial partners.

- Deployment of advanced fuel cycle technologies will depend upon policy decisions that will determine the implementation of advanced spent fuel reprocessing technologi8es (e.g. the Secretary of Energy's mid-2008 decision on GNEP) as well as reducing risks and establishing an appropriate business case for private sector investment and commercial deployment.

- All nuclear energy research programs rely heavily on data produced through collaborations with foreign nations. Should vital data from foreign partners prove unavailable, an increased U.S. effort in technology development would be required.

In carrying out the program's mission, NE performs the following collaborative activities:

- The Department and the NRC coordinate program planning to assure that their R&D activities are complimentary, cost effective, and not duplicative.

- The Department is working with industry on a cost-shared basis to conduct demonstrations of untested Federal regulatory and licensing processes governing the siting, construction, and operation of nuclear power plants.

- The Gen IV is receiving broad international cooperation and support, consistent with the objectives of the program. The GIF, composed of representatives from twelve governments and the European Union, provides guidance for executing the R&D of these next-generation nuclear energy systems.

- Participation in international experiments related to the development of advanced fuel cycle technologies is being performed in support of AFCI/GNEP objectives.

- NE collaborates with other programs within the Department, such as the Office of Science, the Office of Fossil Energy, and the Office of Energy Efficiency and Renewable Energy, on the President's Hydrogen Fuel Initiative.

- NE will collaborate with other programs within the Department, such as the Office of Science, the Office of Civilian Radioactive Waste management, and the National Nuclear Security Administration, all of whom have roles supporting AFCI/GNEP.

Validation and Verification

To validate and verify program performance, NE conducts various internal and external reviews and audits. NE's programmatic activities are subject to periodic review by Congress, the Government Accountability Office, the Department's Inspector General, the NRC, the U.S. Environmental Protection Agency, state environmental and health agencies, the Defense Nuclear Facilities Safety Board, and the Department's Office of Engineering and Construction Management. In addition, NE provides continual management and oversight of its R&D programs—NP 2010, Gen IV, NHI and AFCI. Periodic internal and external program reviews evaluate progress against established plans. These reviews provide an opportunity to verify and validate performance. Monthly, quarterly, semi-annual and annual reviews, consistent with program management plans and project baselines, are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.

The Department obtains advice on the direction of nuclear energy R&D programs from the independent Nuclear Energy Advisory Committee (NEAC). NEAC, a formal Federal advisory committee, provides expert advice on long-range plans, priorities, and strategies for the nuclear technology R&D and research infrastructure activities of NE. NEAC has several active subcommittees examining various aspects of nuclear technology R&D. Reports issued by these subcommittees that address the future of nuclear energy include: the "Long-Term Nuclear Technology Research and Development Plan", the "Nuclear Science and Technology Infrastructure Roadmap", "A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010", "A Technology Roadmap for Generation IV Nuclear Energy Systems", "Report of the Subcommittee on Nuclear Laboratory Requirements", and "An Evaluation of the Proliferation Resistant Characteristics of Light Water Reactor Fuel with the Potential for Recycle in the United States".

At the end of FY 2006, the General Accountability Office issued a report, *Status of DOE's Effort to Develop the Next Generation Nuclear Plant*, which highlighted that the initial NGNP R&D activities are favorable and that the project has a well laid out schedule for completing construction of a demonstration plant by 2021 as authorized under the Energy Policy Act of 2005. The report notes that a significant amount of R&D remains to be conducted and that DOE is making progress on its efforts to involve industry stakeholders.

In FY 2007, the General Accountability Office began a comprehensive audit of GNEP. Once released, the findings will help inform the AFCI/GNEP implementation strategy.

Program Assessment Rating Tool (PART)

The Department has implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. NE's R&D programs have incorporated feedback from OMB into the FY 2009 Budget Request, and have taken the necessary steps to continue to improve performance.

The results of the FY 2005 review are reflected as follows: for NP 2010 program, an overall PART score of 69 was achieved with a perfect 100 score for Section I, Program Purpose & Design. A score of 89 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between

budget and performance data at the Departmental level. A score of 88 was achieved for Section III, Program Management reflecting the need to measure and achieve cost effectiveness in program execution. A score of 45 was achieved for Section IV, Program Results/Accountability, indicating that the program needed to establish on an annual basis an independent assessment of the overall program, evaluating the program's progress against established annual and long-term goals. In addition, OMB did recognize that the NP 2010 was a relatively new program with limited progress in achieving its long-term goals. This area was strengthened in early FY 2004 by the establishment of the new NEAC Subcommittee on Evaluations. After the issuance of the PART recommendation, independent assessments of the program were carried out by NEAC. However, in the more recent fiscal years, independent baseline reviews are being conducted and will provide the necessary analysis to demonstrate program progress. In addition, the NP 2010 program has established monthly earned value management reporting by the participants which tracks current progress and aids in implementing corrective actions to maintain progress.

For Gen IV, an overall PART score of 79 was achieved with perfect scores of 100 for Section I, Program Purpose & Design, and Section III, Program Management. These scores reflect the continued effective management of the program. A score of 90 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 60 was achieved for Section IV, Program Results/Accountability, which reflects the strengthening of long-term performance goals for the program compared with the previous year's performance goals. The need for improvements in the conduct of independent evaluations was identified. This area was strengthened in early FY 2004 by the establishment of the new NEAC Subcommittee on Evaluations.

For AFCI, an overall PART score of 76 was achieved with top scores of 100 in Section I, Program Purpose & Design, and Section III, Program Management. These scores are attributable to the continued use of effective program management practices. A score of 90 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 53 was achieved for Section IV, Program Results/Accountability, indicating the need to better demonstrate the cost effectiveness of the program. To address these findings, the program revised its near and long-term goals, and is working to increase cost effectiveness by continuing to increase international cost-shared R&D costs through expanded collaborations.

In addition, the AFCI program was found to rely upon process oriented, output based metrics that did not indicate whether the program is successful or demonstrating meaningful progress. These programs revised their performance measures in FY 2006 to capture progress made on the programs' core elements. By focusing on a future outcome, the measure allows for trending of annual progress toward a consistent objective.

In FY 2006, as a follow-up action assigned as part of this assessment, NE contracted with the National Academy of Sciences to conduct an extensive, comprehensive, and independent evaluation of R&D and Infrastructure program goals and plans, including the process for establishing program priorities and oversight. The evaluation resulted in a detailed set of policy and research recommendations and associated priorities for an integrated agenda of research activities to support the long-term commercial energy option to provide diversity in energy supply. A pre-publication version of the report was issued in October 2007; the final report is scheduled for publication in January 2008. NE continues to review

the report findings, and is working with OMB to develop a viable strategy for implementing the committee's recommendations.

Basic and Applied R&D Coordination

NE is requesting $55M within R&D for the AFCI to support applied research in advanced mathematics for optimization of complex systems, control theory, and risk assessment. This R&D integration focus area was the subject of workshops sponsored by the Office of Science in August 2006 and December 2006. DOE program activities address advanced math for understanding, controlling, and optimizing complex systems such as the electric grid, novel combustion systems and industrial processes and advanced nuclear reactors. Offices within DOE that will benefit from this research integration effort include the Offices of Energy Efficiency and Renewable Energy, Electricity Delivery and Energy Reliability, and Science.

In addition, NE is requesting $59M within AFCI to support applied research in the characterization of radioactive waste. This R&D integration focus area was the subject of workshops sponsored by the Office of Science in September 2005, July 2006 and August 2006. DOE program activities address critical unanswered scientific questions to facilitate the stabilization, long-term storage, treatment, and ultimate disposal of radioactive waste. Offices within DOE that will benefit from this research integration effort include the Offices of Environmental Management, Civilian Radioactive Waste Management, Legacy Management, and Science.

AFCI R&D is focused on transmutation fuels, separations science and engineering and fast reactor design to support the GNEP vision. As part of its coordination with basic R&D activities conducted by the Office of Science, AFCI R&D is executed as an integrated experimental R&D and simulation effort focused on developing the key capabilities and products required for an advanced fuel cycle.

As part of the advanced mathematics focus area, the program will initiate code groups to develop advanced design and simulation codes in support of the goals of AFCI/GNEP. For example, the work of these groups would include three-dimensional integrated modeling to improve safety, performance, design and construction costs for an advanced burner reactor.

As part of the characterization of radioactive waste focus area, the program is conducting significant R&D activities in spent fuel separations research and development to develop advanced aqueous and electrochemical separations technology alternatives capable of treating spend nuclear fuel in a safe, efficient and proliferation resistant manner. In addition, the program is conducting transmutation R&D to determine methods for lowering the radiotoxicity of SNF.

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Advanced mathematics for optimization of complex systems, control theory, and risk assessment[a]			
Office of Nuclear Energy	10,000	19,410	55,000
Characterization of Radioactive Waste[b]			
Office of Nuclear Energy	37,190	53,722	59,000

[a] Includes activities within the Systems Analysis/Advanced Computing and Simulation funding activity within Advanced Fuel Cycle Initiative.
[b] Includes Separations R&D and Transmutation R&D funding activities within Advanced Fuel Cycle Initiative.

Nuclear Power 2010

Funding Schedule by Activity

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Nuclear Power 2010			
Cost-shared Program with Industry	80,166	132,771	241,100
Standby Support Program	125	1,000	500
Total, Nuclear Power 2010	80,291	133,771	241,600

Description

The Nuclear Power 2010 Program (NP 2010) supports near term technology development and regulatory demonstration activities that advance the National Energy Policy (NEP) goals of enhanced long-term U.S. energy independence and reliability through the expanded contribution of nuclear power to the U.S. energy portfolio. Nuclear energy is a large-scale, non-greenhouse gas-emitting energy source that can be expanded to meet growing demand over the next twenty years. Efforts taken with industry to increase the production of nuclear-generated electricity will play an important role in meeting the country's energy and environmental goals.

NP 2010 is a joint government/industry cost-shared effort to identify sites for new nuclear power plants, develop and bring to market advanced standardized nuclear plant designs, demonstrate untested regulatory processes, and evaluate the business case for building new nuclear power plants. These efforts are designed to pave the way for industry decisions to build and operate new, advanced nuclear power plants in the United States.

The deployment of new nuclear plants supports the NEP and the Energy Policy Act of 2005 (EPAct) objectives for energy supply diversity and energy security. With about 20 percent of our Nation's current electricity production generated by nuclear power plants, deploying new baseload, nuclear generating capacity will help maintain nuclear power's contribution to the national electricity production portfolio as the U.S. demand for electricity increases. Projections in the Energy Information Administration's "Annual Energy Outlook 2007" indicate that the United States will need to construct more than 292 gigawatts of new generating capacity by 2030 requiring 3-4 gigawatts per year of new nuclear power be brought on-line beginning in 2015 to maintain 20 percent of the electricity share.

NP2010 seeks to support utility decisions by 2010 to build new nuclear plants. To achieve the objective of new nuclear plant deployment, NP2010 closely cooperates with industry and other government agencies to address the technical, regulatory, and institutional barriers that currently exist. More specifically, these obstacles include the uncertainties associated with new nuclear plant designs and the Federal regulatory and licensing processes and the business risks resulting from these uncertainties. NP 2010 was designed to address these obstacles through partnership with industry.

The FY 2009 budget request continues new nuclear plant licensing and reactor engineering and design activities started in previous years. In FY 2009, the NP 2010 program will cost share the work being performed by industry partners to respond to information requests from the Nuclear Regulatory Commission (NRC) as they advance their review of the two combined Construction and Operating License (COL) applications. Additionally, NP 2010 will continue to cost share the engineering and design activities of the reactor vendors for two Generation III+ advanced, light water reactors including issues related to design certification requests being reviewed by NRC. The scope of work being executed in FY 2009 will achieve progress necessary to maintain the goal of licensing and design certification decisions by NRC in FY 2010 and FY 2011, an industry decision to build in FY 2010, and completion of standardized reactor designs in FY 2011. Successful completion of these activities will lead to deployment of new nuclear plants in the next decade.

NP2010 supports technology development leading to the deployment of Generation III+ advanced, light water reactors, which offer advancements in safety and economics over the Generation III designs certified in the 1990s by the Nuclear Regulatory Commission (NRC). To reduce the regulatory uncertainties and enable the deployment of new Generation III+ nuclear power plants in the United States, it is essential to demonstrate the untested Federal regulatory processes for the siting, construction, and operation of new nuclear plants. In addition, design finalization of two standard plant technologies along with NRC certification is needed to reduce the high initial capital costs of the first new plants so that these advanced technologies can be competitive and deployable within the next decade.

NP2010 partners with industry teams, led by Dominion Energy (Dominion) and NuStart Energy Development, LLC (NuStart), representing power generation companies that operate more than two-thirds of all the U.S. nuclear power plants in operation today. The FY 2009 budget request continues the licensing demonstration activities started in previous years. Activities include continuation of the New Nuclear Plant Licensing Demonstration projects that will exercise the untested licensing process to build and operate a new nuclear plant and will achieve the certification of two advanced Generation III+ advanced reactor designs. Engineering activities in support of the submission of two combined Construction and Operating License (COL) applications to NRC will continue.

In FY2009, first-of-a-kind design activities under NP 2010 project teams led by GE-Hitachi Nuclear Energy Americas (GE-Hitachi) and Westinghouse Electric Company (WEC) will be accelerated for two standard nuclear plants, the Westinghouse AP1000 and the General Electric (GE) Economic Simplified Boiling Water Reactor (ESBWR). The focus in FY 2009 will be on the engineering and design necessary to complete vendor component/equipment procurement specifications and allow the utilities to issue contracts to initiate fabrication of modular plant components and to finalize firm project construction cost and schedule estimates required by the utilities to receive approval for cost recovery through their Public Utility Commissions; commit to build a new nuclear plant; execute Engineering, Procurement, and Construction contracts; and begin loan discussions with financial institutions. These activities ensure that the projects will stay on track to meet deployment schedules in 2010.

As a result of the NP 2010 Program and EPAct 2005 financial incentives, in 2007 four power companies applied to the Nuclear Regulatory Commission for combined COLs, and another 14 companies announced their intentions to apply for COLs over the next two years. These companies will benefit from the work being accomplished under the NP 2010 Program. In FY 2008 and FY 2009, companies

that have already announced plans to submit COL applications to NRC will have submitted these applications, most referencing the AP1000 or ESBWR designs supported by the NP 2010 program.

In addition to NP 2010's cost shared efforts, the program includes additional incentives to further mitigate regulatory and financial hurdles faced by utilities outlined in Title VI, Section 638, "Standby Support for Certain Nuclear Plant Delays," of the EPAct 2005, which authorizes the Secretary of Energy to pay covered costs to project sponsors if full power operation of an advanced nuclear facility is delayed by regulatory or litigation occurrences as defined in the final rule for Standby Support. Standby Support is a form of insurance protection from delay in nuclear plant operation beyond the control of the power company owner. The Secretary is authorized to enter into contracts covering a total of six reactors. The Department anticipates that sponsors will submit requests for standby support coverage as soon as FY 2008. When received, the Department will review these requests and enter into conditional agreements with sponsors in advance of executing standby support contracts. In FY 2009, the Department will continue to process Conditional Agreements. Additionally, the Department will be prepared to accept project sponsors' required documentation for Standby Support contracts as such information is finalized by the sponsor. Further, the Department will pursue implementation of other EPAct 2005 related incentives supporting nuclear power.

Detailed Justification

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Cost-shared Program with Industry	**80,166**	**132,771**	**241,100**

To demonstrate the untested regulatory process for obtaining NRC approval for constructing and operating new nuclear power plants, the Department established competitively selected, cost-shared cooperative agreements in FY 2005 with industry to obtain combined COLs. Additionally, the agreements included scope for completion of design certification and standard plant designs for Westinghouse's AP1000 and GE's ESBWR. The submission of the COL applications and the timely responses to inquiries from the NRC review of requests for design certification and the COL applications will demonstrate the progress needed to support an industry decision to deploy in 2010.

In FY 2007, the licensing and engineering activities necessary to complete the preparation of two COL applications were completed and followed by an independent quality review prior to application submission to the NRC early in FY 2008. The Department:

- Continued support of industry to complete the Atomic Safety Licensing Board hearings and issuance of two Early Site Permits by the NRC; the first NRC-approved sites available for building new nuclear power plants in over 25 years.
- Continued preparation of the Dominion and the NuStart COL applications including pre-application licensing interactions with NRC. Initial draft applications underwent an industry peer review process prior to submittal to the NRC.
- Resolved all open items in the ESBWR design certification draft safety evaluation report.
- Completed initial first-of-a-kind engineering (FOAKE) required to prepare COL applications for the ESBWR and AP1000 reactor designs and closed all design certification COL action items.

- Continued design finalization activities for the ESBWR and AP1000 standardized designs, including the engineering analyses and calculations, design criteria documents, and design technical information necessary for an industry decision to purchase new nuclear plants. Design activities achieved in FY 2007 allowed the program to remain on track to support industry completion of standardized reactor designs in 2011.

Successful implementation of these activities in FY 2007 maintained the schedule for an industry decision in 2010 to build a new nuclear power plant.

In FY 2008, the COL project teams (NuStart, Dominion, GE-Hitachi, and WEC) begin working with the NRC staff to resolve COL application questions arising from the NRC staff review. The Department support will:

- Continue industry efforts to obtain the Dominion Early Site Permit.
- Enable submission of the Dominion and NuStart COL applications to NRC in the first quarter of FY 2008.
- Begin interactions with NRC to address questions on the COL applications including development of responses to NRC Requests for Additional Information (RAIs).
- Continue first-of-a-kind design finalization activities for the standardized AP1000 and ESBWR designs and prepare the engineering analyses and calculations, design criteria documents, design technical information, and total cost and schedule necessary for an industry purchase of a new nuclear plant.
- Resolve open items related to the ESBWR design certification to allow NRC to issue completed chapters of the safety evaluation report.

Successful implementation of these activities is necessary to maintain the schedule for an industry decision in 2010 to build a new nuclear power plant.

In FY 2009, the COL project teams (NuStart, Dominion, GE-Hitachi, and WEC) will continue working with the NRC to resolve COL application questions resulting in issuance of Safety Evaluation Reports and Environmental Impact Statements. Reactor vendor activities will focus on accelerated completion of FOAKE for the AP1000 and ESBWR standard plant designs. In addition, GE will be interfacing with NRC to obtain issuance of Safety Evaluation Report (SER) for the design certification document and the Final Design Approval for the ESBWR. Westinghouse will interface with NRC to obtain approval of the revised AP1000 design certification.

The Department support will:

- Continue industry interactions with NRC on the COL applications including responses to NRC RAIs, meetings with the Advisory Committee on Reactor Safety, and issuance of Safety Evaluation Reports and Final Environmental Impact Statements.
- Continue first-of-a-kind design finalization activities for the standardized AP1000 and ESBWR

designs and preparation of the engineering analyses and calculations, design criteria documents, and design technical information.

- Accelerate design finalization activities necessary to complete vendor component/equipment procurement specifications and allow the utilities to issue contracts to initiate fabrication of modular plant components and other long lead equipment. Initiate additional FOAKE and design details to increase standardization of component design, selection, and qualification and formulate training and procedure programs.
- Lower the risk of new plant construction by ensuring better price stability and cost control resulting in power company decisions to execute Engineering, Procurement, and Construction contracts.
- Resolve open ESBWR certification items to allow the NRC to issue the Final Design Approval and initiate the design certification rulemaking. Support NRC issuance of final SER for design certification.

Successful implementation of these activities is necessary to maintain the schedule for an industry decision in 2010 to build a new nuclear power plant.

Standby Support Program **125** **1,000** **500**

The Energy Policy Act of 2005 authorizes the Secretary to provide standby support contracts for up to six new advanced nuclear reactors.

In FY 2007, the Department:

- Developed the process and criteria under which the Department would accept and approve requests for conditional agreements between the Department and project sponsors that will convert to standby support contracts once plant construction has commenced. The Department contracted with subject matter experts to assist in the development of financial guidance and estimates of standby support contracts.

In FY 2008, the Department will:

- Receive and review requests for conditional agreements from sponsors of new nuclear power plants as well as develop estimated costs of each request using financial and technical subject matter experts.
- Support initiatives addressing other EPAct 2005 incentives for advanced nuclear energy facilities.

In FY 2009, the Department will:

- Complete review of application requests and issue conditional agreements for standby support.
- Begin to receive and review required documentation for standby support contracts.
- Continue to support initiatives addressing other EPAct 2005 incentives for advanced nuclear energy facilities.

Total, Nuclear Power 2010 **80,291** **133,771** **241,600**

Explanation of Funding Changes

	FY 2009 vs. FY 2008 ($000)
Cost-shared Program with Industry	
The increase from $132,771,000 to $241,100,000 is needed to maintain the overall NP 2010 schedule to complete the reactor design certifications and continue licensing interactions with NRC to support utility decisions by 2010 to build new nuclear plants. Funds support the licensing activities focused on design and engineering activities, including increased interactions between NRC and the power companies and reactor vendors to resolve outstanding issues.	
The increase further supports the acceleration of FOAKE to support long-lead procurement, decisions by state regulators, and construction decisions in support of 2015 operation, as well as, additional FOAKE and design details needed to develop and design construction-level modularization plans; increase standardization of component design, selection, and qualification; and formulate training and procedure programs. In addition, this funding will drive risks of new plant construction lower ensuring better price stability and cost control thus providing a more sound basis upon which an industry decision to build can be made and potentially accelerating that decision up to a year.	+108,329
Standby Support Program	
The decrease from $1,000,000 to $500,000 is due to the reduction of program activities resulting from the transition from the evaluation of requests for conditional agreements with support of subject matter experts to review of supporting documentation.	-500
Total Funding Change, Nuclear Power 2010	**+107,829**

Generation IV Nuclear Energy Systems Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Generation IV Nuclear Energy Systems Initiative			
Generation IV R&D	7,799	0	9,750
Next Generation Nuclear Plant R&D	26,415	114,092	59,500
International Nuclear Energy Research Initiative (I-NERI)	1,000	0	0
SBIR/STTR	0	825	750
Total, Generation IV Nuclear Energy Systems Initiative	35,214	114,917	70,000

Description

The President's National Energy Policy and the Energy Policy Act of 2005 (EPAct) acknowledge the potential for nuclear energy to help meet our nation's growing need for safe, reliable, and environmentally responsible energy supply. The goal of the Generation IV (Gen IV) Nuclear Energy Systems Initiative is to address the fundamental research and development (R&D) issues necessary to establish the viability of next-generation nuclear energy system concepts and investigate the application of the R&D results to extend the operating life of existing light water reactors (LWR). Successfully addressing the fundamental R&D issues of Gen IV concepts that excel in safety, sustainability, cost-effectiveness, and proliferation-resistance, will allow these advanced reactor concepts to be considered for future commercial development and deployment by the private sector. Specific international benchmarking methodologies are being developed to enable the critical evaluation of each Gen IV concepts' relative merits. This includes the development of an economics evaluation and modeling of proliferation resistance and physical protection.

The Generation IV Nuclear Energy Systems Initiative has two R&D elements: Gen IV R&D and Next Generation Nuclear Plant (NGNP) R&D. Gen IV R&D is aimed at readying technologies that will further improve the economic and safety performance of existing LWR and advanced Gen IV reactor concepts. The Gen IV R&D is specifically focused on component and material aging and degradation resulting from long-term operation in the harsh nuclear environment (temperature, chemistry, and radiation). Results of this research will directly benefit existing nuclear plants by enabling the extension of their current operating licensing period. It will also enable the design of advanced reactor concept plants with a longer operating life. NGNP R&D is a very-high temperature reactor (VHTR) research, design, and demonstration program that will establish the commercial potential of gas reactors as a provider of process heat for industrial applications. The Nuclear Hydrogen Initiative (treated under a separate line in the budget) is working closely with NGNP R&D to develop technologies that will apply high temperature process heat and/or electricity from next generation nuclear energy systems to produce hydrogen at a cost competitive with other alternative transportation fuels.

The Department's strategic plan lays the groundwork of an ambitious, long-term vision for a zero-emission future that is free from the reliance on imported energy. To realize this vision, the Department administers a portfolio of nuclear research programs to support near term deployable reactor technologies and, for the longer-term, advanced reactor and fuel cycle management technologies.

Gen IV Nuclear Energy Systems Initiative activities have potential benefits that cut across the full range of the NE R&D portfolio. These include pioneering the use of risk-informed reactor licensing and developing advanced systems to measure accurately system-operating parameters for use in multiple reactor types. The principle focus of Gen IV Nuclear Energy Systems Initiative is to develop next-generation gas reactor technologies that can contribute to meeting the President's Advanced Energy Initiative and compete economically with advanced fossil and renewable technologies, enabling power providers to select from a diverse group of options that are economical, reliable, safe, secure, and environmentally acceptable.

Overall, Gen IV concepts are being developed to use high-burnup fuel, transmutation fuel, and recycled fuel. Such fuel cycle strategies allow for efficient utilization of domestic uranium resources and minimization of waste generation. Proliferation resistance and physical protection improvements are being designed into Gen IV concepts to help thwart those who would target nuclear power plants for terrorist acts or use them improperly to develop materials for nuclear weapons. Gen IV concepts will feature advances in safety to improve public confidence in the safety of nuclear energy while providing enhanced investment protection for plant owners. Competitive life-cycle costs and acceptable financial risk are being factored into Gen IV concepts with high-efficiency electricity generation systems, modular construction, and shortened development schedules before plant startup.

The FY 2009 budget request continues critical gas reactor R&D that will help achieve desired goals of sustainability, economics, and proliferation resistance to ready the technology for commercial deployment in the 2030 timeframe. In FY 2009, Gen IV R&D focuses specifically on component and material aging and degradation where results will directly benefit existing nuclear plants by extending their current operating licensing period and designing advanced reactor concept plants with a longer operating life.

Continued investigation of technical and economical challenges and risks are needed to support NGNP design and licensing basis development. In FY 2009, NGNP R&D includes broader activities conducted in support of the VHTR concept and benchmarking methodologies in conjunction with the Generation IV International Forum (GIF). Successful completion of these activities is necessary to support the 2011 decision to proceed with the demonstration of an NGNP by 2021, as directed by EPAct. Key to the strategy for conducting R&D under the Gen IV Nuclear Energy Systems Initiative is the multiplication effect on investment derived from international collaboration. By coordinating U.S. efforts with those of the GIF partner nations, our funding is leveraged by a factor of two to ten, depending on the reactor concept involved.

Detailed Justification

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Generation IV R&D	**7,799**	**0**	**9,750**

Gen IV R&D activities are aimed at long-term technology advances to further improve the safety performance and lower production costs of advanced reactor concepts for potential commercial deployment in the 2030 timeframe. In addition, the program is undertaking component and material aging and degradation activities that will help provide the basis for supporting the extension of the current operating licensing period for existing nuclear reactors, and will enable the design of advanced reactor concept plants with longer operating life spans.

In FY 2007, the Gen IV program focused on developing the SFR and VHTR reactor technologies that support GNEP and NGNP, respectively. Beginning in FY 2008, long-term VHTR technologies are funded as a part of Next Generation Nuclear Plant (NGNP) R&D and long-term SFR activities are funded as a part of the AFCI.

The VHTR concept features a helium-cooled reactor with excellent passive safety features. The VHTR uses a coated-particle fuel form that can withstand extreme temperatures (up to about 1600ºC) while maintaining its fission product inventory. This makes the VHTR uniquely capable of delivering high-temperature heat (up to 1000ºC) to industrial processes, including innovative efficient hydrogen production processes. A number of GIF partner countries are cooperating with the U.S. to accelerate the design of a prototype reactor. The GIF System Arrangement for the VHTR was signed in November 2006 by Canada, Euratom, France, Japan, Korea, Switzerland, and the U.S. The Republic of South Africa is conducting its internal ratification process. Second-tier implementing arrangements on Hydrogen Production and Fuels under the GIF VHTR System Arrangement were signed in 2007 and the VHTR Materials Project Arrangement is scheduled for signature in 2008. The use of liquid salt as a cooling mechanism is also being examined in conjunction with the VHTR under a novel concept known as the Advanced High-Temperature Reactor (AHTR) due to its potential advantages in economics over the helium-cooled VHTR. In FY 2007, the Department:

- Conducted cost-share research in GIF VHTR Projects for Design, Safety, and Integration; Computational Methods and Benchmarks; Materials; and Fuel and Fuel Cycle.
- Initiated collaborative project with France on composite materials for VHTR control rod structures.
- Initiated collaborative project with France and the Republic of Korea on mechanical and corrosion testing of nickel-based alloys for VHTR applications.
- Conducted, in cooperation with France and the Republic of Korea, thermal-hydraulic analyses and experiments for VHTR safety.
- Continued collaboration with Japan on zirconium-carbide fuel particle coatings.
- Continued pre-conceptual design studies on prismatic-core and pebble-bed versions of the AHTR to establish the concept's viability and advantages.
- Co-chaired the GIF VHTR Steering Committee and contributed to the joint GIF VHTR R&D Plans.

Successful completion of activities in FY 2007 furthered knowledge of the VHTR reactor technology, substantively contributing to an enhanced understanding of the safety, economics and proliferation challenges and risks associated with this reactor technology. In FY 2008 and FY 2009, the VHTR activities are funded under NGNP R&D. See NGNP R&D section for information on VHTR FY 2008 and FY 2009 activities.

The SFR concept features a fast-spectrum reactor capable of spent fuel recycling. The primary mission for the SFR is the management of high-level wastes and, in particular, management of plutonium and other actinides. The U.S. participates in long-term SFR R&D activities with the objective of developing a medium-sized (~600 MWe) SFR with the flexibility to consume transuranic actinides (TRUs). The primary system operates at essentially atmospheric pressure. A secondary sodium system acts as a buffer between the radioactive sodium in the primary system and the energy conversion system in the power plant. The GIF System Arrangement for the SFR was signed in February 2006 by France, Japan, the Republic of Korea, and the U.S.; Euratom acceded in November 2006. The first second-tier implementing arrangement, the SFR Project Arrangement for Advanced Fuels, was signed in early FY 2007, followed by the Project for Component Design and Balance of Plant (BOP) and the Project for Global Actinide Cycle International Demonstration in late 2007.

In FY 2007, the Department:

- Continued test irradiations of coupons of various metallic and composite materials in collaboration with France under the FUTURIX SMI program.
- Initiated development of ODS steels for high-temperature and long-life service as SFR structural materials, in collaboration with France, under the materials crosscut activities.
- Conducted a series of tests on a bench-scale Brayton cycle turbine-generator with helium at nominal pressures as the working fluid, to obtain experience with Brayton-cycle machinery behavior and validate computational methods.
- Issued a contract with a commercial vendor for design of a bench-scale (~1 megawatt) closed-loop Brayton-cycle turbine-compressor system using supercritical carbon dioxide as the working fluid.
- Developed computational methods to analyze the system behavior near the carbon dioxide critical point and to develop appropriate control methods.
- Co-chaired the GIF SFR Steering Committee and authored a rewrite of the joint GIF R&D Plan for the SFR.

Successful completion of activities in FY 2007 furthered knowledge of the SFR reactor technology, substantively contributing to an enhanced understanding of the safety, economics and proliferation challenges and risks associated with this reactor technology. In FY 2008 and FY 2009, the SFR activities are funded under the AFCI. See AFCI request for information on SFR FY 2008 and FY 2009 activities.

In FY 2007, Gen IV R&D also continued to monitor international R&D activities on the Lead-Cooled Fast Reactor, Gas-Cooled Fast Reactor, and Supercritical-Water-Cooled Reactor, and collaborate with GIF partner nations in areas that may be advantageous to the United States. These reactor technologies

are discussed below:

Lead-Cooled Fast Reactor: The Lead-Cooled Fast Reactor (LFR) concept is a lead (Pb) or lead-bismuth-eutectic (LBE) cooled small modular reactor with a closed fuel cycle. The design features a long-lived core (15-30 years) replaceable as an integral unit with vessel and coolant for high proliferation resistance. The LFR will utilize the advantages of lead or LBE coolant to achieve high core outlet temperatures, which will allow realization of high system efficiency. The reactor will accommodate a closed fuel cycle while ensuring substantial proliferation resistance by limiting access to fuel and associated fuel handling infrastructure. GIF partner countries including EURATOM, Japan, Switzerland, and Korea have expressed interest in exploring this concept in cooperation with the United States.

In FY 2007, LFR activities were focused on:

- Monitoring international R&D, participation in GIF LFR forums, and completion of bilateral collaboration projects with Euratom and Korea.
- Completed the preliminary concept design of the LFR reactor and associated systems. This includes analyses to ensure that the systems meet design objectives of 15-30 year core refueling intervals for enhanced proliferation resistance, natural circulation, and other passive safety features and autonomous load-following.

Gas-Cooled Fast Reactor: The Gas-Cooled Fast Reactor (GFR) system features a fast-spectrum, helium-cooled reactor and closed fuel cycle as the reference concept. The GFR uses a direct-cycle helium turbine for highly efficient electricity production. An alternate GFR concept, which uses supercritical carbon dioxide as the coolant, may offer similar high efficiency while maintaining lower coolant temperatures. The GFR's fast neutron spectrum makes it possible to utilize available fissile and fertile materials (including depleted uranium from enrichment plants) several orders of magnitude more efficiently than thermal-spectrum gas reactors with once-through fuel cycles. Furthermore, through the combination of a fast neutron spectrum and full recycle of actinides, GFRs minimize the production of long-lived radioactive waste isotopes and can be designed for management of minor-actinides in spent fuel. Interest for the GFR is high in GIF member countries EURATOM, France, Japan, Korea, South Africa, and the U.K.

In FY 2007, GFR activities were focused on:

- Monitoring international R&D and participation in GIF GFR forums.
- Continued preliminary concept design of GFR forced natural circulation decay heat cooling system.

Supercritical-Water-Cooled Reactor: The Supercritical-Water-Cooled Reactor (SCWR) concept is a high-temperature, high-pressure water-cooled reactor that operates above the thermodynamic critical point of water. The system may have a thermal or fast neutron spectrum depending upon the core design. The SCWR holds the potential for significant advantages compared to existing water-cooled reactors. The advantages are due to greater thermal efficiency, lower coolant mass flow rate per unit of core thermal power, elimination of discontinuous heat transfer regimes within the core, and the elimination of steam dryers, steam separators, re-circulation pumps, as well as steam generators.

Therefore, the SCWR will be a simpler plant with fewer major components and better economics. There is strong international interest in the SCWR within the GIF from Canada, EURATOM, Japan, and Korea.

In FY 2007, SCWR activities were focused on:

- Monitoring international R&D and participating in GIF SCWR forums.

Successful completion of activities in FY 2007 furthered knowledge of the LFR, GFR, and SCWR reactor technologies, contributing to an enhanced understanding of the safety, economics and proliferation challenges and risks associated with these reactor technologies. No funds were provided for LFR, GFR and SCWR activities in FY 2008. No funds for these activities are requested in FY 2009, as the focus of the GenIV R&D program is shifting to component and material aging and degradation (discussed below).

In the past, crosscutting research activities, were conducted where results will have applicability to two or more of the Gen IV concepts. In FY 2007, Gen IV crosscutting technology activities focused on:

- Completing the organization, data base structure, software, and web-enabled user interface of the *Generation IV Materials Handbook*, started the initial materials data population with historical data and new data developed in the Gen IV Program, and persuaded the international GIF community to adopt the *Generation IV Materials Handbook* as the preferred materials database vehicle for all GIF-generated data.
- Completing, in collaboration with GIF partners, *GIF Cost Estimating Guidelines version 3* with associated software (G4ECONS) to provide a standardized methodology for estimating capital cost and life-cycle cost of nuclear energy systems.
- Completing, in collaboration with GIF partners, *Evaluation Methodology for Proliferation Resistance and Physical Protection of Generation IV Nuclear Energy Systems version 5.*
- Providing critical Secretariat and meeting facilitation support for three GIF Policy Group and three GIF Expert Group meetings.
- Represented the U.S. at Steering Committee meetings of the IAEA International Project for Innovative Reactors and Fuel Cycles (INPRO), provided extra-budgetary funding for INPRO's Common User Criteria initiative, and provided a U.S. cost-free expert to the IAEA in support of INPRO.

Successful completion of crosscutting R&D activities in FY 2007 contributed to an enhanced understanding of the safety, economics and proliferation challenges and risks associated with GenIV reactor technologies, and increased the usability of information derived from R&D activities. In FY 2008 and FY 2009, crosscutting areas supportive of gas reactor technology and secretariat support for GIF Policy and Expert Groups are funded under NGNP R&D. See NGNP R&D section for information on GIF Policy and Expert Groups FY 2008 and FY 2009 activities.

Beginning in FY 2009, Gen IV R&D will focus specifically on component and material aging and degradation where results will directly benefit existing nuclear plants by extending their current operating licensing period and designing advanced reactor concept plants with a longer operating life. Previously, Gen IV R&D included monitoring and participation in international R&D activities on fast-

spectrum reactors that are cooled by lead or helium, and thermal-spectrum reactors cooled by liquids slats. The development of benchmarking methodologies (economics, proliferation resistance and physical protection, and reactor safety) and GIF technical and policy development support will continue under NGNP R&D.

In all nuclear plant systems, component, structures and reactor vessel materials undergo aging and other degradation as a result of thermal, mechanical, chemical, and environmental stress factors in conjunction with radiation-induced damage. This research will develop the scientific basis for understanding and managing materials aging by addressing the fundamental issues through tests, experiments, and analyses. Accordingly, the materials activities fall into the following categories:

- ***Materials for Radiation Service:*** The performance of component, structural, and reactor vessel materials is limited by the degradation of physical and mechanical properties as a result of exposure to energetic neutrons, high temperatures conditions, or by the exposure to the chemical environment provided by the primary coolant medium. These material performance issues continue to emerge as nuclear plants age and challenge the extension of plant life beyond 60 years. This research would address aging and degradation failure mechanisms in irreplaceable civil structures, such as containment tendons and concrete at elevated service temperatures, as well as cabling and underground piping in plants past 60 years. It would also investigate and understand the many potential environmental precursors of degradation. Combining the evaluation of materials as a function of neutron exposure offers an opportunity for addressing the development and qualification of materials for multiple systems within a coordinated set of irradiation experiments. The long-term, low-dose irradiation of reactor vessel steels is a key program element for extending the vessel life beyond 60 years. This program will seek to obtain data and material samples of decommissioned irradiated reactor vessel for advanced aging and neutron embrittlement experiments. This understanding would support mechanism-based component life predictions for critical structures, systems, and components and reduce the uncertainty in component life predictions. It would also provide drivers and insights for developing components with longer life, or for possibly pursuing life extension methods such as pressure vessel annealing.
- ***Development of Microstructure-Properties Models:*** The development and evolution of the fundamental microstructural features that establish materials performance need to be understood to further improve material performance and/or ensure the very long operational life envisioned for current and new reactor systems. This will require a combination of theory and modeling activities tied to detailed microstructural characterization and mechanical property measurements. The models must be developed using the best current materials science practices in order to provide a sound basis for interpolating and extrapolating materials performance beyond experimental databases, as well as providing the fundamental understanding needed to make designed changes in material compositions and processing to achieve improved properties.
- ***Materials for High-Temperature Service:*** Although the operating conditions vary significantly from one reactor system to the next, analysis indicates that significant commonality exists with regard to the selection of materials for their high-temperature structural components. Even though many of the materials required for construction of high-temperature, out-of-core components are the same as those used for some in-core applications, the focus of this crosscutting technology

development task will be on their unirradiated, high-temperature qualification. Short-term tensile and fatigue properties will be evaluated for these materials. Time-dependent creep and creep-fatigue will also be addressed since they are the primary limitations for materials use.

In FY 2009, the Department will:

- Initiate laboratory and industry cost-shared research projects on material and component aging and degradation focused on fuel clad failures, structural and reactor vessel materials that challenge nuclear plant operations beyond 60 years. These efforts would also re-establish a long-term, low-irradiation reactor vessel program.

Successful completion of activities in FY 2009 will establish a foundation for work in subsequent years that will ultimately help provide the basis for supporting the extension of the current operating licensing period for existing nuclear reactors, and will enable the design of advanced reactor concept plants with longer operating life spans.

Next Generation Nuclear Plant R&D **26,415** **114,092** **59,500**

The Department's NGNP R&D program is focused on critical path needs that will inform a Secretarial decision on the future of the project no later than 2011 as called for in the Energy Policy Act of 2005 (EPAct). Key considerations include the availability of a licensable fuel for the reactor, design of high project-risk components, such as the heat exchanger between the reactor and the hydrogen production plant, and qualification of nuclear grades of graphite for use in the reactor. In order to prepare for the 2011 Secretarial decision on whether to proceed on to final design and construction activities, the program is conducting activities related to licensing, design, fuel development, and materials qualification. The scope of work for the design activities include descriptions of the reactor, hydrogen production and electricity generation systems, the integrated plant layout, details on design selection rationale, cost and schedule forecasts, and R&D needs for producing a demonstration reactor.

The Department is working closely with both the international community and the U.S. private sector to continue R&D on the NGNP. The Department is engaging the international community via GIF and bilateral agreements pioneered under I-NERI. The Department is optimistic about potential collaborations with countries, such as Canada, France, Japan, the Republic of South Africa, Switzerland, the Republic of Korea, and the European Union. The Department is working with the U.S. private sector to establish industrial requirements, produce design information for the NGNP, and explore potential public-private partnerships to advance the project.

(dollars in thousands)

FY 2007	FY 2008	FY 2009

In FY 2007, the Department:

- Completed a draft of the NGNP licensing strategy in collaboration with the U.S. Nuclear Regulatory Commission (NRC) as directed in the EPAct 2005.
- Competitively selected three industry teams comprised of 26 domestic and foreign engineering companies to develop pre-conceptual designs of the NGNP. A conceptual design specification was developed by Idaho National Laboratory (INL) based on the results of the three pre-conceptual designs.
- Worked with industry to build a substantial community to help guide our R&D investments. Companies involved with NGNP include representatives from the petrochemical and utility businesses, as well as, traditional nuclear reactor vendors, component suppliers, and design/construction firms.
- Commenced irradiation testing, in the Advanced Test Reactor (ATR), of the first fuel specimens in a state-of-the-art, multi-cell capsule, and test train to provide shakedown test information for NGNP fuel.
- Continued the support of industry code committees in qualifying high-temperature materials and analytical methods.
- Completed the design and constructed mock-ups for testing graphite material properties (creep) inside the ATR.
- Completed pre-conceptual design studies for the NGNP that define NGNP plant layout, key design parameters, and additional R&D needs.
- Conducted a study to identify the fueling options for the NGNP, including foreign and domestic manufacturer readiness and their ability to obtain a NRC manufacturing license.

Successful completion of activities in FY 2007 supports the program's scheduled 2011 selection of functional and operational design requirements of the NGNP in accordance with the Energy Policy Act of 2005.

In FY 2008 and FY 2009, the Department will be conducting conceptual design activities that focus on high project-risk systems and components. Beginning in FY 2008, longer term R&D associated with the very-high temperature reactor (VHTR) will be funded under NGNP R&D, as well as, those activities associated with the development of benchmarking methodologies (economics, proliferation resistance and physical protection, and reactor safety) and GIF technical and policy development support.

In FY 2008, the Department is:

- Completing the joint development of the NGNP Licensing Strategy with the NRC and submitting the strategy to Congress as required by EPAct 2005.
- Continuing the irradiation of the first NGNP fuel tests in the ATR.
- Completing the fabrication and characterization of low enriched uranium UO2 coated particles for the second in-reactor fuel test for NGNP.
- Incorporating the findings from the fuel trade study conducted in FY 2007 into the NGNP fuels research plan.

- Continuing the support of industry code committees in qualifying high-temperature materials and analytical methods.
- Pursing benchmarked analyses of pebble-bed and prismatic cores for both physics and heat transport.
- Initiating conceptual design activities aimed at high project-risk systems and components.
- Completing the assembly of the graphite creep test apparatus.
- Conducting cost-shared research in GIF VHTR Projects for Design, Safety, and Integration; Computational Methods and Benchmarks; Materials; and Fuel and Fuel Cycle.
- Continuing international collaborative projects on composites, and high-temperature metallic materials testing, thermal-hydraulic analyses and experiments, and zirconium-carbide fuel particle coatings.
- Continue development benchmarking methodologies (economics, proliferation resistance and physical protection, and reactor safety).
- Co-chairing the GIF VHTR Steering Committee and providing critical GIF Secretariat and meeting facilitation support for two GIF Policy Group and two GIF Expert Group meetings.
- Support for two Congressionally Directed Projects – $1,000 for CVD single –crystal diamond optical switch (MD); and $3,000 for Technology Transfer Activities (NM).

Successful completion of these activities in FY 2008 will support the program's scheduled 2011 selection of functional and operational design requirements of the NGNP in accordance with the Energy Policy Act of 2005.

In FY 2009, the Department will:

- Complete the irradiation of the first NGNP fuel tests in the ATR.
- Continue conceptual design activities for high project-risk systems and components.
- Negotiate with industry an agreement on cooperative development of NGNP.
- Continue analytical method and code development for benchmarking pebble-bed and prismatic cores in both physics and heat transport.
- Continue the support of industry code committees in qualifying high-temperature materials and analytical methods.
- Complete the design of the test train for simulating severe fuel damage.
- Work with the NRC to resolve regulatory uncertainties for gas reactors.
- Conduct cost-shared research in GIF VHTR Projects for Design, Safety, and Integration; Computational Methods and Benchmarks; Materials; and Fuel and Fuel Cycle.

(dollars in thousands)

- Continue international collaborative projects on composites, and high-temperature metallic materials testing, thermal-hydraulic analyses and experiments, and zirconium-carbide fuel particle coatings.
- Continue development benchmarking methodologies (economics, proliferation resistance and physical protection, and reactor safety).
- Co-chair the GIF VHTR Steering Committee and providing critical Secretariat and meeting facilitation support for two GIF Policy Group and two GIF Expert Group meetings.
- Maintain the *Generation IV Materials Handbook* and arrange for other GIF organizations to share existing data and new materials data developed in the Gen IV Program.

Successful completion of these activities in FY 2009 will support the program's scheduled 2011 selection of functional and operational design requirements of the NGNP in accordance with the Energy Policy Act of 2005.

A significant amount of NGNP R&D activities are conducted in partnership with United States' university research community in part through the use of NERI grants. Competitive solicitations for NERI research include key research components for the NGNP. NERI will continue to be executed using independent peer reviews critical to ensuring the pursuit of leading edge technologies.

International Nuclear Energy Research Initiative (I-NERI)	**1,000**	**0**	**0**

The Generation IV Technology Roadmap identifies near-term reactor concepts being investigated by the international research community that have relevancy to U.S. technology needs. These International Near-Term Deployment (INTD) concepts identified by Nuclear Energy Research Advisory Council and GIF allow the U.S. to engage the international community in bi-lateral fashion beyond the six Gen IV concepts. International, cost-shared R&D enhances the Department's ability to leverage its limited research funding with nuclear technology research funding from other countries, while also providing the U.S. greater credibility and influence in international activities associated with the application of nuclear technologies. The Department currently has in place bilateral I-NERI agreements with France, the Republic of Korea, Organization for Economic Co-operation and Development Nuclear Energy Agency, the European Union, Canada, Brazil, and Japan. Negotiations to establish new bilateral agreements are underway with the Republic of South Africa and the United Kingdom.

In FY 2007, the Department used the requested funding to complete INTD R&D projects initiated in FY 2005.

No funds are requested in FY 2008 and FY 2009.

SBIR/STTR	**0**	**825**	**750**

The FY 2007 and FY 2008 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Generation IV Nuclear Energy Systems Initiative	**35,214**	**114,917**	**70,000**

Explanation of Funding Changes

	FY 2009 vs. FY 2008 ($000)
Generation IV R&D	
The increase from $0 to $9,750,000 is focused on component and material aging and degradation, where results will have applicability to existing light water reactors and advanced reactor concepts.	+9,750
Next Generation Nuclear Plant R&D	
The decrease from $114,092,000 to $59,500,000 reflects elimination of $9,000,000 for Russian gas reactor work, elimination of $7,000,000 on deep burn characteristics of gas-cooled reactors, and a refined focus on critical R&D as informed by design activities conducted in FY 2007 and FY 2008.	-54,592
SBIR/STTR	
The decrease from $825,000 to $750,000 reflects a more accurate accounting of R&D expenditures subject to SBIR and STTR.	-75
Total Funding Change, Generation IV Nuclear Energy Systems Initiative	**-44,917**

Nuclear Hydrogen Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Nuclear Hydrogen Initiative			
Nuclear Hydrogen Initiative	18,855	9,632	16,135
SBIR/STTR	0	277	465
Total, Nuclear Hydrogen Initiative	18,855	9,909	16,600

Description

The Nuclear Hydrogen Initiative (NHI) will support the future production of hydrogen for commercial applications by conducting research and development (R&D) of enabling technologies, demonstrating nuclear-based hydrogen production technologies, and studying potential hydrogen production strategies. The objective of the NHI is to develop technologies that will apply heat and/or electricity from next generation nuclear energy systems to produce hydrogen at a cost competitive with other alternative transportation fuels. The Next Generation Nuclear Plant (NGNP), a High-Temperature Gas Reactor concept being developed as part of the Generation IV Nuclear Energy Systems Initiative (Gen IV), is being coordinated and optimized to work with the hydrogen generation technologies developed under NHI. Hydrogen is an essential ingredient in many energy production and chemical industries. It is currently produced using natural gas, which is a costly and often imported fuel source. Hydrogen is used in oil refining, coal liquifaction, bio-fuel production, and many other applications. Hydrogen may also be used in the future directly as a transportation fuel, however, its importance to existing industry is sufficient justification for developing and assisting industry in demonstrating the technology required to efficiently produce hydrogen using a nuclear heat source.

United States (U.S.) climate change policy is focused on reducing the greenhouse gas (GHG) intensity of the U.S. economy. The transportation sector is one of the largest contributors to GHG emissions. Hydrogen is the most promising greenhouse gas-free fuel for use in transportation. Hydrogen may also be used to boost the energy value of existing fossil fuels, making them burn much cleaner, and in the recovery of liquid fuels from our vast domestic resources of coal, tar oil sands, and oil shale. Currently, the only economical, large-scale method of hydrogen production involves the conversion of methane into hydrogen through a steam reforming process. This process produces ten kilograms of GHG for every kilogram of hydrogen, defeating a primary advantage of using hydrogen—its environmental benefits. Another existing method, conventional electrolysis, converts water into hydrogen using electricity. Conventional electrolysis is typically used for small production quantities and is inherently less efficient because electricity must first be produced to run the equipment used to convert the water into hydrogen. The NHI is developing processes that couple with advanced nuclear reactors for highly-efficient, large-scale production of hydrogen without emission of GHG.

The FY 2009 budget request continues integrated laboratory-scale (ILS) experiments begun in FY 2008 on two baseline nuclear hydrogen production technologies. It also completes the design of an ILS experiment for the Hybrid Sulfur thermochemical cycle. These experiments are being conducted in

order to provide the necessary information needed to make a recommendation of the hydrogen production technology to be coupled with the NGNP as required by the Energy Policy Act of 2005 (EPAct 2005). Additional NHI activities planned in FY 2009 are targeted at improving the efficiency and economics of advanced, high temperature hydrogen production technologies. Successful completion of these activities will represent tangible progress toward demonstrating nuclear hydrogen production at a cost competitive with other hydrogen production technologies.

Detailed Justification

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Nuclear Hydrogen Initiative	**18,855**	**9,632**	**16,135**

The program focuses on R&D activities associated with thermochemical and high-temperature electrolysis processes designed to demonstrate the viability of using heat and/or electricity from various advanced reactors being researched by the Gen IV, with the goal of producing hydrogen at a price that is cost competitive with other alternative fuels. Much of the program's focus is vested in the most promising technologies—the Sulfur-Iodine (S-I) and Hybrid Sulfur thermochemical cycles and high-temperature electrolysis. The objective of this program is to demonstrate the technologies at increasingly larger scales, culminating in a demonstration of an industrial-scale hydrogen production process that would be technically and economically suited for commercial deployment. FY 2007 activities focused on the final design and construction of integrated laboratory-scale experiments. In FY 2008 and FY 2009, these experiments will be operated to validate closed-cycle operations and evaluate long-term performance of components and materials. Based on the outcomes of the integrated laboratory-scale experiments, a technology down select to the most promising technology for a pilot-scale experiment will be made by 2011, with construction of a pilot-scale experiment by 2013, and a commercial-scale demonstration by 2019.

Based on their level of technical maturity, the sulfur family of thermochemical cycles (S-I and Hybrid Sulfur) and high-temperature electrolysis are considered "baseline" processes and have the highest R&D priority. Operation of integrated laboratory-scale experiments on an S-I thermochemical system in FY 2008 will be used to confirm the technical and economic viability of the chosen materials. To better leverage this research and increase the probability of achieving the program schedule and objective, the Hybrid Sulfur cycle will also be investigated. An integrated laboratory-scale High-temperature electroloysis (HTE) experiment with one 240-cell module was first operated at the end of FY 2007. The experiment will be operated in FY 2008 and FY 2009 with the addition of two more electrolyzer modules for a total of 720 cells.

NHI R&D activities will be conducted through several vehicles including international collaborations via the Gen IV International Forum and bilateral agreements pioneered under the International Nuclear Energy Research Initiative and domestically via the national laboratories. Program reviews are conducted as a part of the planning and evaluation process and as a part of DOE's Hydrogen Program Annual Merit Review. Additional reviews will be performed in conjunction with the Hydrogen Technical and Fuel Cell Advisory Committee established under Section 807 of the EPAct 2005.

As described above, near-term activities are focused on constructing and operating integrated laboratory-scale thermochemical and high-temperature electrolysis hydrogen production systems.

In FY 2007, the Department prepared for integrated laboratory-scale system experiments for the two technologies and performed the following activities:

- Completed assembly of integrated laboratory-scale S-I thermochemical system and pre-operational testing consisting of system operation using water as a surrogate fluid.
- Completed initial longevity testing for materials for pilot-scale, sulfur-based thermochemical process equipment.
- Developed and tested electrolyzer membranes for Hybrid Sulfur thermochemical process.
- Conducted component reaction tests and completed a down select process to the two most promising alternative cycles.
- Completed assembly and pre-operational testing of integrated laboratory-scale HTE system consisting of verification of individual component performance.
- Started feasibility studies, which had been awarded at the end of FY 2006, to determine whether the use of existing nuclear power plants is a cost-effective means of producing hydrogen.
- Incorporated materials and heat exchanger test data into the system interface model for integrating nuclear and hydrogen plants.
- Performed laboratory-scale tests on heat exchangers and materials.

Successful achievement of these activities significantly contributes to the program's 2011 selection of a technology that will be demonstrated in a pilot scale hydrogen production project, scheduled for 2013. This technology may also be employed in the demonstration of the next generation nuclear power plant.

In FY 2008, the Department will begin testing of integrated laboratory-scale experiments and perform the following:

- Conduct integrated laboratory-scale experiments on S-I thermochemical system to confirm the technical viability of the integrated system.
- Conduct tests of multi-cell electrolyzers for the Hybrid Sulfur thermochemical cycle.
- Operate solid oxide electrolysis cell stacks at prototypic temperatures (750 – 900 C) to confirm efficiency and demonstrate cell sealing and interconnect technologies.
- Conduct HTE integrated laboratory-scale experiment operation consisting of three 240-cell modules at 5 kWe power level each and 15 kWe total.

Successful achievement of these integrated tests and research on membranes, catalyst and materials performed in FY 2008 will be used to inform the 2011 selection of a hydrogen technology that will be demonstrated in a pilot scale project, scheduled for 2013.

In FY 2009, the Department will:

- Continue operation and testing on the SI integrated laboratory-scale thermochemical experiment to assess long-term process stability and component durability.
- Evaluate the effect of process improvements, such as membranes and improved catalysts, on thermochemical cycle efficiency.
- Design an integrated laboratory-scale experiment for the Hybrid Sulfur cycle at the Savannah River National Laboratory in preparation for construction in FY 2010.
- Continue HTE experiments begun in FY 2008 to investigate long-term cell operability and

thermal cycling issues.

- Incorporate the results from the integrated laboratory scale experiments into the hydrogen production economic analysis model to identify cost drivers and support the hydrogen technology selection required by the EPAct 2005 in 2011.

Successful achievement of continued testing of integrated laboratory-scale systems and operation of additional experiments will enable the 2011 selection of the technology that will be demonstrated in a pilot-scale hydrogen production experiment, scheduled for 2013.

SBIR/STTR	**0**	**277**	**465**
The FY 2008 and FY 2009 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.			
Total, Nuclear Hydrogen Initiative	**18,855**	**9,909**	**16,600**

Explanation of Funding Changes

	FY 2009 vs. FY 2008 ($000)
Nuclear Hydrogen Initiative	
The increase from $9,632,000 to $16,135,000 reflects the need to obtain additional operational performance data from the Integrated Laboratory Scale experiments that were deferred in FY 2008.	+6,503
SBIR/STTR	
The increase from $277,000 to $465,000 is due to changed R&D levels within the NHI program.	+188
Total Funding Change, Nuclear Hydrogen Initiative	**+6,691**

Advanced Fuel Cycle Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Advanced Fuel Cycle Initiative			
Separations Research and Development	34,595	0	59,217
Advanced Fuels Research, Development and Testing	38,160	0	53,000
Transmutation Research and Development	2,595	0	53,400
Systems Analysis/Advanced Computing and Simulation	18,877	0	73,000
Transmutation Education	24,185	0	1,000
Advanced Fuel Cycle Facility	9,000	0	10,383
Consolidated Fuel Treatment Center	8,000	0	18,000
Advanced Burner Reactor	8,750	0	18,000
GNEP Technology Development	17,930	0	0
GNEP Global Partnership Development	0	0	4,500
Fast Neutron Test Capability	4,000	0	10,000
SBIR/STTR	0	0	1,000
Total, Advanced Fuel Cycle Initiative	166,092	0[a]	301,500

Description

The mission of the Advanced Fuel Cycle Initiative (AFCI) is to develop fuel cycle technologies that will support the economic and sustained production of nuclear energy while minimizing waste and satisfying requirements for a controlled, proliferation-resistant nuclear materials management system. In FY 2008, AFCI is included in the Fuel Cycle Research and Facilities program.

AFCI is focused on implementing the Global Nuclear Energy Partnership (GNEP), which is our nation's comprehensive initiative that supports the safe, secure expansion of nuclear power both internationally and domestically. Internationally, GNEP is working to establish a framework to ensure that nuclear power expansion can be achieved appropriately with reduced risk of nuclear weapons proliferation. Domestically, GNEP is developing the advanced technologies and facilities needed to change the nuclear fuel cycle to one in which spent nuclear fuel (SNF) is recycled. Once deployed, this new approach will allow the United States (U.S.) to separate SNF into waste and usable components, allowing reactors to extract additional energy, and providing options for more effective management of the residual waste. AFCI is developing these new technologies so that they may be deployed as part of the nuclear fuel cycle to support operation of current nuclear power plants, Generation III+ advanced light water reactors (LWR), and Generation IV advanced reactors.

[a]In FY 2008, the Advanced Fuel Cycle Initiative is included in the Fuel Cycle Research and Facilities program.

World energy demand is projected to significantly increase over the coming decades. The Energy Information Agency projects that electricity demand will double by 2030 with much of the increase coming in developing countries as they experience double-digit rates of economic growth and seek to improve standards of living. Energy is a necessary driver for human development and this demand for energy will be met using available production technologies.

The U.S. currently has 104 operating commercial nuclear reactors providing approximately 20 percent of our domestically produced electricity, and producing over 2000 metric tons of SNF per year. Expansion of nuclear power is a key component of the National Energy Policy (NEP) and Climate Change Technology Strategy. However, expansion cannot occur without a sustainable path forward for managing SNF.

Historically, the U.S. has used a once through or open fuel cycle in which nuclear fuel is used a single time in the reactor prior to disposal. AFCI/GNEP will develop new technologies that will enable beneficial recycling of SNF. This would enable the U.S. to ultimately move to a closed fuel cycle, where SNF is recycled and reused as fuel to produce additional energy, rather than disposing of it after one use.

To meet growing energy demands and to ensure a viable strategy for SNF management, the National Security Strategy of the United States proposed:

> *"…the Global Nuclear Energy Partnership to work with other nations to develop and deploy advanced nuclear recycling and reactor technologies. This initiative will help provide reliable, emission-free energy with less of the waste burden of older technologies and without making available separated plutonium that could be used by rogue states or terrorists for nuclear weapons. These new technologies will make possible a dramatic expansion of safe, clean nuclear energy to help meet the growing global energy demand."*[a]

The global expansion of nuclear power promoted by the National Security Strategy of the United States is designed to enhance the national, environmental, and economic security of the U.S. The contribution of AFCI/GNEP in each of these areas is discussed below.

National Security

Principally, AFCI/GNEP benefits U.S. national security by developing advanced spent fuel recycle technologies which extract actinides (Np, Pu, Am, Cm) from SNF without separating out pure plutonium; these highly radioactive elements are then destroyed through their use as fuel or as targets in fast reactors. These technologies address proliferation risk through the reduction of inventories of commercially-generated plutonium (which is contained in all commercial spent fuel) throughout the world.

AFCI/GNEP will further advance the nonproliferation and national security interests of the U.S. by reinforcing its nonproliferation policies through establishment of an international framework to provide a reliable fuel service for those counties with nuclear power by making it unnecessary for them to develop indigenous enrichment or reprocessing capabilities.

[a] *The National Security Strategy of the United States of America* (March, 16, 2006): 29.

In addition to the inherent benefits derived from a spent fuel recycling process that consumes plutonium but does not result in the extraction of pure plutonium, AFCI/GNEP will, in collaboration with the National Nuclear Security Administration (NNSA), help enhance the international non-proliferation regime by development of advanced materials accountability and control, monitoring and safeguards systems that will contribute to enhancing proliferation resistance of integrated spent fuel recycling systems, here and potentially throughout the world.

Environmental Security

Of the challenges that must be addressed to enable future expansion of nuclear energy in the U.S. and worldwide, none is more important than dealing effectively with SNF and high-level waste. Compared to other industrial waste, SNF generated per unit of electricity is relatively small in mass. However, it contains components that are radioactive for many thousands of years, and its disposal requires resolution of many political, social, technical, and regulatory issues. For many years, several countries, including the United States, have pursued advanced technologies that could treat and transmute SNF from nuclear power plants. These technologies have the potential to significantly reduce the quantity, heat loading, and radiotoxicity of waste requiring geologic disposal.

Technologies developed by AFCI/GNEP would enable nuclear power reactors to recover additional energy value from SNF by recycling reusable materials to fuel nuclear power reactors. Recycling SNF reduces the volume and toxicity of waste requiring disposal in a geologic repository, and supports the development of proliferation-resistant technologies related to the global expansion of nuclear power. Continuing the current path of a once-through fuel cycle will require additional U.S. spent fuel repositories. Establishing a closed fuel cycle, as outlined under the GNEP Strategic Plan, will minimize the number of U.S. repositories required in this century.

Nuclear power is a key component of the U.S. Climate Change Technology Strategy. The global expansion of nuclear power supported by AFCI/GNEP will significantly reduce greenhouse gas emissions associated with energy production. Domestic nuclear power plants are saving as much as 600 million metric tons of carbon dioxide emissions every year. The development of a closed fuel cycle can significantly help in the deployment of new nuclear capacity through the development of a sustainable SNF management process.

Economic Security

AFCI/GNEP is expected to be a major stimulant to the revitalization of the domestic nuclear industry through development of the nuclear infrastructure required to support a closed fuel cycle. The GNEP vision includes the deployment of several major facilities, each of which plays a significant role in a domestic nuclear revitalization.

The Consolidated Fuel Treatment Center (CFTC) is a nuclear fuel recycling center that will separate spent nuclear fuel into reusable and waste components. The Advanced Burner Reactor (ABR) is an advanced recycling reactor that will produce electricity while destroying transuranic elements from SNF. The Advanced Fuel Cycle Facility (AFCF) is a world class research and development (R&D) facility that will support all aspects of the closed fuel cycle envisioned by AFCI/GNEP.

The CFTC will validate key elements of a SNF recycling program, including the separation of LWR and fast reactor SNF into usable components, the fabrication of transmutation fuel from those components and the preparation of advanced waste forms for geologic disposal. The facility will meet AFCI/GNEP objectives including substantial advancements in safeguards, material control and accountability, separations, fuel fabrication, and waste forms.

The ABR is a fast reactor capable of consuming transuranics and other actinides in support of a closed nuclear fuel cycle. Eliminating these materials from LWR SNF reduces both heat and waste loads on a geologic repository, potentially expanding the capacity of a geologic repository by at least an order of magnitude. As a fast reactor, it is capable of providing the fast neutron flux needed for future Generation IV reactor development and advanced fuels qualification. Without a domestic fast reactor, technology development activities that cannot be adequately pursued via computer and simulation modeling and using other domestic facilities, will require the U.S. to purchase in-reactor test time from foreign states. Prior to construction of the ABR, the Department will develop a domestic fast neutron source to provide limited technology development capabilities.

The AFCF will be the premier U.S. R&D facility for the engineering-scale demonstration of advanced fuel cycle technologies. The facility will consist of four modules fundamental to the development and ultimate deployment of these advanced proliferation-resistant technologies: Aqueous Separations, Electrochemical Processing, Fuel Fabrication, and Waste Forms. It will advance development of the entire integrated fuel recycling system from receiving SNF, to separating it into recyclable and waste materials, fabricating new advanced fuel forms including Lead Test Assemblies, and developing advanced waste forms destined for final disposition.

The AFCF is not intended to replace the research being performed at the national laboratories. Advanced fuel cycle R&D will continue at those locations. As this laboratory research matures and it becomes desirable test technologies that may prove successful at a larger scale, then the AFCF shall perform these tasks and fulfill its mission.

The engagement of industry to provide input on the technology and policy issues that need resolution in order to successfully implement the AFCI/GNEP facilities is considered to be a key element of the overall strategy. Industry involvement will help the program analyze the feasibility of commercial deployment and identify approaches that accomplish AFCI/GNEP goals at a lower cost, lower risk, or accelerated schedule. While the CFTC and ABR facilities are envisioned as industry-led projects, the AFCF is envisioned as a Department owned and operated facility located at a DOE site.

AFCI/GNEP is pursuing a research agenda that supports the National Energy Policy and Energy Policy Act of 2005 to explore advanced spent fuel treatment technologies in cooperation with our international partners. The Department will continue to emphasize joint collaborative activities in spent fuel treatment research, design, and development.

Considerable expertise in these technologies has been developed internationally, and the potential for significant cooperation, cost-sharing and collaboration is very high. The Department is currently collaborating with many countries including France, Japan, Russia, and China in areas such as separations, fuels, transmutation engineering and test facilities. Additional collaborations with other fuel cycle states, such as the United Kingdom, are being considered as well.

AFCI/GNEP international collaborations could provide a near-term means for an off-set in the cost of development of various reactor and fuel cycle technologies. Fuel cycle technology collaboration has the potential for accelerating development time by sharing knowledge and experimental data.

In FY 2009, AFCI/GNEP continues to develop methods to reduce the volume and long-term toxicity of high-level waste from spent nuclear fuel, reduce the long-term proliferation threat posed by civilian inventories of plutonium in spent fuel, and provide for proliferation-resistant technologies to recover the energy content in spent nuclear fuel. These activities continue R&D to develop advanced recycling technologies capable of extracting highly radioactive elements from commercial spent nuclear fuel and using that material as fuel in nuclear reactors to generate additional electricity. The FY 2009 request also supports continuation of conceptual design activities for the AFCF, ABR and CFTC, necessary to support the GNEP vision of a closed fuel cycle. Successful achievement of these activities will improve the way spent nuclear fuel is managed, and will facilitate the expansion of civilian nuclear power in the United States and encourage civilian nuclear power internationally to evolve in a more proliferation-resistant manner.

Detailed Justification

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Separations Research and Development	**34,595**	**0**	**59,217**

The goal of the Separations Research and Development (R&D) activity is to develop advanced aqueous and electrochemical separations technology alternatives capable of treating the existing and projected inventory of SNF and fast reactor recycle fuel in a safe, efficient and proliferation-resistant manner. The U.S., which developed essentially all separations technologies currently deployed in the world, has not been directly involved in civilian spent fuel processing since 1974. The central purpose of Separations Research and Development is to support that effort though R&D on processes that do not separate plutonium and providing technologies for industrial applications. Vigorous efforts will be required to achieve those aims. Information developed under this activity will be used to help inform a recommendation to the Secretary of Energy in 2008 on the future course of GNEP. The current suite of advanced aqueous processes has potential for meeting proliferation-resistant separations objectives, while improving the waste management associated with current aqueous separations technologies. However, electrochemical processing (referred to previously as pyroprocessing) may be better suited to address the requirements of sodium-bonded metallic fast reactor fuels. This R&D provides alternatives for important parts of the separations processes where a high or moderate risk is present. This task also supports long-term R&D for next-generation facilities. Data for modeling and simulation validation is developed under this activity.

This program will:

- Significantly reduce the volume and hazard of spent nuclear fuel that must be stored in a repository.
- Allow actinides in spent nuclear fuel to be used as a future fuel for either or both LWR and ABR in a safe and proliferation resistant manner.
- Provide a way that long lived actinides can be consumed so the ultimate waste products are less radiotoxic.
- Support GNEP in producing an energy source that has a very low emission of greenhouse

gases.
- Develop and test advanced monitoring and accountability technologies that will strengthen nuclear nonproliferation.
- Improve simulation technologies that will reduce separations costs and improve reliability.
- Develop advanced waste forms.

Before separations can be adopted by industry on a commercial scale the technology must be proven to provide the needed separations in a cost-effective manner, while reducing proliferation problems associated with the PUREX process. Issues such as extracting strontium/cesium for separate decay storage; finding better processes for extracting americium and curium; developing equipment for materials accountability; and finding better waste forms for gaseous effluents including tritium, carbon-14 and iodine-129 are examples of where improvements are desirable. A long term R&D program will take on each of the issues to make the process increasingly efficient for the future. In the very short term the program has emphasized activities which will give the Secretary better information for the 2008 decision on GNEP direction for the future. Currently the program is focused on Advanced Proliferation-Resistant Aqueous Fuel Treatment and Other Separation Processes including Electrochemical Processing.

- **Advanced Proliferation-Resistant Aqueous Fuel Treatment** **24,445** **0** **25,000**

  Laboratory-scale experiments have proven the advanced, aqueous-based UREX+ technologies to be capable of removing uranium from spent fuel at purity levels of up to 99.999 percent and essentially free of high-level radioactive contaminants. The resulting material (uranium, which comprises approximately 95% of SNF) could theoretically be disposed of as low-level waste or retained for use as reactor fuel. If spent fuel were processed in this manner, the volume of high-level waste requiring disposal in a geologic repository could be significantly reduced, potentially lowering the cost of storage and disposal of the remaining high-level waste and significantly increasing the technical capacity of a geologic repository.

  Additional research is continuing to evaluate aqueous chemical treatment methods to separate selected actinide and fission product isotopes from the process stream after the uranium has been removed. Certain long-lived fission products (i.e., iodine-129 and technetium-99) are significant contributors to the potential dose from a repository and the long-term radiotoxicity of spent fuel, and could also be separated for transmutation or incorporation into new waste forms for safe disposal. Other gaseous radionuclides will be collected and safely sequestered. Materials now considered high-level wastes in LWR spent fuel processing facilities, such as fuel element hulls and end boxes from chop-leach dissolution, may be decontaminated sufficiently to qualify as low-level waste or even recycled for reuse in new fuel elements.

(dollars in thousands)

FY 2007	FY 2008	FY 2009

In FY 2007, the Department:

- Continued the AFCI separations technology development activity to advance the knowledge of advanced aqueous separations process development though refined and focused laboratory based demonstrations, data collection, and evaluations. Specifically, there were laboratory-scale end-to-end demonstrations of recycling technologies using actual spent LWR fuel at multiple national laboratories to develop a statistical performance database, the use of an oxidation process to recover tritium, a test involving separation of americium and curium from other transuranics, qualification of a new strontium/cesium extraction process to increase system operability and reduce system complexity, and demonstration of the recovery of tritium and then mixing it with zirconium.
- Demonstrated uranium and transuranic product conversion and treatment of undissolved solids and cladding hulls were performed.
- Continued work on product and waste storage forms, particularly for transuranics, strontium/cesium, iodine and technetium. The complete collection of gaseous fission products and activation products was evaluated and experiments begun to demonstrate their collection and waste forms.

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, the Department will:

- Continue development of advanced aqueous separations processes with an increasing emphasis on simplification of the process steps. Coupled end-to-end demonstrations of various UREX+ flowsheets will be conducted, with the separated products made available for advanced fuels and waste form development activities.
- Replace the current design base flowsheet for strontium/cesium recovery and alternate extraction processes will be investigated to minimize the number of different solvents needed to obtain the required transuranic separations. Tests will continue on the applicability and efficiency of aqueous processing and recycle of high burn-up fast reactor spent fuel.
- Investigate the direct transition from transuranic products in solution in nitric acid to solid oxides containing uranium and capable of effective pellet formation in detail, along with the fabrication processes which allow remote fuel fabrication such as microsphere formation and vibration consolidation.
- Continue R&D to optimize the stability of waste forms and efficiency of waste form production including the bench scale demonstration of solidification processes for both cesium/strontium waste and technetium alloys. Improved waste forms for gaseous effluents from aqueous processing, including tritium, carbon-14, iodine-129 and the rare earth gases, will also be developed. In the case of the latter, effort will be devoted to the selection of an efficient process for separation of radioactive krypton from non-radioactive xenon.

(dollars in thousands)

FY 2007	FY 2008	FY 2009

- Advanced safeguards instrumentation and detection equipment development and testing will continue.
- Conduct international collaborations into advanced reprocessing, including possible integrated demonstrations of advanced aqueous separations flowsheets in Russia, Japan, and France.

- **Other Separations Processes (Including Electrochemical processing) 10,150 0 34,217**

Electrochemical processing (previously referred to as pyroprocessing) is a proliferation-resistant non-aqueous approach used to separate the actinides in spent fuel from fission products. AFCI electrochemical processing activities support reduction of nuclear waste radiotoxicity by separating minor actinides from spent fuel coming from metal-fueled fast reactors for recycle. While using electrochemical processing to treat spent fuel from the Experimental Breeder Reactor-II (EBR-II), electrochemical process improvements have been made, which increase its applicability to other advanced reactor fuels.

In FY 2007, the Department:

- Continued electrochemical treatment of EBR-II spent driver fuel and testing of high-throughput electrorefiners and testing of processes involving the combined use of both aqueous and electrochemical separations technologies. The aqueous portion of the process development included an extension of process instrumentation development for on-line, real-time accountability measurements applied to separations facilities for increased proliferation resistance.
- Continued studies on the applicability of pyrochemistry to the separation of cesium and strontium from spent fuels. The most promising approaches to the application of electrochemistry to the separation of americium and curium were evaluated, and the process with the highest promise was studied in greater detail for its application to the recycle of fast reactor fuel and the preparation of long-term storage forms. Improved sampling and other monitoring activities were conducted in order to increase proliferation resistance.

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, the Department will:

- Test the applicability of electrochemical processing to the treatment and recycle of high burnup fast reactor spent oxide and metal fuels using FFTF fuel irradiated to more than 200,000 megawatt days per ton.
- Process of EBR-II spent fuel, with final decisions on the optimum way to treat EBR-II blanket fuel expected.

- Conduct collaborative electrochemical processing R&D with South Korea, Japan, and possibly Canada and Russia will continue, with focus on off-gas treatment methods.
- Establish the feasibility of the separation of americium from curium and the optimum method of isolating strontium and cesium from the other fission products remaining in the waste salt.
- Investigate safeguards issues related to special material accountability. The development of electrochemical processing equipment capable of processing rates equivalent to a scale of 100 tons/year capacity will be emphasized. The development of waste forms for gaseous effluents from preprocesses, including carbon-14, iodine-129, tritium, krypton-95 and various xenon isotopes will be pursued.
- Continue research activities supporting the nuclear fuel recycling center including aqueous processes at one DOE national laboratory, and electrochemical processes at one DOE national laboratory facility. Research activities are fully integrated with the design and construction schedules. The Department will continue to work collaboratively with the international community to efficiently leverage existing infrastructure resources. A strategy for joint collaboration with Japan and France on the utilization of existing infrastructure and new capabilities will continue to be pursued.

Advanced Fuels Research, Development, and Testing	**38,160**	**0**	**53,000**

The goal of the Advanced Fuels Research, Development, and Testing activity is to develop, fabricate, and test transmutation fuels and transmutation targets using recycled SNF. While a portion of this fuel development effort is aimed at producing transmutation fuels for use in LWRs, most of this effort is being directed at producing fuels suited for use in fast reactors which offer the best opportunity to transmute (consume) most of the transuranics in the recycled fuel efficiently and safely. Advanced transmutation fuels fabricated from LWR spent fuel are the critical, linchpin components of the AFCI/GNEP concept. These advanced fuel designs will permit extracting vast amounts of currently unavailable energy from spent fuel materials while doing so in a proliferation-resistant manner and increasing the load capacity of the Yucca Mountain repository by as much as fifty-fold. This activity also supports long-term R&D for next-generation nuclear reactors (i.e., Generation IV), including generating data which can be used to validate modeling and simulation activities.

Currently, advanced transmutation fuels are fabricated in small batches (e.g. one to four fuel pins) using bench-scale facilities primarily at Idaho National Laboratory, and include nitride fuels, dispersion fuels, sphere-pac fuels, inert matrix fuels and transmutation targets. Advanced fuel development work is focused on near term R&D in support of qualifying transmutation fuel and targets for an advanced burner reactor. In addition, this Advanced Fuel Research, Development and Testing work is closely integrated with the technology development activities that support the engineering and design of the planned AFCF. The AFCF will be capable of fabricating sufficient

transmutation fuel for lead test assemblies. These lead test assemblies will be irradiated in an advanced burner reactor and will provide the performance data needed by the Nuclear Regulatory Commission (NRC) for transmutation fuel qualification.

Much of the advanced fuels irradiation testing and examination work is being done in the Advanced Test Reactor (ATR) thermal neutron source at the Idaho National Laboratory (INL). Irradiation testing at the ATR is shifting from less precise, un-instrumented tests which estimate conditions at the fuel sample to more precise instrumented tests. These instrumented tests will provide valuable data on irradiation conditions at the fuel sample and will reduce development time and costs while improving the efficiency of the advanced transmutation fuels. Irradiations will also take place domestically when a fast neutron source is available. In addition, the cost, scope and schedule to provide a transient test capability are being developed.

Research efforts in advanced fuels are being leveraged through several ongoing and planned international research collaborations. Two U.S. origin fast reactor transmutation fuel irradiation tests (FUTURIX-FTA and MI) have been initiated in the French Phenix reactor. In addition, discussions for an international arrangement for transmutation fuel irradiation tests in the Japanese JOYO fast reactor and in fast test reactors in Russia have been initiated. This international cooperation is necessary since the U.S. does not have a fast reactor in which to perform these irradiations.

In FY 2007, the Department:

- Completed irradiation tests of the initial set of high burn-up transmutation fuels in the ATR, commenced post irradiation examinations, and completed fabrication of metal transmutation fuels for future irradiation tests in the ATR.
- Initiated two U.S. origin fast reactor transmutation fuel irradiation tests (FUTURIX-FTA and MI) in the French Phenix reactor.
- Initiated discussions for transmutation fuel irradiation tests in the Japanese JOYO fast reactor and explored expansion of international fast spectrum irradiation test possibilities with Russia.

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, the Department will:

- Continue irradiation and testing of metal and oxide transmutation fuels in the ATR and fabricate and begin irradiation of a new series of instrumented transmutation tests.
- Complete irradiation of U.S. origin transmutation fuels in the French Phenix fast reactor.
- Continue to develop plans and agreements for irradiation of U.S. origin fuels and materials in Japanese and Russian fast reactors.
- Expand the fundamental research to support the development of computational simulation and modeling of fuel behavior.

(dollars in thousands)

FY 2007	FY 2008	FY 2009

- Continue to develop cost, scope, and schedule information for a transient test capability which will enable the testing of advanced fuels in atypical reactor conditions.
- Initiate post irradiation examination activities for high burn-up fuel that was irradiated in the FFTF in Hanford, Washington.
- Initiate research on alternative transmutation fuels and targets with high potential and low technical maturity (e.g. sphere-pac and dispersion fuels) including preparations for irradiation testing.
- Initiate research activities to develop an alternate fuel cycle in which LWR spent fuel would be separated and the resulting uranium and plutonium oxide (MOX) would be recycled into fuel for LWRs. Research would be conducted to determine the MOX fuel performance of varying fuel compositions of plutonium and uranium.
- Continue activities that support the design of advanced fuel cycle systems, addressing only the highest-priority activities associated with remote fuel and target fabrication technology. This includes limited evaluations of improvements needed for existing DOE laboratory facilities that can be used for remotely fabricated test pins and limited size fuel elements. The Department will continue to work collaboratively with the international community to efficiently leverage existing infrastructure resources. A strategy for joint collaboration with Japan and France on the utilization of existing infrastructure and new capabilities will continue to be pursued.

Transmutation Research and Development **2,595** **0** **53,400**

Transmutation Research and Development includes Transmutation Research and Development and Grid Appropriate Reactors.

- **Transmutation Research and Development** **2,595** **0** **33,400**

  Transmutation, as it applies to AFCI/GNEP, converts long-lived radioactive isotopes into shorter-lived, and therefore, produces less radiotoxic long-lived isotopes. As a result, transmutation can lower the radiotoxicity of spent nuclear fuel to below that of natural uranium ore by reducing the time for decay from hundreds of millennia to as little as centuries. The Transmutation R&D effort is focused on long-term R&D to reduce operational uncertainties, improve transmutation system performance, and reduce costs through development of advanced technologies. The effort is focused on fast reactors because the transmutation of transuranics is best performed in fast reactors.

  Because capital investment in reactors is the dominant cost of any nuclear fuel cycle, the work described here is a critical component to assure an economically viable closed fuel cycle. To reduce the cost of future fast reactors, a variety of innovative solutions are being researched. Reduced uncertainty on the physics behavior of the reactor can eliminate unwarranted design margins that are costly and add little or no value. Improved materials that perform better and longer are needed. The Transmutation R&D Program is a long-term program that will address these issues. Its success will largely determine if industry will

deploy fast reactors beyond the initial ABR and ultimately determine the success of the GNEP fuel cycle vision.

It is envisioned that this program will expand from its current bench scale R&D effort to a full scale research and development effort that can develop and demonstrate the needed components, physics, and safety technologies that will provide the desired breakthroughs. This will be accomplished by expanding existing facilities, developing key domestic facilities, leveraging program knowledge by exchanging information with the international fast reactor programs, and performing joint research in foreign facilities with unique capabilities.

In FY 2007, the Department:

- Completed design concept studies to evaluate the feasibility of innovative technologies.
- Evaluated and refined cross sections for plutonium isotopes to reduce the uncertainties in reactor physics calculations.
- Conducted mechanical testing and analysis of structural materials irradiated in the FFTF, which provided valuable and rare data on the effects of long term irradiation on structural steels.
- Conducted assessment of existing fast reactor design tools; the selection of candidate structural materials for use in fast spectrum transmutation systems.
- Completed a sodium technology gap analysis.
- Coordinated international activities dealing with transmutation systems.

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, the Department will:

- Continuing work on advanced concept studies designed to reduce the cost and improve the performance of the future commercial fast reactor fleet.
- Continuing R&D activities on evaluation and refinement of physics cross sections for plutonium and other priority isotopes.
- Initiating development and/or restart of key fast reactor technology facilities.
- Retrieving irradiated advanced material samples which were placed in the Phenix fast reactor in France in 2007, and preparing for their post irradiation examination.
- Continuing R&D on improvements in areas such as advanced materials and safety technologies.
- Continuing integration of advanced modeling and simulation activities with those of Transmutation R&D.
- Continuing high-priority development of candidate materials, components, and equipment that provide a significant opportunity to reduce the costs to design, construct and operate the initial ABR prototype, as well as improve plant performance in the near-term will be pursued. The Department will continue to work collaboratively with the international community to efficiently leverage existing infrastructure. A strategy for joint collaboration with Japan and France on the utilization of existing infrastructure and new capabilities will continue to be pursued. The Department will continue

investigation of increased scale fuel recycling concepts, including initial site evaluation and infrastructure design to support the hosting of a (100-200 metric ton per year) nuclear fuel recycling center and an advanced recycling reactor. DOE will obtain a nuclear utility perspective for evaluating and deploying GNEP facilities.

- **Grid Appropriate Reactors** **0** **0** **20,000**

A core component of the AFCI/GNEP vision is the creation of international partnerships that facilitate the expanded, world-wide use of nuclear energy while reducing proliferation risk associated with global deployment. In support of this goal, AFCI/GNEP supports the development of grid-appropriate reactors (previously referred to Small Reactors), which are well suited to the capabilities and needs of developing countries where electricity demand is expected to more than double by 2030. These reactors would be designed to achieve high standards of safety, security and proliferation resistance and would be sized to suit those countries smaller and less developed power grids. The successful deployment of these reactors, coupled with the GNEP vision of reliable fuel services, will provide an attractive energy solution to many countries and will serve to eliminate the need for them to develop the more proliferation-vulnerable parts of the nuclear fuel cycle (e.g., uranium enrichment facilities).

Smaller power plants (<500 MWe) are particularly suitable for expansion into the less developed countries because they would: match grid capacities better; offer simplified operations with greater margins of safety; require less capital outlay; allow countries to add capacity in smaller increments to better match demand growth; and be better suited to provide important non-electrical products such as process heat and fresh water through desalination.

Besides the United States, several countries, including France, Russia, Japan, Korea, South Africa, India, and Argentina, have already recognized the global market need for smaller sized nuclear power plants and are moving forward aggressively with the development of small and medium-sized reactors (SMR). Because it is ultimately the responsibility of private industry to develop and market commercial nuclear power plants, the role of AFCI/GNEP will be to pave the way for U.S. industry to effectively compete in the international market by helping to remove various barriers for deployment and to accelerate development and demonstration of new designs. To accomplish this, a dual-path approach has been formulated for development and demonstration of an AFCI/GNEP-sponsored grid-appropriate reactor.

Near-term Path

The first path provides a fast-track implementation that strives to have a plant design ready for deployment by 2015. In addition to addressing the existing international demand for increased power, this fast-track deployment will better allow the U.S. to: influence other supplier countries working to deploy similar reactors to meet GNEP strategic objectives; facilitate U.S. industry participation and competitiveness in the rapidly emerging nuclear market; and provide near-term credibility in meeting key GNEP objectives.

The near-term development track will target countries with current but limited nuclear experience, such as countries operating one or more research reactors. Pursuing this fast track will serve to identify and help resolve related infrastructure and regulatory needs for deployment of grid-appropriate systems in developing countries, such as plant licensing, workforce education and training, international agreements, etc.

AFCI/GNEP has determined that light water technology is the most suitable for near-term deployment for several reasons, including operational experience, time to achieve safety certification, availability of vendors and feedback from potential user states. To this end, a public-private partnership established via a competitive solicitation is being pursued with an award forecast in FY 2009. The solicitation would create a cooperative agreement to support design certification by the NRC of an advanced light-water design of less than 500 MWe. This would result in the world's first small reactor certified by the NRC, a recognized leader in nuclear regulation, and would provide a near-term ability to deploy nuclear energy in developing countries that have some nuclear experience, thereby enabling a key GNEP objective to be met. Finally, a U.S. reactor design with NRC design certification would have a significant competitive advantage in this emerging world market. It is envisioned that DOE's role will be cost-sharing and facilitation of a NRC design safety analysis leading to a design certification by 2016. Total DOE funding to accomplish this will be about $100 million spread approximately equally over five years (FY 2009 – 2013) representing about 20% of the estimated costs to develop the final design for the reactor and conduct the NRC design evaluation.

Long-term Path

The second path in the dual-path strategy focuses on accelerating reactor technology developments that are needed to deploy next-generation designs suitable for a broader global market. These designs will offer further enhancements in plant performance, such as improved safety, proliferation resistance, security, and economics. It is too early to know precisely the technologies but possibilities include next-generation LWRs, gas-cooled reactors, liquid-metal cooled reactors and other advanced systems. The next-generation designs will build on the successful resolution of critical infrastructure issues for the near-term system and will involve the development of more robust reactor technologies in order to extend the availability of nuclear power plants to countries with no current nuclear experience. Because of the R&D needed to achieve these performance objectives, the next-generation reactors are targeted for a deployment date of 2030.

It is planned that DOE will fund preliminary designs for 3-5 systems before selecting a preferred technology. Private industry involvement will be sought with a goal to build and operate a prototype reactor as the means to obtain NRC design approval to allow commercial sales. This next-generation reactor would be suitable for deployment in developing countries with little or no infrastructure, a significant marker potential and key to reaping GNEP's strategic benefits of national, economic and environmental security.

In FY 2009, the Department will:

- Award a competitively bid public-private partnership to cooperatively fund a safety evaluation by the NRC of a small nuclear reactor (< 500 MWe). This funding will continue through FY 2013 with the goal of achieving a NRC Final Design Approval by 2016.
- Begin nuclear infrastructure assessment and assistance to developing countries to help them prepare to introduce nuclear energy and ensure it is accomplished to the highest levels of safety and safeguards. Two assessments and at least one assist visit are planned in developing countries using a team of national laboratory employees with experience in the International Nuclear Safety Program.
- Develop innovative next-generation systems suitable for deployment in developing countries with no nuclear experience will be done through competitive process beginning in FY 2009. Crosscutting technology development activities specific to small reactors (e.g. instrumentation and control, advanced manufacturing, physical protection and safeguards) will also be funded in support of the near-term and next-generation concepts.

Systems Analysis/Advanced Computing and Simulation **18,877** **0** **73,000**

Systems Analysis/Advanced Computing and Simulation includes Systems Analysis and Integration and Advanced Computing and Simulation.

- **Systems Analysis and Integration** **14,977** **0** **18,000**

  The Systems Analysis and Integration activity examines the possible combinations of nuclear technologies to optimize the technical, economic, and environmental aspects of the fuel cycle as a whole, from mining to waste disposal. This includes an administrative function centered at INL to manage the integration process so that all technical activities of AFCI are coordinated and Integrated. Systems Analysis develops and applies evaluation tools to formulate, assess, and guide program activities to evaluate various combinations of reactor types, reprocessing techniques, and waste disposal systems to meet program goals and objectives.

  In addition to optimization, Systems Analysis and Integration is also focused on the evaluation and down-selection of the most promising spent fuel treatment technologies, fuels technologies, reactors, and advanced fuel cycle deployment strategies acquired from AFCI and Generation IV R&D activities. Proliferation resistance analyses conducted by the NNSA and efforts conducted under the Safeguards Technology campaign are factored in as a high-priority, ongoing activity, especially in the area of advanced separations technologies.

  Additionally, Systems Analysis and Integration investigates optimal systems architecture to reduce the burden on potential future geologic repositories by removing the uranium and major heat-generating components of SNF, and optimizing the destruction of actinides to reduce the time it takes for the radiotoxicity of the waste to decay to levels comparable to the

radiotoxicity of uranium ore. A systematic analysis of fuel cycle performance is performed for promising options, the results of which assist the Department in effectively prioritizing program R&D and establishing requirements for proposed projects. In a related activity, Systems Analysis and Integration produces the annual "AFCI Comparison Report" for Congress, which compares various separations, fuels and reactor technologies being researched by the AFCI and Generation IV programs against the goals and objectives of those programs.

Systems Analysis and Integration also includes cost analysis activities and establishing consistent cost bases for use in evaluating the advanced fuel cycle technologies. To this end, the "Advanced Fuel Cycle Cost Basis Report" provides a comprehensive set of cost data for use in evaluating various AFCI and Generation IV technology deployment options. The report and its associated modeling efforts are intended to aid the evaluation of those elements that dominate nuclear fuel cycle costs, and help develop more efficient and less costly fuel cycle systems.

In FY 2007, the Department:

- Focused on the development of information to support a Secretarial recommendation to Congress by January 2010 on the need for second repository, and the development of key technical and economic information to support the Secretary's decision in 2008 on the GNEP path forward. Analyses comparing direct disposal of spent fuel with disposal after the fuel has been recycled and actinides have been consumed in advanced recycling reactors were conducted and continue in FY 2008.
- Developed an integrated, systems-level model analyzed all elements of the fuel cycle including economics, safety and environmental issues, proliferation issues, and sustainability. The functionality of this systems-level model will be enhanced each year. Applications of this model included an initial deployment analysis for a potential recycling system.
- Updated the "Advanced Fuel Cycle Cost Basis Report" and the business studies of the accelerated recycling program to obtain inputs from industry, investment communities, and academic communities on implementation of a large scale advanced fuel cycle complex in the U.S. and across the globe. These activities will support the development of a technology roadmap, a business plan containing cost projections and comparisons to other fuel cycle alternatives, and a plan outlining a schedule, waste streams, milestones, and performance metrics.
- Established a GNEP Technical Integration Office (TIO) at the INL staffed with participants from both INL and other laboratories. The TIO assists the program by providing a technical integration and systems engineering support function between proposed facility projects and between the projects and research and technology development areas. It assists the Department with execution by ensuring consistency in approach to project controls, and also is responsible for conducting technical activities in support of top-level, cross-cutting work activities. The TIO is fully staffed and operational. An integrated waste management strategy is under development. Updates to the Comparison Report to Congress and A Systems Analysis Report to Congress were

submitted. In addition, deployment systems analyses were conducted for a variety of deployment system alternatives and supporting technology development. These analyses provide planning support for GNEP implementation.

- Expanded effort Systems Analysis/Advanced Computing and Simulation to focus on the high priority of developing advanced simulation codes for fast reactor design and fuel performance.

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, the Department will:

- Focus primarily on activities to support an effective and rapid implementation of the Secretary's 2008 decision concerning GNEP. This is anticipated to include necessary technical and systems integration of the advanced fuel cycle R&D with the advanced burner reactor, the recycling program, and the advanced fuel cycle facility.
- Focus on assessing the details of GNEP implementation, technical options and issue analysis, and overall optimization.
- Implement a technical risk mitigation plan for the program to promote success, and work to address key remaining technical decisions and interface requirements.

- **Advanced Computing and Simulation 3,900 0 55,000**

DOE leads the world in the development and application of high performance computing and science based computational simulation. Maintaining and applying this capability is a priority of the American Competitiveness Initiative. The goal of the Advanced Computing and Modeling and Simulation program element is to develop and apply capabilities developed in the Office of Science's Advanced Simulation and Computing Research (ASCR) program and NNSA's Advanced Simulation and Computing (ASC) program to advance the state of the art in nuclear energy applications thereby using the power of massively parallel science based computing to improve the safety, performance and economics of nuclear reactors and potential fuel recycling and waste disposition systems.

This effort is being planned and executed in collaboration with NNSA, and the ASCR, Basic Energy Sciences and Nuclear Physics programs in the Office of Science to build on the capabilities and expertise developed through the multi-billion dollar investment in those programs in recent years. This activity will be executed through the DOE national laboratory system in collaboration with domestic industry and with foreign partners. It will engage our leading research universities in the development of models and methods as well as provide training of students in fields relevant to the nuclear enterprise. These activities will leverage computational and experimental assets, resources, capabilities and experience throughout DOE to avoid duplication and to reduce development times.

This effort began in mid- FY 2007 and was focused on the high priority of developing advanced

simulation codes for fast reactor design and fuel performance. These efforts will continue into FY 2008 under the Fuel Cycle Research and Facilities.

In FY 2009, the Department will significantly expand the Modeling and Simulation (M&S) activities and broaden the scope of problems for which simulation tools are being developed. The principal focus is to put together the "code teams" that will develop the advanced applications codes for each of the areas of interest. The experience of the ASC program and the ASCR shows that each code team requires support at the level of $5M to over $30M per year depending upon the complexity of the application being developed. Fully integrated reactor codes that combine neutronics, structural mechanics and thermo-hydraulics into one code with high resolution in 3-dimensions will be similar to the most complex challenges facing the ASC code and over time the program will pursue multiple approaches to the problem, to reduce risk, and to ensure that physics models are developed that are optimized for each of the principle classes of problems to be solved. Such codes currently do not exist, but the benefit in terms of reactor cost and safety performance will be enormous, and even a 5% resulting savings in the cost of construction of future reactors would repay investments many times over.

Likewise, current experience shows that the qualification of a new fuel type can take 20 years and cost over $200M because of the cycle required for in-core irradiation testing. The application of science–based, massively parallel codes may substantially reduce both the cost and time required, while providing a much more optimized fuel design to be submitted for final certification testing. Such developments will be essential to making the development of transmutation fuels for recycling reactors feasible.

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, the Department will:

- Expand code team efforts to develop a fast reactor design code to couple thermal-hydraulics, neutronics and structural mechanics with 3-dimmensional capabilities.
- Improve the fidelity of thermo-mechanical codes used for fuel modeling and improving the models of multi-component materials used in reactor fuels.
- Develop methods to model the performance of advanced waste forms in adverse geological environments for very long-term storage and disposition.
- Initiate the development of simulation codes to model the SNF separations process allowing for improvement of the design of a recycling facility.

Transmutation Education	**24,185**	**0**	**1,000**

Transmutation education supports the development of new U.S. scientists and engineers needed to develop transmutation and advanced nuclear energy technologies through university fellowships and applied research. Transmutation Education activities include the successful university fellowship program, which is developing new U.S. scientists and engineers for the fields of transmutation and advanced nuclear fuel cycle technologies.

(dollars in thousands)

FY 2007	FY 2008	FY 2009

In FY 2007, the Department:

- Awarded eight fellowships as a continuation of the AFCI fellowship program.
- Funded additional university research activities including those by University of Nevada – Las Vegas (UNLV), University of Nevada – Reno (UNR), and the Idaho Accelerator Center (IAC). UNLV conducted student research on GNEP relevant subjects, including a new radiochemistry doctoral program. UNR studied GNEP transportation and materials issues, while the IAC was actively involved in safeguards research and development.
- Awarded NERI grants competitively to universities of a university consortium for GNEP related research.

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, the Department will:

- Continue only the AFCI Fellowship program under this category, including expansion with the addition of a PhD. Fellowship.
- Perform additional university research activities within the various AFCI/GNEP research and development activities.

Advanced Fuel Cycle Facility **9,000** **0** **10,383**

The AFCF will be a first-of-a-kind, world-class nuclear fuel cycle research, development, and demonstration facility. It will have engineering-scale capabilities that will be used to develop and demonstrate advanced proliferation-resistant fuel recycling technologies. The AFCF will demonstrate these technologies as part of integrating the non-reactor portion of the nuclear fuel cycle, an important element to the cost-effective commercialization of these technologies. Fuel cycle operations will include: remote fabrication of various transmutation fuels and targets; advanced aqueous and electrochemical separations; and advanced waste forms. AFCF will also provide a test bed capability for advanced nuclear material accounting and control systems, one of the primary technologies for significantly reducing nuclear weapon proliferation risks. Many of the technologies developed by AFCI/GNEP on the laboratory scale are expected to be demonstrated at a larger scale by the AFCF.

In the long term, the AFCF is required for the U.S. to regain a leadership role in the nuclear fuel cycle. This is essential if the U.S. is to influence and promote the non-proliferation goals of GNEP. Moreover, the AFCF is needed to continually improve the performance and cost-effectiveness of an integrated fuel cycle and help the U.S. maintain competitiveness in the global nuclear market. While upgrades to existing DOE facilities can support this role to a limited degree over the next 10 to 20 years, this facility can accelerate the evolutionary, as well as revolutionary, improvement to nuclear the commercial applications of advancement of fuel recycling technologies. This facility will continue to depend on a robust laboratory-scale R&D program by talented researchers from around the DOE complex in order to feed viable candidate technologies for demonstration prior to commercial applications.

(dollars in thousands)

FY 2007	FY 2008	FY 2009

A phased construction plan for AFCF is envisioned. During the first phase, those facilities that support separations of LWR SNF into its reusable and waste components will be built, as well as those for fuel fabrication and waste processing. It is important that these technologies be successfully demonstrated on an engineering scale for ultimate commercial deployment and waste volume reduction. Phase I will also include the remote manufacture of lead test assemblies. These are experimental fast reactor fuels—fabricated from the separated products of used commercial LWR fuel—and will be placed inside a fast reactor for qualification and validation. This is a necessary step for the development of viable commercial fast reactor fuels for advanced recycling reactors that will get the maximum energy value from the fuel while simultaneously reducing waste and proliferation risks. This capability will be needed to continually improve the commercial application of GNEP technology introduced by the CFTC and evolutionary improvements over the coming decades.

The second phase of construction will focus on building those facilities required for the separations and recycling of used fast reactor fuel, most notably that coming from an advanced recycling reactor. The composition of this fuel will differ from the used LWR fuel that was recycled in the first phase and may require different treatment technologies. The fast reactor fuels may be in metallic form (although other forms are currently being evaluated). If such is the case, an electrochemical approach to fuels separation may be required, and would be developed in the AFCF. If the optimal fuel forms are not metallic, then other recycling approaches must be considered, including that used for LWR fuel.

The facility is being sized to cover the range of research, development and demonstration activities envisioned by GNEP over the next 50 years. The Aqueous Separations Module, for example, is being evaluated for processing LWR used fuel at a throughput rate of 10 to 75 metric tons per year and is being sized for a suite of promising advanced separations processes.

In the near term, the AFCF will focus on demonstrating fabrication of transmutation fuels and targets at a scale necessary prior to commercialization. When built and operational, it will be the only facility in the world capable of providing this capability. Because of this unique capability, the AFCF will be a user facility through which many working partnerships will be established. These partnerships will include participants from all DOE laboratories (a robust scientist exchange program is anticipated), industry, universities, foreign governments and labs, and regulatory agencies (for independent analyses).

In FY 2007, the Department:

- Continued work on the AFCF and 30 percent of the conceptual design was completed. Key elements of this design are the four key technology areas of AFCF: remote transmutation fuel/target fabrication, advanced aqueous separations, electrochemical processing, and advanced waste forms. The FY 2007 AFCF design work was instrumental in identifying near term technology development requirements associated with each of the advanced technology areas.

- Established a quality assurance program and produced over three hundred flow sheets, drawings, and engineering works that supported an initial facility hazards analysis and design trades studies.
- Highlighted the need to integrate the existing DOE laboratory capabilities—and potential upgrades or expansion of existing facilities--with the future increased capabilities of AFCF. While DOE will benefit from the upgrade of existing laboratory facilities, the increased throughput and system integration provided by a new, appropriately-sized engineering-scale AFCF can support the efficient demonstration of multiple advanced GNEP technologies over the coming decades, such as remotely fabricated uranium-transuranic transmutation fuel/targets, and support commercial deployment with acceptable risks and without multiple "single purpose" pilot demonstration facilities.

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, the Department will:

- Continue conceptual design work on the AFCF. This work advances the design of modules such as those used for advanced aqueous and electrochemical separations, advanced waste forms development, as well as the balance of plant. The conceptual design could be up to 60 percent complete at the end of the fiscal year.

Consolidated Fuel Treatment Center **8,000** **0** **18,000**

The CFTC, previously called the Recycling Demonstration Program, will provide the critical steps and support necessary to recycle used nuclear fuel in the U.S. on a scale of commercial significance. The recycling program carried out at the CFTC aims to recover additional energy value from used nuclear fuel by recycling re-useable materials and to reduce the volume and toxicity of waste slated for disposal in a geologic repository. Ultimately the CFTC will include four sub-projects to improve the overall efficiency of the fuel cycle: LWR spent fuel separations facility, transmutation fuel fabrication facility, transmutation fuel separation facility, and advanced recycling reactor startup fuel fabrication facility.

This capability will support a sustained nuclear renaissance by providing domestic and international fuel services and improved waste and product management. Recycled products could be reused in existing LWR and eventually in new advanced recycling reactors that consume the longest-lived and most radiotoxic isotopes. The use of advanced recycling reactors will reduce the amount and hazards of the remaining high-level waste requiring disposal in a geologic repository and result in new waste forms and management approaches more commensurate with their reduced hazards. Approaches considered by AFCI/GNEP in the recycling of used nuclear fuel will employ proliferation-resistant technologies to support GNEP objectives. The program will engage with industry partners to establish spent fuel separations capability as a cornerstone for U.S. nuclear energy leadership.

In FY 2007, the Department:

- Initiated the competitive industrial engagement necessary to start design activities on

engineering- and commercial-scale nuclear fuel recycling center concepts that will meet GNEP proliferation-resistance, waste management, and product management objectives. This initial industry competition focused specifically in areas that support an informed 2008 Secretarial decision through cooperative agreements with several industry teams. A May 2007 Funding Opportunity Announcement offered industry the opportunity to propose work to initiate conceptual designs, develop business models, prepare technology roadmaps, and submit communications plans for a nuclear fuel recycling center based on their experience. Four industry teams were selected and cooperative agreements negotiated. Selection of industry teams was based upon the expectation of public-private cost sharing. These industry engagement efforts will also explore the possibility of private financing and may identify additional technical and programmatic opportunities that improve the GNEP business model. Based on the level of industry interest expressed to date, the Department is confident that industry involvement in engineering- or commercial-scale application of spent fuel chemical separations technology will result in a viable deployment approach for GNEP.

- Performed engineering alternative studies (EAS) were also performed in FY 2007, including one of a commercial scale SNF recycling facility that examined the environmental impacts, cost and schedule of building a nuclear fuel recycling center and identified areas of process improvement and risk mitigation. Follow-on EAS investigated opportunities to refine requirements and reduce costs for the used nuclear fuel recycling facility. In addition, several data input reports were issued to support the development of the GNEP Programmatic Environmental Impact Statement.

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, the Department will:

- Assume that the Secretary of Energy will decide to pursue nuclear fuel recycling at some level.
- Continue involvement of industry in leading the development and implementation of a program for recycling used nuclear fuel.
- Support the continued industry development of concepts for one or more technology solutions, such as an aqueous process and an electro-chemical process, to achieve the separation and recycling of used nuclear fuel. The conceptual design activity encompasses activities such as system descriptions, flowsheets, and material balances. The work products developed by industry through the cooperative agreements will also be used to modify the planning for the used nuclear fuel recycling center as needed to achieve a flexible approach that promotes an industry led effort that achieves the waste reduction, energy recycling, and non-proliferation goals of GNEP.
- Continue to evaluate design alternatives from engineering alternative studies, based on the concepts provided by industry, in areas where uncertainties exist in the areas of technical maturity and cost analysis. Efforts beyond the DOE cooperative agreements with industry will rely substantially upon industry investment to further develop conceptual designs. The DOE GNEP research and development efforts on CFTC technology described in the above sections will support the industry-led conceptual design activities in FY 2009.

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Advanced Burner Reactor	**8,750**	**0**	**18,000**

The ABR is a fast-spectrum reactor capable of consuming transuranics and other actinides in support of a closed nuclear fuel cycle. In addition to eliminating these materials from LWR SNF, reducing both heat and waste loads on a geologic repository; the ABR will produce electricity. Reducing the volume, heat-loading, and radiotoxicity of nuclear waste could exponentially increase the capacity of the geological repository at Yucca Mountain. The ability to transmute and destroy transuranics in the ABR is the principal long-term waste management benefit of GNEP.

Input from industry and international partners confirm the feasibility of deploying a prototype fast reactor in the 2020-2025 timeframe. With the shutdown of the FFTF and EBR-II in the 1990s, there are no fast spectrum reactors currently operating in the U.S.

The ABR project will be implemented through two closely integrated paths. An industry-led path will design and build a prototype reactor, which will demonstrate transmutation, qualify advanced reactor fuels and materials, demonstrate advanced design and safety features, and employ modern reactor safeguards. A complimentary path, led by the national laboratories, has two objectives. In the near-term, it will identify and deliver the most promising technologies for incorporation into the prototype ABR. In addition, the labs will conduct the long-term research and engineering to assure that subsequent commercial ABRs will be economically competitive with modern light water reactors. The Department will collaborate with international and industry partners on both paths.

In FY 2007, the Department:

- Awarded cooperative agreements to multiple industry consortia to develop the cost, scope and schedule for conceptual design studies for an initial fast spectrum reactor. The design, cost and schedule information developed will help to determine the optimal technical parameters for the reactor prototype (size, power level, conversion ratio, etc.).

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, the Department will:

- Select the most promising reactor technology(s) to proceed with conceptual design.
- Continue to work closely with the NRC to facilitate the development of an appropriate regulatory framework and compliance strategy for advanced fast-spectrum reactors.
- Focus on international collaboration on fast-spectrum reactor development.
- Collaborate with the Japan Atomic Energy Agency (JAEA) and the French Atomic Energy Commission (Commissariat à l'énergie atomique) (CEA) on the harmonization of sodium fast reactor prototypes and shared infrastructure development and utilization in accordance with a Memorandum of Understanding established in FY 2008. A more formal agreement is planned for FY 2009 to collaborate on a U.S. based prototype reactor.
- Continue to facilitate future deployment of advanced reactors through supporting policy, incentives, regulations and proposed legislation.

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009

GNEP Technology Development **17,930** **0** **0**

The GNEP Technology Development activity provides support to each of the three GNEP projects (the engineering- to commercial-scale demonstration nuclear fuel recycling center, advanced recycling reactor, and AFCF), driven by the development and design needs of each project.

The technology development activities described below are fully integrated with the design and construction schedules for each of these projects.

In FY 2007, the Department:

- Established initial technology development needs based on initial engineering alternatives and design concepts considered by each project. This included assessments of the technical maturity level for each of the major technology area (e.g., SFR main systems and components for the ABR) and gap analyses developed to determine priority development and supporting infrastructure needs.
- Developed engineering alternatives, and design concepts for use as a benchmark in evaluating industry input for the CFTC and ABR project technology development needs.

In FY 2008, funding and accomplishments are included in the Fuel Cycle Research and Facilities program.

In FY 2009, funding associated with key Technology Development efforts are directly within the components of the research and development program.

GNEP Global partnership Development **0** **0** **4,500**

Global partnership development is required to accomplish the international goals embodied within GNEP. Those goals include developing advanced technologies for recycling SNF for deployment in facilities that do not separate pure plutonium, with a long term goal of ceasing separation of plutonium and eventually eliminating stocks of separated civilian plutonium; take advantage of the best available fuel cycle approaches for utilization of energy resources; develop and deploy, advanced fast reactors that consume transuranic elements from recycled spent fuel; establish international supply frameworks to enhance reliable, cost-effective fuel services and supplies to the world market; promote development of advanced, more proliferation resistant nuclear power reactors appropriate for the power grids of developing countries and regions; in cooperation with the International Atomic Energy Agency (IAEA), continue to develop enhanced nuclear safeguards to effectively and efficiently monitor nuclear materials and facilities, to ensure nuclear energy systems are used only for peaceful purposes.

GNEP international engagement has been exceptionally well received around the world. The five fuel cycle nations (France, Japan, Russia, China, and the United States) and fourteen other nations have all signed the "GNEP Statement of Principles," the goal of which is "the expansion of nuclear energy in a safe and secure manner that supports clean development without air pollution or greenhouse gases, while reducing the risk of nuclear proliferation."

(dollars in thousands)

FY 2007	FY 2008	FY 2009

In support of the Statement of Principles, the United States has signed "Civil Nuclear Energy Bilateral Action Plans" with France, Japan, Russia, and China. These Action Plans outline GNEP cooperative R&D on advanced reactors, exportable small and medium power reactors, nuclear fuel cycle technologies, and non-proliferation, with the focus on achieving the long-term GNEP vision – expansion of nuclear power in a manner, which reduces the risk of proliferation. The most significant agreed upon areas of cooperation are: the development of technologies for recycling SNF that do not separate pure plutonium, and establishment of a framework for "Reliable Fuel Services" which eliminate the need for countries to establish their own enrichment and reprocessing capability.

The second phase of GNEP international engagement was introduced at the 2nd GNEP Ministerial meeting, hosted by Secretary of Energy Bodman, and the Ministers from France, Japan, Russia and China, on September 16, 2007, in Vienna, Austria. Thirty-six countries were invited to become GNEP partners, and to date, nineteen nations have signed the "Statement of Principles." A GNEP steering Group of Partner Nations was established to manage GNEP working groups on nuclear infrastructure and reliable nuclear fuel services. The Steering Group held its first meeting December 11-13, 2007 in Vienna, Austria and the United States was elected to chair the Steering Group with vice-chairs from France, Japan, and China.

In FY 2009, the Department will:

- Support international engagement on GNEP principles.

Fast Neutron Test Capability **4,000** **0** **10,000**

The purpose for developing a fast-neutron test capability is to be able to perform the irradiation testing of advanced fuels and materials under prototypical fast reactor conditions. Currently, the U.S. has no capability of this kind and must therefore rely on the use of foreign reactors. Such reliance will limit the pace at which we will be able to develop the necessary fuels, targets, and materials because of limited irradiation space and time available in the reactor facilities. This activity includes the design, fabrication, and installation of a fast-neutron source at an existing DOE accelerator facility or nuclear reactor. This project is being managed as the acquisition of a major item of equipment.

As directed by Congress, funding was provided in prior years to the AFCI program to determine which test capabilities are needed and to complete pre-conceptual and conceptual design. The options considered include building this capability at the Los Alamos Neutron Science Center at Los Alamos National Laboratory, modifying the ATR at INL, and using the High Flux Isotope Reactor at Oak Ridge National Laboratory. Mission Need is planned in FY 2008 using carryover funds, to pursue identification of options. An Alternative Selection and Cost Range will be requested by the first quarter of FY 2009.

In FY 2009, the Department will:

- Select facility alternatives and establish the cost range.
- Begin preliminary site preparation, design activities, and procurement of long-lead items.

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
SBIR/STTR	**0**	**0**	**1,000**
The FY 2009 amount shown is an estimate of the requirement for the continuation of the SBIR and STTR program.			
Total, Advanced Fuel Cycle Initiative	**166,092**	**0**	**301,500**

Explanation of Changes

	FY 2009 vs. FY 2008 ($000)
Separations Research and Development	
The increase from $0 to $59,217,000 provides appropriate advanced R&D activities to support qualification of the flowsheet to be utilized in GNEP processing through the conduct of multiple end-to-end tests using actual LWR spent fuel and the shift from technology efforts.	+59,217
Advanced Fuels Research, Development, and Testing	
The increase from $0 to $53,000,000 for expanded fuels research and the shift from technology efforts.	+53,000
Transmutation Research and Development	
The increase from $0 to $53,400,000 incorporates longer-term activities for the advanced recycling reactor such as nuclear physics data, advanced materials research and advanced integrated or compact components and incorporates grid appropriate reactor research and the shift from technology efforts.	+53,400
Systems Analysis/Advanced Computing and Simulation	
The increase from $0 to $73,000,000 results from expansion of the Advanced Computing and Modeling and Simulation program element to use the power of massively parallel science based on computing to improve the safety, performance and economics of nuclear reactors.	+73,000
Transmutation Education	
The increase from $0 to $1,000,000 reflects a new approach under which universities faculty and students are directly involved in GNEP projects through a competitive solicitation process and funding coming directly from AFCI research and development programs.	+1,000

	FY 2009 vs. FY 2008 ($000)
Advanced Fuel Cycle Facility	
The increase from $0 to $10,383,000 represents additional conceptual design activities in support of the 2008 Secretarial decision on the GNEP path forward.	+10,383
Consolidated Fuel Treatment Center	
The increase from $0 to $18,000,000 reflects continuation of the industry led deployment studies that helped to inform the Secretary's decision on the GNEP path forward and to facilitate the legal, regulatory, and policy changes needed to achieve a flexible approach that promotes an industry led effort that achieves the waste reduction, energy recycling, and non-proliferation goals of GNEP.	+18,000
Advanced Burner Reactor	
The increase from $0 to $18,000,000 reflects continuation of the industry led deployment studies that helped to inform the Secretary's decision on the GNEP path forward and an increase in the international collaboration on SFR prototypes.	+18,000
GNEP Global Partnership Development	
The increase from $0 to $4,500,000 is necessary to implement work with other nations to implement the global aspects of GNEP.	+$4,500
Fast Neutron Test Capability	
The increase from $0 to $10,000,000 provides the funds necessary to continue development of a fast neutron test source.	+10,000
SBIR/STTR	
The increase from $0 to $1,000 provides an overall increase in AFCI R&D funding.	+1,000
Total Funding Change, Advanced Fuel Cycle Initiative	**+301,500**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

Major Items of Equipment

(dollars in thousands)

	Total Project Cost (TPC)	Total Estimated Cost (TEC)	Prior-Year Appro-priation	FY 2007	FY 2008	FY 2009	Completion Date
Fast Neutron Test Capability	50-95M	84,000	0	4,000	0	10,000	FY 2013
Total, Major Items of Equipment				4,000	0	10,000	

Fuel Cycle Research and Facilities

Funding Profile by Subprogram

(dollars in thousands)

	FY 2007 Current Appropriation	FY 2008 Original Appropriation	FY 2008 Adjustments	FY 2008 Current Appropriation	FY 2009 Request
Fuel Cycle Research and Facilities					
Advanced Fuel Cycle Initiative	0	181,000	-1,647	179,353	0
MOX Fuel Fabrication Facility	0	281,349	-2,560	278,789	0
Total, Fuel Cycle Research and Facilities	0	462,349	-4,207	458,142	0[a]

Public Law Authorizations:
P.L. 110-5, Revised Continuing Appropriations Resolution, 2007
P.L. 110-161, The Consolidated Appropriations Act, 2008

Mission

The mission of the Fuel Cycle Research and Facilities program is to develop fuel cycle technologies that will support the economic and sustained production of nuclear energy and produce fuel for nuclear reactors from spent nuclear fuel and surplus weapon-grade plutonium.

The Advanced Fuel Cycle Initiative (AFCI) is focused on implementing the Global Nuclear Energy Partnership (GNEP), which is our nation's comprehensive initiative that supports the safe, secure expansion of nuclear power both internationally and domestically. Internationally, GNEP is working to establish a framework to ensure that nuclear power expansion can be achieved appropriately with reduced risk of nuclear weapons proliferation. Domestically, GNEP is developing the advanced technologies and facilities needed to change the nuclear fuel cycle to one in which spent nuclear fuel (SNF) is recycled. Once deployed, this new approach will allow the United States (U.S.) to separate SNF into waste and usable components, allowing reactors to extract additional energy, and providing options for more effective management of the residual waste. AFCI is developing these new technologies so that they may be deployed as part of the nuclear fuel cycle to support operation of current nuclear power plants, Generation III+ advanced light water reactors (LWR), and Gen IV advanced reactors.

The Mixed Oxide (MOX) Fuel Fabrication Facility (MFFF) program will dispose of surplus weapon-grade plutonium by fabricating it into fuel for use in nuclear reactors. Once irradiated, the plutonium is no longer readily useable for nuclear weapons. The disposal of the material will meet the U.S. commitments made in the Plutonium Management and Disposition Agreement with Russia. NE will fund the design, construction and operation of a MFFF. The MFFF will be built at the Department's Savannah River Site (SRS) near Aiken, South Carolina. In August 2007, the National Nuclear Security Administration initiated construction of the facility.

[a] Beginning in FY 2009, funding for the Advanced Fuel Cycle Initiative is requested within the Nuclear Energy Research and Development and the Mixed Oxide Fuel Fabrication Facility is requested within the Other Defense Activities appropriation.

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for energy security, nuclear security, scientific discovery, environmental responsibility and management excellence), plus 16 Strategic Goals that tie to the Strategic Themes. The Fuel Cycle Research and Facilities program supports the following goals:

Strategic Theme 1, Energy Security: Promoting America's energy security through reliable, clean, and affordable energy

Strategic Goal 1.2, Environmental Impacts of Energy: Improve the quality of the environment by reducing greenhouse gas emissions and environmental impacts to land, water, and air from energy production and use.

Strategic Theme 2, Nuclear Security: Ensuring America's nuclear security

Strategic Goal 2.2, Weapons of Mass Destruction: Prevent the acquisition of nuclear and radiological materials for use in weapons of mass destruction and other acts of terrorism.

The Fuel Cycle Research and Facilities program has two GPRA Unit Program goals which contribute to Strategic Goals 1.2 and 2.2 in the "goal cascade":

GPRA Unit Program Goal 1.2.14.00: Develop New Nuclear Generation Technologies - By 2015, enable industry to construct and operate new nuclear power plants, promoting safe, reliable and carbon-free energy production, through the standardization of Generation III+ plant designs, the successful demonstration of nuclear plant permitting and licensing processes, the advancement of Gen IV plant technologies, the construction of pilot-scale hydrogen production experiments, and the commencement of proliferation-resistant spent nuclear fuel (SNF) recycling technology demonstration activities.

GPRA Unit Program Goal 2.2.43.00: Fissile Materials Disposition – Eliminate surplus Russian plutonium and surplus U.S. plutonium.

Contribution to GPRA Unit Program Goal 1.2.14.00 (Develop New Nuclear Generation Technologies)

The AFCI supports near-term technology development and demonstration activities that advance the goals of the National Energy Policy and Energy Policy Act of 2005 by developing the enabling technologies needed to reduce high level waste volume and separate and transmute long-lived, highly radiotoxic elements. These activities directly support the vision and goals of GNEP. In addition to advanced fuel cycle R&D activities, the program will develop an Advanced Burner Reactor, which will be a prototype for future commercial plants and incorporate advanced design features to improve performance, reduce cost and improve safeguards. A nuclear fuel recycling center will employ state-of-the-art technologies to provide proliferation-resistant LWR separations capability. Finally, AFCF will provide technology development capability to support fast reactor design and development of transmutation fuel and/or transmutation targets.

Contribution to GPRA Unit Program Goal 2.2.43.00 (Fissile Materials Disposition)

The MFFF program (Program Goal 2.2.43) contributes to Strategic Goal 2.2 by converting surplus U.S. weapon-grade plutonium into fuel for commercial LWRs. After irradiation, the plutonium would no longer be directly usable.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Strategic Goal 1.2, Environmental Impacts of Energy			
GPRA Unit Program Goal 1.2.14.00, Develop New Nuclear Generation Technologies			
Advanced Fuel Cycle Initiative	0	179,353	0
Total, GPRA Unit Program Goal 1.2.14.00, Develop New Nuclear Generation Technologies	0	179,353	0
Strategic Goal 2.2, Weapons of Mass Destruction			
GPRA Unit Program Goal 2.2.43.00, Fissile Materials Disposition			
MOX Fuel Fabrication Facility	0	278,789	0
Total, GPRA Unit Program Goal 2.2.43.00, Fissile Materials Disposition	0	278,789	0
Total, Strategic Goals 1.2 and 2.2 (Fuel Cycle Research and Facilities)	0	458,142	0

Annual Performance Results and Target

FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008 Targets	FY 2009 Targets
GPRA Unit Program Goal 1.2.14.00 (Develop New Nuclear Generation Technologies)					
Advanced Fuel Cycle Initiative					
Complete fabrication and irradiation of advanced light water reactor (LWR) proliferation-resistant transmutation fuel samples, and initiate post-irradiation examination of the samples. (MET TARGET)	Issue preliminary report on the post-irradiation examination (PIE) of actinide-bearing metal and nitride transmutation fuels in the Advanced Test Reactor (ATR). (MET TARGET)	Complete research and development activities that allow the AFCI program to support the Secretary of Energy's determination of the need for a second geologic repository for spent nuclear fuel (SNF) by FY 2008. (MET TARGET)	Complete research and development activities, focused on advanced fuel separations technology development and demonstration, to support the Secretary of Energy's determination of the need for a second geologic repository for SNF by FY 2008. (MET TARGET)	Determine a path forward for GNEP in 2008 by creating a technology development document on recycling technology options, including their readiness and risks, the state of technology development achieved to date, future research and development, and economic evaluations needed to achieve the GNEP vision	
Achieve variance of less than 10 percent from cost and schedule baselines for AFCI activities. (MET TARGET)	Conduct laboratory-scale test of group actinide separation process (plutonium, neptunium, americium and curium extracted together) with actual LWR spent fuel and report preliminary results. (MET TARGET)			Determine a path forward for GNEP in 2008 by completing trade-off studies of new versus existing facilities for an Advanced Fuel Cycle Facility, including economic evaluations.	
Issue the report on the demonstration of a laboratory-scale separation of americium/curium from SNF to support the development of advanced fuel cycles for enhanced repository performance. (MET TARGET)				Determine a path forward for GNEP in 2008 by completing initial industry design studies for the Advanced Burner Reactor, including an evaluation of the development costs for the various prototype options.	
				Determine a path forward for GNEP in 2008 by completing technical and economic evaluations of four industry-led conceptual design studies for a nuclear fuel recycling center.	

FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008 Targets	FY 2009 Targets
GPRA Unit Program Goal 2.2.43 (Fissile Materials Disposition)					
Mixed Oxide (MOX) Fuel Fabrication Facility					
	Cumulative percentage of the design, construction, and cold start-up activities completed for the MOX Fuel Fabrication Facility (MFFF) (Long-term Output) R:13% T: 13%	Cumulative percentage of the design, construction, and cold start-up activities completed for the MFFF (Long-term Output) R: 17% T: 17%	Cumulative percentage of the design, construction, and cold start-up activities completed for the MFFF (Long-term Output) R:24 % T: 24%	Cumulative percentage of the design, construction, and cold start-up activities completed for the MFFF (Long-term Output) T: 30%	

Means and Strategies

The Fuel Cycle Research and Facilities program will use various means and strategies to achieve its GPRA Unit Program goals. However, various external factors may impact the ability to achieve these goals. The program also performs collaborative activities to help meet its goals.

The Department will implement the following means:

- AFCI will collaborate with industry to: 1) define the most commercially viable designs and business models under which advanced fuel cycle technologies could be deployed, 2) provide industry representation on appropriate expert review panels and 3) ultimately construct AFCI/GNEP facilities.

- NE will maintain contracts with industry to construct, license, and operate the MFFF and contracts with a nuclear utility to use the fuel.

- NE will follow the established principles and procedures of DOE O 413.3, "Program and Project Management for the Acquisition of Capital Assets" for both AFCI and MFFF activities.

The Department will implement the following strategies:

- Partnering with the private sector, national laboratories, universities, and international partners to develop and deploy advanced nuclear technologies to increase the use of nuclear energy in the U.S.

- Leading the international community in pursuit of advanced nuclear technology that will benefit the U.S. with enhanced safety, improved economics, and reduced production of wastes.

- Conducting international cost-shared R&D in the AFCI/GNEP program.

- Constructing a U.S. MFFF at the Savannah River Site in which to fabricate fuel from surplus U.S. weapon-grade plutonium for use in nuclear reactors.

- Irradiation of the fuel fabricated from the U.S. weapon-grade plutonium after which it will not be readily useable in a nuclear weapon.

- Initiate an external review of the MFFF construction baseline and revise the project plan as appropriate.

These strategies will result in the efficient and effective management of NE programs - thus putting the taxpayer's dollars to more productive use.

The following external factors could affect NE's ability to achieve its strategic goal:

- Deployment of advanced fuel cycle technologies will depend upon policy decisions that will determine the implementation of advanced spent fuel reprocessing technologies (e.g. the Secretary of Energy's 2008 decision on GNEP) as well as reducing risks and establishing an appropriate business case for private sector investment and commercial deployment.

- All nuclear energy research programs rely heavily on data produced through collaborations with foreign nations. Should vital data from foreign partners prove unavailable, an increased U.S. effort in technology development would be required.

U.S. policy could change and therefore affect the ability of NE to dispose of U.S. surplus weapon-grade plutonium or alter the mission of the program.

In carrying out the program's mission, NE performs the following collaborative activities:

- Participation in international experiments related to the development of advanced fuel cycle technologies is being performed in support of AFCI/GNEP objectives.

- NE will collaborate with other programs within the Department, such as the Office of Science, the Office of Civilian Radioactive Waste Management, and the National Nuclear Security Administration, all of whom have roles supporting AFCI/GNEP.

- NE will collaborate with National Nuclear Security Administration (NNSA), and their national laboratories, on the overall effort to destroy U.S. surplus weapon-grade plutonium. NNSA is responsible for two other key components of the effort: the Pit Disassembly and Conversion Facility and the Waste Solidification Building.

Validation and Verification

To validate and verify program performance, NE conducts various internal and external reviews and audits. NE's programmatic activities are subject to periodic review by Congress, the Government Accountability Office, the Department's Inspector General, the Nuclear Regulatory Commission (NRC), the U.S. Environmental Protection Agency, state environmental and health agencies, the Defense Nuclear Facilities Safety Board, and the Department's Office of Engineering and Construction Management. In addition, NE provides continual management and oversight of its R&D programs—the NP 2010 program, the Gen IV, NHI, and AFCI. Periodic internal and external program reviews evaluate progress against established plans. These reviews provide an opportunity to verify and validate performance. Monthly, quarterly, semi-annual and annual reviews, consistent with program management plans and project baselines, are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.

The Department obtains advice on the direction of nuclear energy programs from the independent Nuclear Energy Advisory Committee (NEAC). NEAC, a formal Federal advisory committee, provides expert advice on long-range plans, priorities, and strategies for the nuclear technology R&D and research infrastructure activities of NE. NEAC has several active subcommittees examining various aspects of nuclear technology R&D. Reports issued by these subcommittees that address the future of

nuclear energy include: the "Long-Term Nuclear Technology Research and Development Plan", the "Nuclear Science and Technology Infrastructure Roadmap", "A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010", "A Technology Roadmap for Generation IV Nuclear Energy Systems", "Report of the Subcommittee on Nuclear Laboratory Requirements", and "An Evaluation of the Proliferation Resistant Characteristics of Light Water Reactor Fuel with the Potential for Recycle in the United States".

In FY 2006, as a follow-up action assigned as part of this assessment, NE contracted with the National Academy of Sciences (NAS) to conduct an extensive, comprehensive, and independent evaluation of R&D and Infrastructure program goals and plans, including the process for establishing program priorities and oversight. The evaluation resulted in a detailed set of policy and research recommendations and associated priorities for an integrated agenda of research activities to support the long-term commercial energy option to provide diversity in energy supply. A pre-publication version of the report was issued in October 2007; the final report is scheduled for publication in January 2008. NE continues to review the report findings, and is working with OMB to develop a viable strategy for implementing the committee's recommendations.

In FY 2007, the General Accountability Office began a comprehensive audit of GNEP. Once released, the findings will help inform the AFCI/GNEP implementation strategy.

Program Assessment Rating Tool (PART)

The Department has implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. NE's R&D programs have incorporated feedback from OMB into the FY 2009 Budget Request, and have taken the necessary steps to continue to improve performance.

For AFCI, an overall PART score of 76 was achieved with top scores of 100 in Section I, Program Purpose & Design, and Section III, Program Management. These scores are attributable to the continued use of effective program management practices. A score of 90 was achieved for Section II, Strategic Planning reflecting the need to improve the linkage between budget and performance data at the Departmental level. A score of 53 was achieved for Section IV, Program Results/Accountability, indicating the need to better demonstrate the cost effectiveness of the program. To address these findings, the program revised its near and long-term goals, and is working to increase cost effectiveness by continuing to increase international cost-shared R&D costs through expanded collaborations.

In addition, the AFCI program was found to rely upon process oriented, output based metrics that did not indicate whether the program is successful or demonstrating meaningful progress. These programs revised their performance measures in FY 2006 to capture progress made on the programs' core elements. By focusing on a future outcome, the measure allows for trending of annual progress toward a consistent objective.

OMB gave the Fissile Materials Disposition program (which includes the MFFF) scores of 100 percent on the Program Purpose and Design, and Strategic Planning Sections; 88 percent on the Program Management Section; and 50 percent on the Program Results and Accountability Section. Overall, the OMB rated the FMD program 73 percent, the second highest rating of "Moderately Effective." The OMB assessment found that the program demonstrates proper planning and management, but performance results are limited and program cost and schedule performance is mixed. The OMB also found that the FMD program follows agency project management requirements. In response to the OMB findings, the FMD program is validating cost and schedule baseline to measure performance and maintain change control during construction, and completing certification of project control systems by the responsible federal agency to ensure accurate performance measurement

Advanced Fuel Cycle Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Advanced Fuel Cycle Initiative			
Separations Research and Development	0	37,773	0
Advanced Fuels Research, Development and Testing	0	35,304	0
Transmutation Research and Development	0	15,949	0
Systems Analysis/Advanced Computing and Simulation	0	40,124	0
Transmutation Education	0	4,000	0
Advanced Fuel Cycle Facility	0	4,000	0
Consolidated Fuel Treatment Center	0	13,000	0
Advanced Burner Reactor	0	11,710	0
GNEP Technology Development	0	16,100	0
SBIR/STTR	0	1,393	0
Total, Advanced Fuel Cycle Initiative	0[a]	179,353	0[b]

Description

The mission of the Advanced Fuel Cycle Initiative (AFCI) is to develop fuel cycle technologies that will support the economic and sustained production of nuclear energy while minimizing waste and satisfying requirements for a controlled, proliferation-resistant nuclear materials management system. Prior to FY 2008, the AFCI program was included in the Nuclear Energy Research and Development (NE R&D) program. In FY 2008, the AFCI program is included in the Fuel Cycle Research and Facilities as appropriated. Beginning in FY 2009, the AFCI program will be requested under the NE R&D budget.

Further discussion of the AFCI program is addressed in the AFCI portion of the NE R&D budget.

Detailed Justification

(dollars in thousands)

FY 2007	FY 2008	FY 2009
Separations Research and Development **0**	**37,773**	**0**

The goal of the Separations Research and Development (R&D) activity is to develop advanced aqueous and electrochemical separations technology alternatives capable of treating the existing and projected inventory of SNF and fast reactor recycle fuel in a safe, efficient and proliferation-resistant

[a] In FY 2007, the Advanced Fuel Cycle Initiative was included in the Nuclear Energy Research and Development program. In FY 2008, AFCI is included in the Fuel Cycle Research and Facilities program.

[b] Beginning in FY 2009, the Advanced Fuel Cycle Initiative program will be requested under the Nuclear Energy Research and Development program.

manner. The U.S., which developed essentially all separations technologies currently deployed in the world, has not been directly involved in civilian spent fuel processing since 1974. The central purpose of Separations Research and Development is to support that effort though R&D on processes that do not separate plutonium and providing technologies for industrial applications. Vigorous efforts will be required to achieve those aims. Information developed under this activity will be used to help inform a recommendation to the Secretary of Energy in 2008 on the future course of GNEP. The current suite of advanced aqueous processes has potential for meeting proliferation-resistant separations objectives, while improving the waste management associated with current aqueous separations technologies. However, electrochemical processing (referred to previously as pyroprocessing) may be better suited to address the requirements of sodium-bonded metallic fast reactor fuels. This R&D provides alternatives for important parts of the separations processes where a high or moderate risk is present. This task also supports long-term R&D for next-generation facilities. Data for modeling and simulation validation is developed under this activity.

This program will:

- Significantly reduce the volume and hazard of spent nuclear fuel that must be stored in a repository.
- Allow actinides in spent nuclear fuel to be used as a future fuel for either or both LWR and ABR in a safe and proliferation resistant manner.
- Provide a way that long lived actinides can be consumed so the ultimate waste products are less radiotoxic.
- Support GNEP in producing an energy source that has a very low emission of greenhouse gases.
- Develop and test advanced monitoring and accountability technologies that will strengthen nuclear nonproliferation.
- Improve simulation technologies that will reduce separations costs and improve reliability.
- Develop advanced waste forms.

Before separations can be adopted by industry on a commercial scale the technology must be proven to provide the needed separations in a cost-effective manner, while reducing proliferation problems associated with the PUREX process. Issues such as extracting strontium/cesium for separate decay storage; finding better processes for extracting americium and curium; developing equipment for materials accountability; and finding better waste forms for gaseous effluents including tritium, carbon-14 and iodine-129 are examples of where improvements are desirable. A long term R&D program will take on each of the issues to make the process increasingly efficient for the future. In the very short term the program has emphasized activities which will give the Secretary better information for the 2008 decision on GNEP direction for the future. Currently the program is focused on Advanced Proliferation-Resistant Aqueous Fuel Treatment and Other Separation Processes including Electrochemical Processing.

(dollars in thousands)

FY 2007	FY 2008	FY 2009

- **Advanced Proliferation-Resistant Aqueous Fuel Treatment** **0** **22,773** **0**

Laboratory-scale experiments have proven the advanced, aqueous-based UREX+ technologies to be capable of removing uranium from spent fuel at purity levels of up to 99.999 percent and essentially free of high-level radioactive contaminants. The resulting material (uranium, which comprises approximately 95% of SNF) could theoretically be disposed of as low-level waste or retained for use as reactor fuel. If spent fuel were processed in this manner, the volume of high-level waste requiring disposal in a geologic repository could be significantly reduced, potentially lowering the cost of storage and disposal of the remaining high-level waste and significantly increasing the technical capacity of a geologic repository.

Additional research is continuing to evaluate aqueous chemical treatment methods to separate selected actinide and fission product isotopes from the process stream after the uranium has been removed. Certain long-lived fission products (i.e., iodine-129 and technetium-99) are significant contributors to the potential dose from a repository and the long-term radiotoxicity of spent fuel, and could also be separated for transmutation or incorporation into new waste forms for safe disposal. Other gaseous radionuclides will be collected and safely sequestered. Materials now considered high-level wastes in LWR spent fuel processing facilities, such as fuel element hulls and end boxes from chop-leach dissolution, may be decontaminated sufficiently to qualify as low-level waste or even recycled for reuse in new fuel elements.

In FY 2008, the Department is:

- Continuing the end-to-end demonstrations of recycling technologies. The demonstrations are expected to produce separated transuranics for use in the transmutation fuel development program and waste products for waste form fabrication.
- Integrating laboratory-scale tests of the separations process selected for the recycling demonstration prototype; process demonstration of various advanced separations technologies capable of isolating transuranics (collectively or individually); the collection and recovery of various volatile fractions from the shearing of spent fuel, the oxidation of spent uranium dioxide fuel and its subsequent dissolution, including alternate storage methods for rare fission gases such as krypton-85 separated from inert xenon, for tritium and for carbon-14; and the development of advanced waste forms for iodine and technetium and other long-lived radionuclides.
- Initiating tests on the application of advanced aqueous separations processes to the recycle of high burn-up fast reactor oxide fuel, using spent fuel from the Fast Flux Test Facility (FFTF). High burn-up metal fuel is also available for electrochemical treatment.

(dollars in thousands)

FY 2007	FY 2008	FY 2009

- Testing advanced safeguards instrumentation will also being tested under simulated conditions to identify candidates for later testing in either a recycling demonstration prototype or the Advanced Fuel Cycle Facility (AFCF), depending upon the ultimate design of these facilities.
- Conducting research in collaboration with the Department's Office of Science, to understand the basic chemistry of aqueous separations, including the structure and stability of various organic complexes.

- **Other Separations Processes (Including Electrochemical processing) 0 15,000 0**

Electrochemical processing (previously referred to as pyroprocessing) is a proliferation-resistant non-aqueous approach used to separate the actinides in spent fuel from fission products. AFCI electrochemical processing activities support reduction of nuclear waste radiotoxicity by separating minor actinides from spent fuel coming from metal-fueled fast reactors for recycle. While using electrochemical processing to treat spent fuel from the Experimental Breeder Reactor-II (EBR-II), electrochemical process improvements have been made, which increase its applicability to other advanced reactor fuels.

In FY 2008, the Department is:

- Continuing R&D on advanced recycle processes for fast reactor spent fuel. Such processes must be capable of separating uranium and transuranics from fission products in fuel with very high radioactivity, thus requiring remote handling.
- Conducting advanced recycle process activities required including: treatment of fast reactor metal fuels, laboratory-scale liquid cadmium cathode (LCC) testing of group actinide recovery, high throughput electrorefining, the investigation of crucible materials for LCC applications; advanced sampling methods for electrochemical processing technologies; reductive extraction of actinides and electrolytic drawdown from salt waste; americium separation from curium using electrochemical methodologies as part of the EuroPart cooperative program; and advanced processing methods for spent oxide reactor fuel, using high burnup fast reactor spent oxide fuel from the FFTF; cold testing; irradiated fuel testing and integrated electrochemical modeling as part of an ongoing International Nuclear Energy Research Initiative (I-NERI) project with the Korea Atomic Energy Research Institute.
- Developing engineering-scale oxide reduction equipment, also in collaboration with South Korean researchers.
- In collaboration with the Department's Office of Science, research is being conducted to better understand the basic chemistry of electrochemical processing.

(dollars in thousands)		
FY 2007	FY 2008	FY 2009

Advanced Fuels Research, Development, and Testing **0** **35,304** **0**

The goal of the Advanced Fuels Research, Development, and Testing activity is to develop, fabricate, and test transmutation fuels and transmutation targets using recycled SNF. While a portion of this fuel development effort is aimed at producing transmutation fuels for use in LWRs, most of this effort is being directed at producing fuels suited for use in fast reactors which offer the best opportunity to transmute (consume) most of the transuranics in the recycled fuel efficiently and safely. Advanced transmutation fuels fabricated from LWR spent fuel are the critical, linchpin components of the AFCI/GNEP concept. These advanced fuel designs will permit extracting vast amounts of currently unavailable energy from spent fuel materials while doing so in a proliferation-resistant manner and increasing the load capacity of the Yucca Mountain repository by as much as fifty-fold. This activity also supports long-term R&D for next-generation nuclear reactors (i.e., Generation IV), including generating data which can be used to validate modeling and simulation activities.

Currently, advanced transmutation fuels are fabricated in small batches (e.g. one to four fuel pins) using bench-scale facilities primarily at Idaho National Laboratory, and include nitride fuels, dispersion fuels, sphere-pac fuels, inert matrix fuels and transmutation targets. Advanced fuel development work is focused on near term R&D in support of qualifying transmutation fuel and targets for an advanced burner reactor. In addition, this Advanced Fuel Research, Development and Testing work is closely integrated with the technology development activities that support the engineering and design of the planned AFCF. The AFCF will be capable of fabricating sufficient transmutation fuel for lead test assemblies. These lead test assemblies will be irradiated in an advanced burner reactor and will provide the performance data needed by the Nuclear Regulatory Commission (NRC) for transmutation fuel qualification.

Much of the advanced fuels irradiation testing and examination work is being done in the Advanced Test Reactor (ATR) thermal neutron source at the Idaho National Laboratory (INL). Irradiation testing at the ATR is shifting from less precise, un-instrumented tests which estimate conditions at the fuel sample to more precise instrumented tests. These instrumented tests will provide valuable data on irradiation conditions at the fuel sample and will reduce development time and costs while improving the efficiency of the advanced transmutation fuels. Irradiations will also take place domestically when a fast neutron source is available. In addition, the cost, scope and schedule to provide a transient test capability are being developed.

Research efforts in advanced fuels are being leveraged through several ongoing and planned international research collaborations. Two U.S. origin fast reactor transmutation fuel irradiation tests (FUTURIX-FTA and MI) have been initiated in the French Phenix reactor. In addition, discussions for an international arrangement for transmutation fuel irradiation tests in the Japanese JOYO fast reactor and in fast test reactors in Russia have been initiated. This international cooperation is necessary since the U.S. does not have a fast reactor in which to perform these irradiations.

(dollars in thousands)

FY 2007	FY 2008	FY 2009

In FY 2008 the Department is:

- Completing the post irradiation examinations of high burn-up transmutation fuel irradiated in the ATR and initiating fabrication of oxide transmutation fuel which, along with the metal transmutation fuels fabricated the prior year, is to undergo irradiation testing in the ATR.
- Continuing the two U.S. origin fast reactor transmutation fuel irradiation tests (FUTURIX-FTA and MI) in the French Phenix reactor.
- Negotiating agreements for fuel irradiation tests in foreign fast test reactors and post irradiation examinations with Russia and Japan.
- Providing support for fuels computational modeling as well as support for the development of instrumentation and controls for safeguarding nuclear materials during fuel fabrication.
- Developing cost, scope, and schedule for a transient test capability which will enable the testing of advanced fuels in atypical reactor conditions.

Transmutation Research and Development 0 15,949 0

Transmutation, as it applies to AFCI/GNEP, converts long-lived radioactive isotopes into shorter-lived, and therefore, produces less radiotoxic long-lived isotopes. As a result, transmutation can lower the radiotoxicity of spent nuclear fuel to below that of natural uranium ore by reducing the time for decay from hundreds of millennia to as little as centuries. The Transmutation R&D effort is focused on long-term R&D to reduce operational uncertainties, improve transmutation system performance, and reduce costs through development of advanced technologies. The effort is focused on fast reactors because the transmutation of transuranics is best performed in fast reactors.

Because capital investment in reactors is the dominant cost of any nuclear fuel cycle, the work described here is a critical component to assure an economically viable closed fuel cycle. To reduce the cost of future fast reactors, a variety of innovative solutions are being researched. Reduced uncertainty on the physics behavior of the reactor can eliminate unwarranted design margins that are costly and add little or no value. Improved materials that perform better and longer are needed. The Transmutation R&D Program is a long-term program that will address these issues. Its success will largely determine if industry will deploy fast reactors beyond the initial ABR and ultimately determine the success of the GNEP fuel cycle vision.

It is envisioned that this program will expand from its current bench scale R&D effort to a full scale research and development effort that can develop and demonstrate the needed components, physics, and safety technologies that will provide the desired breakthroughs. This will be accomplished by expanding existing facilities, developing key domestic facilities, leveraging program knowledge by exchanging information with the international fast reactor programs, and performing joint research in foreign facilities with unique capabilities.

In FY 2008, the Department is:

- Continuing design concept studies to assess the impact of cost reduction technologies.
- Conducting additional evaluation and refinement of physics cross sections for actinide isotopes to support the advanced transmutation reactor fuel cycle.

- Completing mechanical testing and analysis of structural materials irradiated in the FFTF; the development and qualification of advanced structural materials for use in fast spectrum transmutation systems.
- Conducting validation testing of existing fast reactor design methods; and coordination of international activities dealing with liquid metal fast reactor coolant and transmutation systems.
- Initiating additional activities to reconstitute domestic sodium technology infrastructure by the specification and design of a sodium component testing facility.
- Continuing coordination of international activities dealing with transmutation systems.
- Integrating advanced modeling and simulation activities with results of materials and physics experiments and utilize improved reactor simulation methods for further reactor cost reduction and safety benefits.

Systems Analysis/Advanced Computing and Simulation **0** **40,124** **0**

Systems Analysis/Advanced Computing and Simulation includes Systems Analysis and Integration and Advanced Computing and Simulation.

- **Systems Analysis and Integration** **0** **18,000** **0**

  The Systems Analysis and Integration activity examines the possible combinations of nuclear technologies to optimize the technical, economic, and environmental aspects of the fuel cycle as a whole, from mining to waste disposal. This includes an administrative function centered at INL to manage the integration process so that all technical activities of AFCI are coordinated and integrated. Systems Analysis develops and applies evaluation tools to formulate, assess, and guide program activities to evaluate various combinations of reactor types, reprocessing techniques, and waste disposal systems to meet program goals and objectives.

  In addition to optimization, Systems Analysis and Integration is also focused on the evaluation and down-selection of the most promising spent fuel treatment technologies, fuels technologies, reactors, and advanced fuel cycle deployment strategies acquired from AFCI and Generation IV R&D activities. Proliferation resistance analyses conducted by the NNSA and efforts conducted under the Safeguards Technology campaign are factored in as a high-priority, ongoing activity, especially in the area of advanced separations technologies.

  Additionally, Systems Analysis and Integration investigates optimal systems architecture to reduce the burden on potential future geologic repositories by removing the uranium and major heat-generating components of SNF, and optimizing the destruction of actinides to reduce the time it takes for the radiotoxicity of the waste to decay to levels comparable to the radiotoxicity of uranium ore. A systematic analysis of fuel cycle performance is performed for promising options, the results of which assist the Department in effectively prioritizing program R&D and establishing requirements for proposed projects. In a related activity, Systems Analysis and Integration produces the annual "AFCI Comparison Report" for Congress, which compares various separations, fuels and reactor technologies being researched by the AFCI and

Generation IV programs against the goals and objectives of those programs.

Systems Analysis and Integration also includes cost analysis activities and establishing consistent cost bases for use in evaluating the advanced fuel cycle technologies. To this end, the "Advanced Fuel Cycle Cost Basis Report" provides a comprehensive set of cost data for use in evaluating various AFCI and Generation IV technology deployment options. The report and its associated modeling efforts are intended to aid the evaluation of those elements that dominate nuclear fuel cycle costs, and help develop more efficient and less costly fuel cycle systems.

In FY 2008, the Department is:

- Focusing on completing analyses and developing information for the 2008 Secretarial decision on the path forward for GNEP. The GNEP Integrated Waste Management Strategy is to be delivered, and the GNEP technology roadmap will be submitted as an annual Report to Congress.
- Initiating new project management tools and procedures by the TIO. Systems analyses of the initial GNEP facilities are being completed and the GNEP deployment systems analysis updated.

- **Advanced Computing and Simulation 0 22,124 0**

DOE leads the world in the development and application of high performance computing and science based computational simulation. Maintaining and applying this capability is a priority of the American Competitiveness Initiative. The goal of the Advanced Computing and Modeling and Simulation program element is to develop and apply capabilities developed in the Office of Science's Advanced Simulation and Computing Research (ASCR) program and NNSA's Advanced Simulation and Computing (ASC) program to advance the state of the art in nuclear energy applications thereby using the power of massively parallel science based computing to improve the safety, performance and economics of nuclear reactors and potential fuel recycling and waste disposition systems.

This effort is being planned and executed in collaboration with NNSA, and the ASCR, Basic Energy Sciences and Nuclear Physics programs in the Office of Science to build on the capabilities and expertise developed through the multi-billion dollar investment in those programs in recent years. This activity will be executed through the DOE national laboratory system in collaboration with domestic industry and with foreign partners. It will engage our leading research universities in the development of models and methods as well as provide training of students in fields relevant to the nuclear enterprise. These activities will leverage computational and experimental assets, resources, capabilities and experience throughout DOE to avoid duplication and to reduce development times.

This effort began in mid- FY 2007 and was focused on the high priority of developing advanced simulation codes for fast reactor design and fuel performance. These efforts will continue into FY 2008.

In FY 2009, the Department will significantly expand the Modeling and Simulation (M&S) activities under the Nuclear Energy Research and Development budget and broaden the scope of problems for which simulation tools are being developed. The principal focus is to put together the "code teams" that will develop the advanced applications codes for each of the areas of interest. The experience of the ASC program and the ASCR shows that each code team requires support at the level of $5M to over $30M per year depending upon the complexity of the application being developed. Fully integrated reactor codes that combine neutronics, structural mechanics and thermo-hydraulics into one code with high resolution in 3-dimensions will be similar to the most complex challenges facing the ASC code and over time the program will pursue multiple approaches to the problem, to reduce risk, and to ensure that physics models are developed that are optimized for each of the principle classes of problems to be solved. Such codes currently do not exist, but the benefit in terms of reactor cost and safety performance will be enormous, and even a 5% resulting savings in the cost of construction of future reactors would repay investments many times over.

Likewise, current experience shows that the qualification of a new fuel type can take 20 years and cost over $200M because of the cycle required for in-core irradiation testing. The application of science–based, massively parallel codes may substantially reduce both the cost and time required, while providing a much more optimized fuel design to be submitted for final certification testing. Such developments will be essential to making the development of transmutation fuels for recycling reactors feasible.

In FY 2008, the Department is:

- Focusing on the high priority of developing advanced simulation codes for fast reactor design and fuel performance.

Transmutation Education **0** **4,000** **0**

Transmutation education supports the development of new U.S. scientists and engineers needed to develop transmutation and advanced nuclear energy technologies through university fellowships and applied research. Transmutation Education activities include the successful university fellowship program, which is developing new U.S. scientists and engineers for the fields of transmutation and advanced nuclear fuel cycle technologies.

In FY 2008, the Department is:

- Continuing the AFCI Fellowship program with both masters and doctoral fellowships awarded.
- Performing additional university research activities within the various AFCI/GNEP research and development activities.
- Funding only NERI grants previously awarded in FY 2006 and FY 2007.

Advanced Fuel Cycle Facility **0** **4,000** **0**

The AFCF will be a first-of-a-kind, world-class nuclear fuel cycle research, development, and demonstration facility. It will have engineering-scale capabilities that will be used to develop and

demonstrate advanced proliferation-resistant fuel recycling technologies. The AFCF will demonstrate these technologies as part of integrating the non-reactor portion of the nuclear fuel cycle, an important element to the cost-effective commercialization of these technologies. Fuel cycle operations will include: remote fabrication of various transmutation fuels and targets; advanced aqueous and electrochemical separations; and advanced waste forms. AFCF will also provide a test bed capability for advanced nuclear material accounting and control systems, one of the primary technologies for significantly reducing nuclear weapon proliferation risks. Many of the technologies developed by AFCI/GNEP on the laboratory scale are expected to be demonstrated at a larger scale by the AFCF.

In the long term, the AFCF is required for the U.S. to regain a leadership role in the nuclear fuel cycle. This is essential if the U.S. is to influence and promote the non-proliferation goals of GNEP. Moreover, the AFCF is needed to continually improve the performance and cost-effectiveness of an integrated fuel cycle and help the U.S. maintain competitiveness in the global nuclear market. While upgrades to existing DOE facilities can support this role to a limited degree over the next 10 to 20 years, this facility can accelerate the evolutionary, as well as revolutionary, improvement to nuclear the commercial applications of advancement of fuel recycling technologies. This facility will continue to depend on a robust laboratory-scale R&D program by talented researchers from around the DOE complex in order to feed viable candidate technologies for demonstration prior to commercial applications.

A phased construction plan for AFCF is envisioned. During the first phase, those facilities that support separations of LWR SNF into its reusable and waste components will be built, as well as those for fuel fabrication and waste processing. It is important that these technologies be successfully demonstrated on an engineering scale for ultimate commercial deployment and waste volume reduction. Phase I will also include the remote manufacture of lead test assemblies. These are experimental fast reactor fuels—fabricated from the separated products of used commercial LWR fuel—and will be placed inside a fast reactor for qualification and validation. This is a necessary step for the development of viable commercial fast reactor fuels for advanced recycling reactors that will get the maximum energy value from the fuel while simultaneously reducing waste and proliferation risks. This capability will be needed to continually improve the commercial application of GNEP technology introduced by the CFTC and evolutionary improvements over the coming decades.

The second phase of construction will focus on building those facilities required for the separations and recycling of used fast reactor fuel, most notably that coming from an advanced recycling reactor. The composition of this fuel will differ from the used LWR fuel that was recycled in the first phase and may require different treatment technologies. The fast reactor fuels may be in metallic form (although other forms are currently being evaluated). If such is the case, an electrochemical approach to fuels separation may be required, and would be developed in the AFCF. If the optimal fuel forms are not metallic, then other recycling approaches must be considered, including that used for LWR fuel.

The facility is being sized to cover the range of research, development and demonstration activities envisioned by GNEP over the next 50 years. The Aqueous Separations Module, for example, is being evaluated for processing LWR used fuel at a throughput rate of 10 to 75 metric tons per year and is

being sized for a suite of promising advanced separations processes.

In the near term, the AFCF will focus on demonstrating fabrication of transmutation fuels and targets at a scale necessary prior to commercialization. When built and operational, it will be the only facility in the world capable of providing this capability. Because of this unique capability, the AFCF will be a user facility through which many working partnerships will be established. These partnerships will include participants from all DOE laboratories (a robust scientist exchange program is anticipated), industry, universities, foreign governments and labs, and regulatory agencies (for independent analyses).

In FY 2008, the Department is:

- Continuing conceptual design work with focus on the transmutation fuel/target fabrication area of AFCF. FY 2008 work will result in the completion of 50 percent of the conceptual design, completion of key strategic trade studies, and will include development of cost and schedule range estimates in support of the Secretarial Record of Decision in 2008.

Consolidated Fuel Treatment Center **0** **13,000** **0**

The CFTC, previously called the Recycling Demonstration Program, will provide the critical steps and support necessary to recycle used nuclear fuel in the U.S. on a scale of commercial significance. The recycling program carried out at the CFTC aims to recover additional energy value from used nuclear fuel by recycling re-useable materials and to reduce the volume and toxicity of waste slated for disposal in a geologic repository. Ultimately the CFTC will include four sub-projects to improve the overall efficiency of the fuel cycle: LWR spent fuel separations facility, transmutation fuel fabrication facility, transmutation fuel separation facility, and advanced recycling reactor startup fuel fabrication facility.

This capability will support a sustained nuclear renaissance by providing domestic and international fuel services and improved waste and product management. Recycled products could be reused in existing LWR and eventually in new advanced recycling reactors that consume the longest-lived and most radiotoxic isotopes. The use of advanced recycling reactors will reduce the amount and hazards of the remaining high-level waste requiring disposal in a geologic repository and result in new waste forms and management approaches more commensurate with their reduced hazards. Approaches considered by AFCI/GNEP in the recycling of used nuclear fuel will employ proliferation-resistant technologies to support GNEP objectives. The program will engage with industry partners to establish spent fuel separations capability as a cornerstone for U.S. nuclear energy leadership.

In FY 2008, the Department is:

- Accepting industry's first set of deliverables resulting from the cooperative agreements. These documents (initial conceptual designs, business models, technology roadmaps, and communications plans) will provide data to support the Secretary's decision on closing the fuel cycle and identify areas that would benefit from specific R&D activities. Follow on work may be awarded to selected industry teams to continue conceptual design development. The design data needs identified by industry will be evaluated and incorporated into the prioritization for

technology development activities being performed by the national laboratories to respond appropriately to the critical near-term technology development needs identified by industry.

Advanced Burner Reactor **0** **11,710** **0**

The ABR is a fast-spectrum reactor capable of consuming transuranics and other actinides in support of a closed nuclear fuel cycle. In addition to eliminating these materials from LWR SNF, reducing both heat and waste loads on a geologic repository; the ABR will produce electricity. Reducing the volume, heat-loading, and radiotoxicity of nuclear waste could exponentially increase the capacity of the geological repository at Yucca Mountain. The ability to transmute and destroy transuranics in the ABR is the principal long-term waste management benefit of GNEP.

Input from industry and international partners confirm the feasibility of deploying a prototype fast reactor in the 2020-2025 timeframe. With the shutdown of the FFTF and EBR-II in the 1990s, there are no fast spectrum reactors currently operating in the U.S.

The ABR project will be implemented through two closely integrated paths. An industry-led path will design and build a prototype reactor, which will demonstrate transmutation, qualify advanced reactor fuels and materials, demonstrate advanced design and safety features, and employ modern reactor safeguards. A complimentary path, led by the national laboratories, has two objectives. In the near-term, it will identify and deliver the most promising technologies for incorporation into the prototype ABR. In addition, the labs will conduct the long-term research and engineering to assure that subsequent commercial ABRs will be economically competitive with modern light water reactors. The Department will collaborate with international and industry partners on both paths.

In FY 2008, the Department is:

- Completing the initial design studies needed to inform the GNEP path forward. As one of the deliverables under the cooperative agreement, the industry teams will provide input to an overall GNEP technology roadmap which will determine the technology development required (both near-term and longer-term) to support ABR deployment. The roadmap will define what needs to be done, who will do it (industry or government), when it is required and appropriate contingency plans or off-ramps. Options for fuel types and fabrication (or acquisition) will be evaluated. In addition to the technology roadmap, industry will provide input to the business model for GNEP, which will assure that the ABR project is part of an overall sound plan to commercialize a closed fuel cycle. The business model will consider the risks, incentives, revenues, and market considerations needed to establish the appropriate framework for an effective industry and government partnership. The establishment of an appropriate regulatory framework and a compliance strategy for licensing commercial ABRs will be coordinated between DOE, NRC and industry.
- Pursuing international collaboration activities, as well as support for the NEPA process.

GNEP Technology Development **0** **16,100** **0**

The GNEP Technology Development activity provides support to each of the three GNEP projects (the engineering- to commercial-scale demonstration nuclear fuel recycling center, advanced

recycling reactor, and AFCF), driven by the development and design needs of each project.

The technology development activities described below are fully integrated with the design and construction schedules for each of these projects.

In FY 2008, the Department is:

- Conducting activities to support the used nuclear fuel recycling center including technetium extraction, conversion and waste form process development. Engineering studies and /or technology development activities in response to feedback from industry identifying design and technology risks are also expected to be initiated in FY 2008.
- Supporting ABR by establishing the functional and operating requirements for the prototype; beginning to restore the domestic infrastructure required to design, fabricate and test sodium components; and validating the analytical tools used for reactor design. Engineering analysis and trade studies will be used to identify the biggest cost drivers and most promising technologies to reduce the costs to design, construct and operate future commercial ABRs, as well as improve plant performance. Examples include: reactor fuel handling machines, intermediate heat exchangers, advanced liquid metal pumps, reactor control technologies, and balance of plant technologies unique to fast reactor applications.
- Supporting AFCF technology development activities including design of advanced fuel cycle systems to be installed in AFCF. Much of the work will involve fabrication of transmutation fuels and targets that have high radiation fields and, as a result, will need to be performed remotely in hot cells. Work required to modify existing hot cells and install remote fuel fabrication equipment is also included. Also included is feedstock preparation of the minor actinides, americium and curium. Other AFCF work will involve the development of instrumentation and control logic for nuclear material control and accountability. Instruments will be tested in a representative environment. Finally, domestic and international irradiation fuel tests will be required as part of the AFCF technology development activity.
- Establishing an agreement a nuclear utility to develop an increased-scale fuel recycling concept on-site.

SBIR/STTR	**0**	**1,393**	**0**
The FY 2008 amount shown is an estimate of the requirement for the continuation of the SBIR and STTR program.			
Total, Advanced Fuel Cycle Initiative	**0**	**179,353**	**0**

Explanation of Changes

	FY 2009 vs. FY 2008 ($000)
Advanced Fuel Cycle Initiative	
Funding requested under the Nuclear Energy Research and Development program in FY 2009.	**-179,353**

Mixed Oxide Fuel Fabrication Facility

Funding Schedule by Activity

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Mixed Oxide (MOX) Fuel Fabrication Facility			
MOX Construction	0	231,721	0
MOX Other Project Cost Activities	0	47,068	0
Total, MOX Fuel Fabrication Facility	0	278,789	0

Description

The program goal is to eliminate U.S. weapons-grade plutonium declared surplus to national security needs.

The Consolidated Appropriations Bill, 2008 funds the Mixed Oxide (MOX) Fuel Fabrication Facility within the Nuclear Energy appropriation. Previously, all MOX funding was included in Defense Nuclear Nonproliferation. This project is considered central to meeting the U.S. nonproliferation objectives as described in Defense Nuclear Nonproliferation.

U.S. Plutonium Disposition

In September 2000, the United States and Russia signed a Plutonium Management and Disposition Agreement, which commits each country to dispose of 34 metric tons of surplus weapon-grade plutonium (68 metric tons total – enough material for approximately 17,000 nuclear weapons). In 2006, both the U.S. and Russian Governments reaffirmed their commitment to implement the 2000 Agreement for disposing their plutonium as MOX fuel in nuclear reactors. This is a key element of the U.S. Government's nonproliferation strategy to address the potential threat of diversion of materials that can be used in nuclear weapons. In addition to the obvious nonproliferation benefits, proceeding with the U.S. plutonium disposition will help reduce storage costs for nuclear materials, reduce safeguards and security costs, and support the Department's efforts to consolidate nuclear materials within the DOE Complex.

Detailed Justification

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
MOX Construction	**0**	**231,721**	**0**

The Mixed Oxide Fuel Fabrication Facility (MFFF) will provide the United States with the capability to fabricate MOX fuel elements suitable for use in commercial nuclear reactors from plutonium oxide derived from surplus weapon-grade plutonium. The facility will contain the following key functional areas: shipping and receiving, storage, chemical processing oxide blending, pellet manufacturing, fuel rod manufacturing, fuel bundle assembly, fuel bundle storage, and a laboratory. In addition, a number of supporting facilities will be built including an administration building, material receipt warehouse, technical support building, emergency and standby diesel generator buildings, and a chemical reagent building. DOE awarded a contract to a private consortium, Duke Engineering Services, COGEMA, Inc., and Stone & Weber (DCS) in 1999. DCS, through a series of corporate buyouts, is now Shaw AREVA MOX Services. The contract required DCS to design and obtain a Nuclear Regulatory Commission (NRC) license for the MFFF, which is being built at the SRS. Three options are included in the base contract, which can be awarded separately: 1) construction and cold start-up; 2) hot start-up, operations, and irradiation services; and 3) deactivation.

In FY 2008, the Department is:

- Continuing construction activities such as installing additional floors to the MFFF.
- Continuing installation of procured equipment.
- Continuing installing of mechanical and electrical utilities.
- Continuing procurement of processing equipment.

In FY 2009, funding for MOX Construction is requested in the Other Defense Activities.

MOX Other Project Cost Activities	**0**	**47,068**	**0**

MOX Other Project Cost Activities support project activities, such as, management oversight, design reviews, and facility start-up testing.

In FY 2008, the Department is:

- Continuing management oversight and licensing for construction activities, planning for start-up and operation of the MFFF, supporting design and testing of the Aqueous Polishing process contained within the MOX project supporting environmental permitting and monitoring and supporting the NRC review of the operating licensing application for the MFFF.

In FY 2009, funding for MOX Other Project Costs is requested in the Other Defense Activities.

Total, MOX Fuel Fabrication Facility	**0**	**278,789**	**0**

Explanation of Funding Changes

	FY 2009 vs. FY 2008 ($000)
MOX Fuel Fabrication Facility	
Funding for this project is requested within the Other Defense Activities in FY 2009.	**-278,789**

Capital Operating Expenses and Construction Summary
Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appro-priations	FY 2007	FY 2008	FY 2009	Unappro-priated Balance
99-D-143, Mixed Oxide Fuel Fabrication Facility, Savannah River Site	3,938,628	1,167,560	262,500	231,721	417,808	1,859,039
Total, Construction Project			262,500	231,721	417,808	

Infrastructure

Funding Profile by Subprogram

(dollars in thousands)

	FY 2007 Current Appropriation	FY 2008 Original Appropriation	FY 2008 Adjustments	FY 2008 Current Appropriation	FY 2009 Request
Infrastructure					
Radiological Facilities Management	46,775	48,561	-442	48,119	38,700
Idaho Facilities Management	84,435	117,000	-1,065	115,935	104,700
Total, Infrastructure	131,210	165,561	-1,507	164,054	143,400

Public Law Authorizations:
P.L. 110-5, Revised Continuing Appropriations Resolution, 2007
P.L. 110-161, The Consolidated Appropriations Act, 2008

Mission

The mission of the Infrastructure program within Nuclear Energy appropriation is to manage the planning, acquisition, operation, maintenance, and disposition of nuclear facilities and infrastructure to conduct advanced nuclear energy research and to provide radioisotope power systems for space exploration and national security.

The Infrastructure program includes Radiological Facilities Management and Idaho Facilities Management (IFM). The Radiological Facilities Management program is funded under the Nuclear Energy appropriation. Beginning in FY 2009, the Medical Isotopes program included in the Radiological Facilities Management program transfers to the Office of Science. Prior to FY 2008, the IFM Program was funded in both the Energy Supply and Conservation and the Other Defense Activities appropriations. Beginning in FY 2008, funds for these programs were solely in the Nuclear Energy appropriation.

The Infrastructure program keeps mission supporting DOE facilities and infrastructure in a user-ready status. Activities supported by this program include: operation and maintenance of reactors, hot cells, and infrastructure needed to carry out research and development in support of Nuclear Energy programs; construction of power systems for national security missions and space exploration; and testing of new fuels and core components for the Naval Nuclear Propulsion Program. DOE enables advances in science by making its nuclear facilities available to national and international users. The Department does not subsidize programmatic costs incurred by non-DOE users.

The Idaho National Laboratory (INL) plays a lead role in the Global Nuclear Energy Partnership, the Generation IV Nuclear Energy Systems Initiative, the Next Generation Nuclear Power Plant Program, the Nuclear Hydrogen Initiative, Space and Defense Power Systems, testing of naval reactor fuels and reactor core components, and a range of national security technology programs. While the laboratory focuses its research and development on nuclear energy programs, it is also maintaining its multi-program national laboratory status to serve a variety of current and planned Department and national research and development missions.

Two important research reactors currently operating at this site are the Advanced Test Reactor (ATR) and its supporting ATR Critical Facility. ATR is one of the world's largest and most sophisticated test reactors. ATR currently conducts virtually all irradiation testing for Navy reactor fuels and core components and is vital to achieving the Department's Strategic Goal of providing the U.S. Navy with safe, militarily effective, nuclear propulsion plants and ensuring their continued safe and reliable operation. The Navy mission is projected to continue until at least mid-century. A series of independent studies have shown that the ATR can operate until mid-century and potentially beyond. The increased deployment of new light water reactor designs, the need to improve performance and extend the licensed life of existing light water reactors, and the maturing of advanced reactor technologies all require an expanded fuel and materials irradiation capability for use by the Office of Nuclear Energy. The ATR is ideally suited to provide this test capability for the projected NE nuclear energy programs in much the same way as it has for the Office of Naval Reactors (NR) program. These two programs are working closely and cooperatively to schedule work, fairly distribute the costs associated with maintaining and operating the ATR, and more fully exploit the testing potential of the reactor.

In FY 2007, DOE designated the ATR to be a national scientific user facility. This action was taken to allow additional research and development to be conducted by Universities and industry using irradiation locations that are not currently used by NE or NR. The costs associated with using vacant irradiation locations within the core, will be charged to the sponsoring organization in accordance with DOE pricing policies for user facilities. The user facility concept will benefit the long term viability of the ATR and will enhance NE irradiation test programs by involving a larger and more diverse group of experimenters.

The IFM Program supports the Energy Policy Act of 2005, the Atomic Energy Act of 1954, and Federal Acquisition Regulation 35 by maintaining and operating the INL site infrastructure that supports advanced nuclear energy technology research and development and multi-program use. Key activities conducted under these programs include ensuring that all landlord facilities meet essential safety and environmental requirements and are maintained at user-ready levels. Other key activities include managing all special nuclear materials contained in these facilities and managing some aspects of the site's environmental monitoring, facility decommissioning and disposition, and waste management activities.

The FY 2009 funding request associated with Radiological Facilities Management maintains the basic facilities and associated personnel at Idaho National Laboratory, Oak Ridge National Laboratory and Los Alamos National Laboratory, whereas mission specific development or hardware fabrication costs are provided by the user agencies (e.g., NASA). This arrangement is essential in order to preserve the basic capability regardless of periodic fluctuations in the demand of the end product users. In FY 2009, NE will complete activities associated with the assembly and testing of generators for national security applications and for the National Aeronautics and Space Administration (NASA) Mars Science Laboratory (MSL) mission, and deliver the unit to NASA for launch. In FY 2009, the program will fabricate fresh fuel and ship spent fuel from two university reactors; fuel will be fabricated for at least one university reactor; and highly enriched uranium (HEU) fuel will be removed and shipped from the three university reactors.

The FY 2009 funding request associated with Idaho Facilities Management will continue to ensure that the Department's unique facilities, required for advanced nuclear energy technology research and development, are maintained and operated such that they are available to support national priorities. The program will continue to fund routine maintenance to assure that programmatic facilities and equipment can be operated safely and reliably. IFM will maintain and operate essential ATR support activities to be available and ready to support ATR operations, including upgrades to correct degrading reliability in these essential systems and assessments to determine what is need to ensure the long term sustainability of the ATR.

Strategic and GPRA Unit Program Goals

The Department's Strategic Plan identifies five Strategic Themes (one each for energy security, nuclear security, scientific discovery, environmental responsibility and management excellence) plus 16 Strategic Goals that tie to the Strategic Themes. The Infrastructure program supports the following goal:

Strategic Theme 1, Energy Security: Promoting America's energy security through reliable, clean, and affordable energy

Strategic Goal 1.2, Environmental Impacts of Energy: Reduce greenhouse gas emissions and other environmental impacts (water use, land use, criteria pollutants) from our energy production and use.

The Infrastructure program has one GPRA Unit Program goal which contributes to Strategic Goals 1.2 in the "goal cascade":

GPRA Unit Program Goal 1.2.15.00: Maintain and Enhance National Nuclear Infrastructure - Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability to meet the Nation's energy, space exploration, and national security needs.

Contribution to GPRA Unit Program Goal 1.2.15.00 (Maintain and Enhance National Nuclear Infrastructure)

The Infrastructure program contributes to this goal by ensuring that the Department's unique facilities, required for advanced nuclear energy technology research and development, are maintained and operated such that they are available to support national priorities. Key activities conducted under this program include ensuring that all NE facilities meet essential safety and environmental requirements and are maintained at user-ready levels. Other key activities include managing all special nuclear materials contained in these facilities and the disposition of DOE materials under NE ownership.

Funding by Strategic and GPRA Unit Program Goal

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Strategic Goal 1.2, Environmental Impacts of Energy			
GPRA Unit Program Goal 1.2.15.00, Maintain and Enhance National Nuclear Infrastructure			
Radiological Facilities Management	46,775	48,119	38,700

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Idaho Facilities Management	84,435	115,935	104,700
Total, Strategic Goal 1.2 (Infrastructure)	131,210	164,054	143,400

Annual Performance Results and Targets

FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008 Targets	FY 2009 Targets
GPRA Unit Program Goal 1.2.15.00 (Maintain and Enhance National Nuclear Infrastructure)					
Infrastructure					
Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management and Idaho Facilities Management programs. (MET TARGET)	*Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management and Idaho Facilities Management programs. (MET TARGET)*	*Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management and Idaho Facilities Management programs. (MET TARGET)*	*Consistent with safe operations, achieve cumulative variance of less than 10 percent from each of the cost and schedule baselines for the Radiological Facilities Management (RFM) and Idaho Facilities Management (IFM) programs at INL. (MET TARGET)*	*To ensure unique nuclear facilities are available to support critical Departmental missions, achieve cumulative variance of less than 10 percent from cost and schedule baselines at Idaho National Laboratory for Idaho Facilities Management program facilities and activities (which include facilities used by the Radiological Facilities Management program), consistent with safe operations.*	*To ensure unique nuclear facilities are available to support critical Departmental missions, achieve cumulative variance of less than 10 percent from cost and schedule baselines at Idaho National Laboratory for Idaho Facilities Management program facilities and activities (which include facilities used by the Radiological Facilities Management program), consistent with safe operations.*
Radiological Facilities Management					
Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines. (MET TARGET)	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (MET TARGET)	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (MET TARGET)	Maintain operability of key Radiological Facilities Management and Idaho Facilities Management-funded facilities to enable accomplishment of Nuclear Energy, other DOE and Work-for-Others milestones by achieving a Facility Operability Index of 0.9 or greater. (MET TARGET)	To ensure unique nuclear facilities are available to support critical Departmental missions, maintain a facility operability index of 0.9 for key Idaho Facilities Management and Radiological Facilities Management program facilities.	To ensure unique nuclear facilities are available to support critical Departmental missions, maintain a facility operability index of 0.9 for key Idaho Facilities Management and Radiological Facilities Management program facilities.
Safely operate each key nuclear facility within 10 percent of the approved plan, shutting down reactors if they are not operated within their safety envelope and expediting remedial action. (MET TARGET)	Consistent with safe operations, maintain and operate key nuclear facilities so the unscheduled operational downtime will be kept to less than 10 percent, on average, of total scheduled operating time. (MET TARGET)				
Demonstrate the operational capability of radioisotope	Maintain and operate radioisotope power systems				

FY 2004 Results	FY 2005 Results	FY 2006 Results	FY 2007 Results	FY 2008 Targets	FY 2009 Targets
power systems infrastructure by fabricating flight quality products at each of the major facilities (i.e., at least eight iridium clad vent sets at ORNL and at least eight encapsulated Pu-238 fuel pellets at LANL), and by processing at least 2 kilograms of scrap Pu-238 at LANL. (MET TARGET)	facilities with less than 10 percent unscheduled downtime from approved baseline. (MET TARGET)				
Idaho Facilities Management					
Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (Same target used for Radiological Facilities Management). (MET TARGET)	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (Same target used for Radiological Facilities Management). (MET TARGET)	Keep cost and schedule milestones for upgrades and construction of key nuclear facilities within 10 percent of approved baselines, using the cost-weighted mean percent variance (+/-10 percent) approach. (Same target used for Radiological Facilities Management). (MET TARGET)	Maintain operability of key Radiological Facilities Management and Idaho Facilities Management-funded facilities to enable accomplishment of Nuclear Energy, other DOE and Work-for-Others milestones by achieving a Facility Operability Index of 0.9 or greater. (MET TARGET)	To ensure unique nuclear facilities are available to support critical Departmental missions, maintain a facility operability index of 0.9 for key Idaho Facilities Management and Radiological Facilities Management program facilities.	To ensure unique nuclear facilities are available to support critical Departmental missions, maintain a facility operability index of 0.9 for key Idaho Facilities Management and Radiological Facilities Management program facilities.

Means and Strategies

The Infrastructure program will use various means and strategies to achieve its GPRA Unit Program goals. However, various external factors may impact the ability to achieve these goals. The program also performs collaborative activities to help meet its goals.

The Department will implement the following means:

- Ensure that mission essential systems, resources, and services are identified, maintained, and operated in compliance with DOE, Federal, and State safety and environmental requirements in a secure and cost-effective manner. The Idaho Facilities Management has established an INL Ten Year Site Plan to accomplish this that will be updated semi-annually and approved by the DOE.

- Maintain the unique infrastructure and capability to deliver advanced radioisotope power systems for space and national security missions.

- Aggressively implement contracting reforms, including fixed price competitive bidding, earned value management, capital planning processes in accord with DOE Order 413.3A, independent external evaluations, etc., to ensure that the infrastructure program is operating effectively and efficiently to meet the Department's highest priority program needs.

The Department will implement the following strategies:

- Idaho Facilities Management mission essential facilities will be identified in the INL Ten Year Site Plan. Detailed work planning and funding requests will be based on this Plan that will be updated semi-annually.

- Meet periodically throughout the year with INL, Nuclear Regulatory Commission, NNSA and the Test, Research, and Training Reactor Management Group (TRTR) to review university research reactor activities; discuss program issues; and solicit input, advice and guidance.

The following external factors could affect NE's ability to achieve its strategic goal:

- Idaho Facilities Management Key External Factors: Increased nuclear energy R&D would impact the focus and direction of the Idaho Facilities Management Program, but not necessarily impact its overall costs and long-term liabilities. On the other hand, increased nuclear energy R&D needs resulting from new mission initiatives could require accelerated recapitalization and revitalization to support enhanced use of research facilities, new construction and earlier enhancement of the existing infrastructure.

In carrying out the program's mission, NE performs the following collaborative activities:

- Coordinates with national security agencies and NASA in developing radioisotope power systems for their use to ensure proposed systems and technologies satisfy the necessary technical requirements identified by customers for identified mission scenarios.

- Coordinates with the National Nuclear Security Administration to convert the university research reactors with highly enriched uranium to low enriched uranium.

Validation and Verification

To validate and verify program performance, NE will conduct various internal and external reviews and audits. NE's programmatic activities are subject to periodic review by the Congress, the General Accountability Office, the Department's Inspector General, the Nuclear Regulatory Commission, the U.S. Environmental Protection Agency, state environmental and health agencies, and the Department's Office of Engineering and Construction Management. In addition, NE provides continual management and oversight of its vital field infrastructure programs—the Radiological Facilities Management program and the Idaho Facilities Management program. Periodic internal and external program reviews evaluate progress against established plans. These reviews provide an opportunity to verify and validate performance. Monthly, quarterly, semi-annual and annual reviews, consistent with program management plans, are held to ensure technical progress, cost and schedule adherence, and responsiveness to program requirements.

In FY 2006, as a follow-up action assigned as part of this assessment, NE contracted with the National Academy of Sciences (NAS) to conduct an extensive, comprehensive, and independent evaluation of R&D and Infrastructure program goals and plans, including the process for establishing program priorities and oversight. The evaluation resulted in a detailed set of policy and research recommendations and associated priorities for an integrated agenda of research activities to support the long-term commercial energy option to provide diversity in energy supply. A pre-publication version of the report was issued in October 2007; the final report is scheduled for publication in January 2008. NE continues to review the report findings, and is working with OMB to develop a viable strategy for implementing the committee's recommendations.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by OMB to provide a standardized way to assess the effectiveness of the Federal Government's portfolio of programs. The structured framework of the PART provides a means through which programs can assess their activities differently than through traditional reviews. NE's Infrastructure program has incorporated feedback from OMB into the FY 2009 Budget Request and has taken the necessary steps to continue to improve performance.

The results of the FY 2006 review are reflected as follows:

The assessment found that the program is effectively targeted through the formal INL Ten Year Site Plan that identifies the mission-essential infrastructure and facilities, planned annual work scope, and performance measures for the laboratory. An overall PART score of 49 was achieved with a perfect 100 score for Section I, Program Purpose & Design; a score of 89 for Section II, Strategic Planning; a perfect 100 score for Section III, Program Management; and a score of 0 for Section IV, Program Results/Accountability since the program is too new to have demonstrated accomplishments. The assessment also found that the program needed to collect timely and credible performance information to manage the Idaho Facilities Management program in providing effective and efficient infrastructure support to INL's program missions. The program has developed measures to track its performance against cost and schedule baselines for FY 2007 and beyond. Further, the program has developed a Facility Operability Index measure that assesses the operability of key indicator facilities required for the achievement of NE, other DOE and Work-For-Others milestones.

Radiological Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Radiological Facilities Management			
Space and Defense Infrastructure	30,650	30,371	35,000
Medical Isotopes Infrastructure	15,634	14,828	0
Enrichment Facility Infrastructure	491	0	0
Research Reactor Infrastructure	0	2,920	3,700
Total, Radiological Facilities Management	46,775	48,119	38,700

Description

The mission of the Radiological Facilities Management program is to maintain nuclear facilities, primarily those housing large gloveboxes, hot cells, and their associated support facilities in a safe, environmentally-compliant and cost-effective manner to support national priorities. The Radiological Facilities Management program funds the management of the Department's vital resources and capabilities at Office of Nuclear Energy (NE) managed facilities at Idaho National Laboratory (INL), Oak Ridge National Laboratory (ORNL), and Los Alamos National Laboratory (LANL). Beginning in FY 2009, the Medical Isotopes program transfers to the Office of Science.

These funds assure that the infrastructure for the above mentioned NE nuclear facilities meets essential safety and environmental requirements and is maintained at or above minimum safe levels. Beginning in FY 2009, costs required to raise LANL facilities from minimum safe to operable user-ready levels will be paid for by other Federal agency users. Programmatic activities, including production and research, are also funded by other Federal agency users.

In FY 2009, the program will complete activities associated with the assembly and testing of generators for national security applications and for the National Aeronautics and Space Administration (NASA) Mars Science Laboratory (MSL) mission, and deliver the unit to NASA for launch. The program will also continue to maintain the unique facilities and capabilities facilities at INL, ORNL and LANL that enable the Department to provide the radioisotope power systems for space exploration and national security applications. The FY 2009 funding request maintains the basic facilities and associated personnel, whereas mission specific development or hardware fabrication costs are provided by the user agencies (e.g., NASA). This arrangement is essential in order to preserve the basic capability regardless of periodic fluctuations in the demand of the end product users.

In FY 2009, the program will fabricate fresh fuel and ship spent fuel from two university reactors. In addition, fuel will be fabricated for at least one university reactor (others may be fabricated, as requested). Highly enriched uranium (HEU) fuel will be removed and shipped from the three university reactors. The Department provides fresh reactor fuel to universities and disposes of spent fuel from university reactors. Currently, there are 27 operating university research reactors at 27 institutions

in the United States. Many of these facilities have permanent fuel cores and, therefore, do not require regular fuel shipments. However, DOE supplies approximately a dozen universities with fresh fuel and shipments of spent fuel as needed.

Detailed Justification

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Space and Defense Infrastructure	**30,650**	**30,371**	**35,000**
▪ **Idaho National Laboratory (INL)**	**8,200**	**9,000**	**10,040**
• **Radioisotope Power Systems Assembly Operations**	**8,000**	**8,500**	**9,340**

The Department maintains the facilities at INL in an operational status and the user agencies fund mission specific assembly or testing operations. The focus in FY 2009 is the assembly and testing of generators for national security applications and for the National Aeronautics and Space Administration (NASA) Mars Science Laboratory (MSL) mission. A set of generators for a national security application is scheduled to be delivered to the customer in FY 2009. The new Multi-Mission Radioisotope Thermoelectric Generator radioisotope power system (RPS) will be used by NASA for the first time on the MSL rover scheduled for launch in September-October 2009. The fueling operations for the RPS flight unit for the MSL mission will be conducted from FY 2008 through FY 2009, and the unit will be delivered to NASA in FY 2009 for launch. The Department's funding will support the continuation of safe and reliable assembly operations for two independent programs at INL.

• **Capital Equipment for Radioisotope Power System Assembly Operations**	**200**	**500**	**700**

In order to sustain the facility in an operational status, capital equipment funding is required for routine maintenance and infrastructure support.

▪ **Los Alamos National Laboratory (LANL)**	**13,800**	**12,321**	**15,410**
• **Pu-238 Encapsulation and Scrap Recovery Facilities**	**12,500**	**12,000**	**13,030**

The Department maintains and operates dedicated Pu-238 processing, encapsulation, and scrap recovery facilities within the Plutonium Facility (PF-4) at Technical Area 55 (TA-55) at LANL. These unique facilities provide the only U.S. capability to purify, pelletize and encapsulate the Pu-238 so that it can be used in radioisotope power systems. These facilities will be available at least through FY 2014 to help meet agency missions. The FY 2009 funding request will maintain the basic capabilities and infrastructure for these facilities in minimum safe status. If expanded effort is required to produce material for specific missions or applications, the funding for this extra effort is provided by the user agencies.

• **Capital Equipment for the Pu-238 Facilities**	**1,300**	**321**	**2,380**

Maintenance of the Pu-238 facilities requires regular upgrades and replacement of gloveboxes and equipment in the processing, encapsulation, and scrap recovery lines. Increased maintenance, upgrading of gloveboxes and other equipment will take place in FY 2009.

▪ **Oak Ridge National Laboratory (ORNL)**	**4,650**	**4,750**	**5,160**
• **Iridium Fabrication Facilities for Radioisotope Power Systems**	**4,150**	**4,250**	**4,410**

The Department maintains a unique infrastructure and capability at ORNL to fabricate iridium cladding and carbon insulators used to encapsulate and contain the Pu-238 pellets used in radioisotope power systems. These heat source components are necessary for the safe operation of the radioisotope power systems. FY 2009 funding will allow continued safe and reliable operation of the facility.

- **Capital Equipment for Iridium Fabrication Facilities** **500** **500** **750**

  In FY 2009, ORNL will replace an aging arc melting furnace and a hot forming press.

- **Other Activities** **4,000** **4,300** **4,390**
  - **Safety/Program Analysis and Testing Infrastructure** **4,000** **4,300** **4,390**

    The Department maintains an analytical and testing infrastructure that enables the Department to analyze the performance and ensure the safety of the radioisotope power systems for various applications. This capability allows the operation and update of sophisticated analytical codes that can analyze the behavior of materials and systems under potential accident environments. These codes will also predict performance under different operational conditions for various types of systems. The Department funding maintains the capability and infrastructure, but if additional mission specific analysis or testing is required, the user agency provides the funding for these mission specific efforts. In FY 2009, the Department will complete the MSL launch approval safety assessment activities for the NASA MSL 2009 mission, and continue the process of updating analysis techniques and computer codes to address the evolution of launch vehicles and analysis standards. This allows the Department to provide accurate and detailed projections for risks related to missions using nuclear power systems and materials.

Medical Isotopes Infrastructure **15,634** **14,828** **0**

- **Oak Ridge National Laboratory (ORNL)** **7,165** **7,428** **0**
  - **Building 3047 Hot Cells** **3,100** **0** **0**

    As part of the ORNL consolidation and facility revitalization, all isotope processing has been transferred at the end of FY 2006. FY 2007 funding was used to remove remaining equipment and supplies and cleanup of the hot cells to prepare for decontamination and decommissioning and to start up the hot cells activities in building 4501 and 7920.

  - **Buildings 4501 and 7920 Hot Cells** **0** **3,664** **0**

    All isotope processing activities have been transferred from Building 3047 to Buildings 4501 and 7920. The Department will maintain these facilities in a safe and environmentally compliant condition for processing, packaging, and shipment of radioisotopes and other related services needed in medical diagnostic and therapeutic applications, homeland security applications, and other scientific research used by Federal and non-Federal entities. Activities include facility and shipping container maintenance, radiological monitoring, facility

inspections, isotope inventory and shipment scheduling and delivery tracking. Isotope customers pay the cost of isotope processing in these facilities. Beginning in FY 2009, these activities transfer to the Office of Science.

- **Buildings 9204-3 and 5500 – Chemical and Materials Laboratories** **3,000** **3,764** **0**

  The Department maintains the two laboratories in a safe and environmentally compliant condition for the processing, packaging, and shipment of stable isotopes and other services needed in medical diagnostic and therapeutic applications and other scientific research used by Federal and non-Federal entities. Activities include facility maintenance and inspections and customer order and account tracking system maintenance (E-Government). Over the next several years, the Department will continue to phase out the Calutrons in Building 9204-3 at Y-12. Beginning in FY 2009, these activities transfer to the Office of Science.

- **Isotope Production** **715** **0** **0**

  FY 2007 funding provided for the Department's isotope business management including isotope order processing, billing, official quotations, shipping schedules, cash collections, advance payments, and accounting for products and services provided by all Department isotope producing sites. Business trend analyses, surveys, and tracking responses to customer inquiries are also centralized at ORNL. This E-Government isotope business management information system not only expedites customer orders, but also saves several hundreds of thousands of dollars of administration expenses annually. Starting in FY 2008, funds for these activities are included in the other ORNL activity lines.

- **Capital Equipment** **350** **0** **0**

  In FY 2007, upgraded the National Regulatory Commission license for one type of shipping container to a type BU-96 to enable shipment of a larger number of isotope products to customers and between isotope producing sites.

▪ **Los Alamos National Laboratory (LANL)** **3,214** **3,650** **0**

- **Isotope Production Facility/TA-48 Hot Cell, Building RC-1** **3,214** **3,650** **0**

  The Department maintains facilities in a safe and environmentally compliant condition for the production, processing, packaging, and shipment of radioisotopes and other services needed in medical diagnostic and therapeutic applications, and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in these facilities. Beginning in FY 2009, these activities transfer to the Office of Science.

▪ **Sandia National Laboratories (SNL)** **1,800** **0** **0**

- **TA-5 ACRR & Hot Cells** **1,800** **0** **0**

(dollars in thousands)

FY 2007	FY 2008	FY 2009

The Isotope Program no longer has a programmatic need for the Annular Core Research Reactor (ACRR) and associated hot cells. The National Nuclear Security Administration (NNSA) is now the only user of the ACRR. The transfer to NNSA of the ACRR and hot cells was completed by the end of FY 2007.

▪ **Brookhaven National Laboratory (BNL)**	**2,905**	**3,200**	**0**
• **Brookhaven Linear Isotope Producer (BLIP) Building 931 and Hot Cell Building 801**	**2,905**	**3,200**	**0**

The Department maintains the BLIP Building 931 and Hot Cell Building 801 facilities in a safe, environmentally compliant condition and state of readiness for the production of radioisotopes and other services needed in medical diagnostic, therapeutic applications, and other scientific research used by Federal and non-Federal entities. Activities include maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in this facility. Beginning in FY 2009, these activities transfer to the Office of Science.

▪ **Other Activities**	**550**	**550**	**0**
• **Associated Nuclear Support**	**550**	**550**	**0**

This funding provides for requirements applicable to isotope producing sites. Such items include certification of isotope shipping casks, independent financial audits of the revolving fund, and other related expenses. Beginning in FY 2009, these activities transfer to the Office of Science.

Enrichment Facility Infrastructure	**491**	**0**	**0**
▪ **Oak Ridge Operations Office**	**491**	**0**	**0**

Funding provides for oversight and monitoring of the maintenance of DOE leased assets at the Paducah Gaseous Diffusion Plant site in accordance with the DOE-United States Enrichment Corporation June 17, 2002 Memorandum of Agreement. Beginning in FY 2008, Oak Ridge Operations Office will assume direct responsibility for these oversight and monitoring activities.

Research Reactor Infrastructure	**0**	**2,920**	**3,700**
▪ **Idaho National Laboratory (INL)**	**0**	**2,920**	**3,700**

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
The Department is responsible for providing fresh reactor fuel to universities and disposing of spent fuel from university reactors. In FY 2007, the Department funded these activities in the University Reactor Infrastructure and Education Assistance program. Beginning in FY 2008 funds are requested in the Radiological Facilities Management program to continue to provide fuel services to universities that have recurring fuel needs. In FY 2009, the program will fabricate fresh fuel and ship spent fuel from Massachusetts Institute of Technology (MIT) and the University of Missouri (MURR) reactors. In addition, Training, Research, Isotopes, General Atomics (TRIGA) fuel will be fabricated for the McClellan reactor (University of California – Davis) and others as requested. Highly enriched uranium (HEU) fuel will be removed and shipped from the Oregon State, Washington State and University of Wisconsin reactors.			
Total, Radiological Facilities Management	**46,775**	**48,119**	**38,700**

Explanation of Funding Changes

	FY 2009 vs. FY 2008 ($000)
Space and Defense Infrastructure	
▪ **Idaho National Laboratory (INL)**	
• **Radioisotope Power Systems Assembly Operations** The increase from $8,500,000 to $9,340,000 represents escalation and maintenance deferred from FY 2008.	+840
• **Capital Equipment for Radioisotope Power System Assembly Operations** The increase from $500,000 to $700,000 represents an increased need for capital equipment in FY 2009.	+200
▪ **Total, Idaho National Laboratory**	+1,040
▪ **Los Alamos National Laboratory (LANL)**	
• **Pu-238 Encapsulation and Scrap Recovery Facilities** The increase from $12,000,000 to $13,030,000 is due to maintenance deferred from FY 2008.	+1,030
• **Capital Equipment for the Pu-238 Facilities** The increase from $321,000 to $2,380,000 is required to replace equipment needed to maintain the facility in a safe and reliable condition.	+2,059
▪ **Total, Los Alamos National Laboratory**	+3,089
Oak Ridge National Laboratory (ORNL)	

	FY 2009 vs. FY 2008 ($000)
• **Iridium Fabrication** The increase from $4,250,000 to $4,410,000 is due to reduced materials testing support capability in FY 2008 and maintenance deferred into FY 2009.	+160
• **Capital Equipment for Iridium Fabrication Facilities** The increase from $500,000 to $750,000 will allow for the replacement of both an aging arc melting furnace and a hot forming press.	+250
▪ **Total, Oak Ridge National Laboratory**	+410
▪ **Other Activities**	
• **Safety/Program Analysis and Testing Infrastructure** The increase from $4,300,000 to $4,390,000 represents escalation to maintain analytical capabilities required to support both a national security and NASA mission.	+90
Total, Space and Defense Infrastructure	**+4,629**
Medical Isotopes Infrastructure	
▪ Decrease of $14,828,000 is due to the Medical Isotopes Infrastructure program being transferred to the Office of Science in FY 2009.	-14,828
Total, Medical Isotopes Infrastructure	**-14,828**
Research Reactor Infrastructure	
▪ **Idaho National Laboratory (INL)**	
• **Research Reactor Infrastructure** The increase from $2,920,000 to $3,700,000 will provide for restoration of fuel inventory for MIT and MURR reactors, the removal and shipment of HEU cores from the FY 2008 conversion of Oregon State and Washington State's reactors from HEU to low enriched uranium fuel, the fabrication of TRIGA fuel elements for several university reactors, and the removal and shipment of the HEU core from the University of Wisconsin reactor scheduled to be converted during FY 2009.	+780
Total Funding Change, Radiological Facilities Management	**-9,419**

Capital Operating Expenses and Construction Summary
Capital Operating Expenses

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Capital Equipment	2,350	1,321	3,830
Total, Capital Operating Expenses	2,350	1,321	3,830

Isotope Production and Distribution Program Fund

Funding Schedule by Activity

In FY 2007 and FY 2008, no funds were requested for the Isotope Production and Distribution Fund. Beginning in FY 2009, the Isotopes Production and Distribution Program Fund is being transferred to the Office of Science. Isotopes are currently produced and processed at three facilities: Los Alamos National Laboratory, Brookhaven National Laboratory, and Oak Ridge National Laboratory. Each of the sites' production expenses for processing and distributing isotopes will be offset by revenue generated from sales.

Description

The Isotope Program (Isotope Production and Distribution Program Fund) produces and sells radioactive and stable isotopes, byproducts, surplus materials, and related isotope services world wide. The Isotope Program operates under a revolving fund established by the 1990 Energy and Water Appropriations Act (Public Law 101-101), as modified by Public Law 103-316. Each isotope is priced such that the customer pays the cost of production.

In FY 2007 and FY 2008, the Program's fiscal year appropriation was received via transfer from the Radiological Facilities Management Program. The appropriation was used to maintain and upgrade the infrastructure that is needed to assure continued reliable production, with the production costs borne by the customers. No Radiological Facilities Management program funds were expended on the development or production of isotopes.

The combination of the annual direct appropriation and revenues from isotope sales are deposited in the Isotope Production and Distribution Program Fund, the revolving fund. The fund's revenue and expenses are audited annually consistent with Government Auditing Standards and other relevant acts, such as the Chief Financial Officers Act of 1990 and the Government Performance and Results Act of 1993.

The Department has supplied isotopes and related services for more than 50 years. These isotope products and services are used by medical institutions, universities, research organizations, and industry for a wide array of uses and applications. These isotope products and services are also provided to many Federal agencies either directly or indirectly. For example, isotopes are provided to the National Institutes of Health and their grantees, Environmental Protection Agency, and Homeland Security.

As the range of available isotopes and the recognized uses for them have increased, new or improved isotope products have contributed to progress in medical research and practice, new industrial processes, and scientific investigation. Substantial national and international infrastructures have been built around the use of isotopes and are dependent on the Department's products and services. Isotopes are used for hundreds of research, biomedical, homeland security, and industrial applications that benefit society every day, for example, heart imaging, cancer therapy, smoke detectors, neutron detectors, explosive detection, oil exploration, and tracers for climate change.

Isotope applications are widely used in medical research, diagnosis, and therapies, which are a growing component of the U.S. health care system. The use of medical isotopes reduces health care costs and improves the quality of patient care. It is estimated that one in every three people treated at a hospital makes use of a radioisotope in their laboratory tests, diagnoses, or therapy. Each day, over 40,000 medical patients receive nuclear medicine procedures in the United States. Such nuclear procedures are among the safest diagnostic tests available. They save millions of dollars each year in health care costs and enhance the quality and effectiveness of patient care by avoiding costly exploratory surgery and similar procedures. For example, it has been demonstrated that the use of myocardial perfusion imaging in emergency department chest pain centers can reduce duration of stay on average from 1.9 days to 12 hours. Therefore, an adequate supply of medical and research isotopes is essential to the Nation's health care system, and to basic research and industrial applications that contribute to national economic competitiveness.

Isotope uses in Homeland Security applications are also increasing. Some isotope applications are: radiation portal monitors used to find unshielded or lightly shielded radiological material; imaging systems used to find densely shielded material; systems to detect presence of nitrogen-based chemical explosives; and other forms of explosive detection.

For the future, the Department foresees more than moderate growth in isotope demand, coupled with possible needs for new isotope products for homeland security, medicine, and industry. In order to satisfy the needs of its customers, the program seeks to meet supply requirements for year-round availability of isotopes for scientific and medical research and, in particular, for human clinical trials. The program's production capability may be called upon for initial ramp-up of production of major new isotope products until market forces bring in private producers who are willing to invest and produce the needed isotopes.

Idaho Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Idaho Facilities Management			
INL Operations and Infrastructure	78,405	115,935	104,700
INL Construction	6,030	0	0
Total, Idaho Facilities Management	84,435	115,935	104,700

Description

The Idaho Facilities Management (IFM) Program operates and maintains the three main engineering and research campuses at the Idaho National Laboratory (INL). The three main engineering and research campuses are: (1) the Reactor Technology Complex (RTC) which includes the Advanced Test Reactor (ATR) and supporting infrastructure, (2) the Materials and Fuels Complex (MFC), and (3) the Research and Education Campus (REC). The RTC and MFC are located at the INL site, an 890 square mile reservation west of Idaho Falls, and the REC is located within Idaho Falls. The Radiological and Environmental Sciences Laboratory (RESL) is a testing facility that is operated by the Office of Nuclear Energy (NE).

The IFM Operations and Infrastructure activity includes nine subprogram activities: (1) Base Operations; (2) Routine Maintenance and Repair; (3) ATR Infrastructure; (4) ATR Operations; (5) ATR Life Extension Program; (6) RESL; (7) Essential State Environmental Compliance; (8) Idaho Facilities and Infrastructure Revitalization Program; and (9) Capital Equipment.

The IFM program supports National Energy Policy goals by maintaining and operating facilities dedicated to advanced nuclear energy technology research and development. The Atomic Energy Act of 1954, Chapter 4, Sections 31, 32, and 33, mandates that the Department conduct research and development for nuclear energy. Section 955 of the Energy Policy Act of 2005 directs the Secretary of Energy to operate and maintain civilian nuclear infrastructure and facilities to support nuclear energy activities, including the development of revitalization priorities and a timeline and proposed budget for the completion of deferred maintenance on plants and equipment. It also requires the development of a comprehensive plan for INL facilities. Federal Acquisition Regulation (FAR) 35.002 requires the Department to support its laboratories so that they remain available to respond quickly to Department requirements. IFM is one of the three programs that respond to FAR 35.002 in the Department. The others are (1) the National Nuclear Security Administration's (NNSA) Readiness in Technical Base and Facilities Program and (2) the Office of Science's Landlord Program.

The INL Ten Year Site Plan (TYSP) is intended to identify annual budget requirements for the IFM Program over an extended period based upon program requirements for DOE programs including: the Global Nuclear Energy Partnership; the Next Generation Nuclear Plant Program; the Generation IV Nuclear Energy Systems Initiative; the Nuclear Hydrogen Initiative; Space and Defense Power Systems; and the Naval Reactors Program. The plan meets the requirements of DOE Order 430.1B, *Real Property Asset Management*.

In FY 2009, IFM will continue to ensure that the Department's unique facilities, required for advanced nuclear energy technology research and development, are maintained and operated such that they are available to support national priorities. In FY 2009, priorities include ensuring facilities are available to conduct post irradiation testing of ATR test articles and fuel and materials development. In addition, the program will continue to fund routine maintenance to assure that programmatic facilities and equipment can be operated safely and reliably. IFM will maintain and operate essential ATR support activities to be available and ready to support ATR operations. The ATR operations program will undertake maintenance upgrades to its control and console display systems to correct degrading reliability in these essential systems. Associated with ATR Life Extension, the program will conduct a Material Condition Assessment (MCA) to determine remaining functional service life of selected plant components and to identify critical spare parts that will need to be purchased.

IFM program does not provide funding to support the facilities or technical base readiness of other DOE, federal or private sector work conducted at the INL nor does it support general site wide infrastructure.

IFM program does not fund major items of equipment, specialized facilities or line item projects that directly support a specific NE program. These acquisitions are the responsibility of the sponsoring program office.

Prior to FY 2008, the IFM Program was funded in both the Energy Supply and Conservation and the Other Defense Activities appropriations. Beginning in FY 2008, IFM is solely funded under the Nuclear Energy appropriation.

Detailed Justification

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
INL Operations and Infrastructure	**78,405**	**115,935**	**104,700**
▪ **Base Operations**	**33,775**	**56,500**	**56,550**

The Base Operations for MFC and REC provides the technical and operational staff, equipment, materials and services necessary to keep essential Research and Development facilities and systems in a state of readiness to support the NE mission at INL. Readiness includes training and qualification programs, maintenance of procedures, safety documentation and technical manuals, and the R&D and support equipment operations. Readiness assures compliance with federal, state and local regulations and the availability of facilities to do programmatic work. Beginning in FY 2008, funding to support the RTC campus is requested under ATR Infrastructure, as the RTC infrastructure primarily supports the ATR Program. As in prior years, the FY 2009 priorities are to assure that essential facilities remain available and ready to support all NE R&D program requirements including post irradiation testing, fuel and materials development, and process development.

▪ **Routine Maintenance and Repair**	**5,639**	**6,000**	**6,000**

The IFM routine maintenance and repair program provides the funding necessary to conduct a program of condition assessment, servicing and repair of R&D and support systems and

equipment for facilities at MFC and REC. Routine maintenance is required to assure that programmatic facilities and equipment can be operated safely and reliably. Beginning in FY 2008, funding for RTC operations and routine maintenance and repair activities is requested in ATR Infrastructure since this campus directly and almost exclusively supports the operation of the ATR. In FY 2009, the program continues to focus on maintaining critical systems to support NE operations. INL has many systems that have exceeded their normal service life and these types of systems require more extensive routine maintenance, more frequent repairs and are often not supported by manufacturer's parts or service programs.

- **ATR Infrastructure** **7,606** **5,600** **5,600**

  The ATR Infrastructure program provides the technical and operational staff, equipment, materials and services necessary, to keep essential support facilities and systems located at RTC in a state of readiness to support the operation of the ATR. The ATR Infrastructure program encompasses light labs, machining and assembly shops, calibration and instrumentation labs, and other ATR support activities at RTC. FY 2009 priorities will continue to maintain and operate essential ATR support activities to be available and ready to support ATR operations.

- **ATR Operations** **7,000** **29,122** **26,500**

  ATR Operations provides funding for ATR operations including the conduct of activities required to plan, analyze, load and unload test assemblies, to manage the reactor fuel inventory, as well as the actual operation and maintenance of the reactor. Maintaining and operating the ATR in a state of regulatory compliance and readiness to perform a spectrum of irradiation services requires an extensive human infrastructure of engineers, scientists, qualified reactor operators, specialized maintenance staff, planners and technicians and the equipment, facilities and supplies necessary to support their work. NE has assessed the ATR and has found it to be a viable test facility capable of supporting additional DOE, commercial and university based research on the behavior of nuclear fuels and materials in a reactor environment. It also has a largely undeveloped capability to produce isotopes for medical research and industrial applications. In FY 2009, the ATR operations program will undertake maintenance upgrades to its control and console display systems to correct degrading reliability in these essential systems. At the requested level of funding in FY 2009, the INL will have the resources necessary to operate the ATR safely and reliably.

- **ATR Life Extension Program (LEP)** **16,000** **3,100** **3,100**

  In FY 2009, a Material Condition Assessment (MCA) will be conducted to determine remaining functional service life of selected plant components and to identify critical spare parts that will need to be purchased. The ATR MCA will use lessons learned from the U.S. Nuclear Regulatory Commission and Electric Power Research Industry. The seismic qualifications as well as the Probabilistic Risk Assessment of the ATR will be updated to assure system performance and inform operations decisions. Also, the ATR's design requirements and

  physical plant configuration will be assessed against the safety authorization basis to inform plant improvements.

(dollars in thousands)

FY 2007	FY 2008	FY 2009

- **Radiological and Environmental Sciences Laboratory (RESL)** **0** **2,450** **2,450**

  Beginning in FY 2008, funding is included for RESL activities, which were previously funded by the Office of Environment, Safety and Health. RESL is a DOE-owned and operated laboratory located at the Central Facilities Area. Its core mission capabilities are in analytical chemistry and in radiation measurements and calibrations. RESL serves as a radiological standards reference laboratory for DOE, conducting measurement quality assurance programs to assure that key DOE activities are completed in a safe and environmentally responsible manner. RESL is responsible for the DOE Laboratory Accreditation Program and the Mixed Analyte Performance Evaluation Program. The program provides unbiased technical data and analysis for DOE oversight of worker radiation protection and analytical services at DOE sites. By assuring the quality and stability of key laboratory measurement systems throughout DOE and by providing expert technical assistance to improve those systems, RESL helps assure the accuracy and reliability of data that protect workers, the public, and the environment. Funding covers technical support to the Federal staff at RESL, laboratory supplies, and capital equipment.

- **Essential State Environmental Compliance** **4,000** **4,000** **4,000**

  Perform remedial actions for NE legacy waste agreed to in Voluntary Consent Orders between the Department and the State of Idaho.

- **Idaho Facilities and Infrastructure Revitalization Program (IFIRP)** **4,385** **7,663** **0**

  The IFIRP is a program to fund the replacement of R&D and support equipment and integrated systems which have exhibited excessive routine maintenance or that can no longer be maintained. These are normally complicated and costly tasks that have developed over time and are difficult to accommodate within routine maintenance and repair budgets. Replacing these systems reduces the cost of maintenance, improves reliability and can often reduce operating cost by employing energy efficient technology. No funding is requested in FY09 due to higher priority requirements.

- **Capital Equipment** **0** **1,500** **500**

  This funding primarily provides replacements for aged, deteriorated items of capital equipment, and procurement of new capital equipment to meet emerging requirements. This includes such things as shop machines, vehicles, heavy equipment, and general purpose laboratory equipment. Capital Equipment planning goals are provided in the INL TYSP in accordance with Department Order 430.1B, Real Property Asset Management.

INL Construction **6,030** **0** **0**

- **06-E-200, Nuclear Energy Project Engineering and Design (PED) for the Remote Treatment Program (RTP)** **6,030** **0** **0**

  The RTP at the MFC was initiated to address near-term waste management needs stemming from the nuclear research legacy waste at the MFC which was the Argonne West site operated by the Office of Science prior to the creation of the INL in 2005. PED funding for the RTP is not requested in FY 2009 due to higher priority requirements.

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Total, Idaho Facilities Management	**84,435**	**115,935**	**104,700**

Explanation of Funding Changes

	FY 2009 vs. FY 2008 ($000)
INL Operations and Infrastructure	
▪ **Base Operations** The increase from $56,500,000 to $56,550,000 reflects variations in work scope from FY 2008 to FY 2009.	+50
▪ **ATR Operations** The decrease from $29,122,000 to $26,500,000 reflects additional funds provided in FY 2008 for ATR national scientific user facility infrastructure and transition activities. The FY 2008 level of funding for the national scientific user facility is not sustainable within the total IFM budget.	-2,622
▪ **Idaho Facilities and Infrastructure Revitalization Program (IFIRP)** The decrease from $7,663,000 to $0 reflects the need to provide funding for high priority nuclear safety basis work at the MFC and to sustain the ATR budget and work scope at approximately the FY 2008 level.	-7,663
▪ **Capital Equipment** The decrease from $1,500,000 to $500,000 reflects the need to provide funding for high priority nuclear safety basis work at MFC, and to sustain the ATR budget and work scope at approximately the FY 2008 level.	-1,000
Total Funding Change, Idaho Facilities Management	**-11,235**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
General Plant Projects (Revitalization) & Deferred Maintenance Reduction (IFIRP)	4,385	7,663	0
Capital Equipment	0	1,500	500
Total, Capital Operating Expenses	4,385	9,163	500

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appro-priations	FY 2007	FY 2008	FY 2009	Unappro-priated Balance
06-E-200, Nuclear Energy PED, Idaho	0	0	6,030	0	0	N/A
Total, Construction			6,030	0	0	

Program Direction

Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2007	FY 2008	FY 2009
Idaho Operations Office			
Salaries and Benefits	0	25,189	25,765
Travel	0	996	996
Support Services	0	866	804
Other Related Expenses	0	5,625	5,111
Total, Idaho Operations Office	0[a]	32,676	32,676
Full Time Equivalents	0	197	197
Radiological and Environmental Sciences Laboratory			
Salaries and Benefits	0	2,325	2,440
Travel	0	65	65
Support Services	0	0	0
Other Related Expenses	0	384	394
Total, Radiological and Environmental Sciences Laboratory	0	2,774[b]	2,899
Full Time Equivalents	0	19	19
Oak Ridge Operations Office			
Salaries and Benefits	1,870	1,945	1,126
Travel	11	13	8
Support Services	0	52	27
Other Related Expenses	151	179	129
Total, Oak Ridge Operations Office	2,032	2,189	1,290[c]
Full Time Equivalents	14	14	8

a Excludes $30,844,000 for program direction expenses at the Idaho Operations Office and 197 Full Time Equivalents appropriated under Other Defense Activities. Beginning in FY 2008, funding for program direction expenses and Full Time Equivalents (FTEs) for the Idaho Operations Office is requested under the Nuclear Energy appropriation.

[b] FY 2008 and beyond includes funding for program direction expenses and 19 FTEs previously funded by the former Office of Environment, Safety and Health.

[c] Beginning in FY 2009, 6 FTEs and funding will be transferred to the Office of Science to support the High Flux Isotope Reactor.

	(dollars in thousands/whole FTEs)		
	FY 2007	FY 2008	FY 2009
Headquarters			
Salaries and Benefits	20,047	28,545	30,771
Travel	970	1,680	1,670
Support Services	3,310	6,504	4,262
Other Related Expenses	5,449	6,504	6,976
Total, Headquarters	29,776	43,233[a]	43,679[b]
Full Time Equivalents	161	189	187
Total Program Direction			
Salaries and Benefits	21,917	58,004	60,102
Travel	981	2,754	2,739
Support Services	3,310	7,422	5,093
Other Related Expenses	5,600	12,692	12,610
Total, Program Direction	31,808	80,872	80,544
Total, Full Time Equivalents	175	419	411

Mission

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Office of Nuclear Energy (NE). NE promotes secure, competitive, and environmentally responsible nuclear technologies to serve the present and future energy needs of the country.

In addition to appropriated funds, NE also manages over $118 million dollars annually in work for others and reimbursable funding. This includes over $40 million annually from the National Aeronautics and Space Administration and the Department of Defense for the development of advanced radioisotope power systems for space exploration and national security missions.

NE's diverse programs are faced with significant human capital challenges in pursuing their growing mission requirements. Extensive downsizing several years ago resulted in numerous skill imbalances and adversely impacted NE's retention of technical and scientific specialists. Wherever possible, employees have been redeployed from lower priority programs to higher priority programs to meet growing mission needs. At this point, NE faces a variety of staffing challenges in managing its expanding programs.

[a] Includes funding for 16 FTEs for the MOX Fuel Fabrication Facilities/Fissile Materials Disposition program.
[b] Beginning in FY2009, 2 FTEs and funding will be transferred to the Office of Science to support the Medical Isotope program.

NE's human capital vision is to develop, recruit, and maintain a diverse organization of highly skilled professionals with the competency and motivation to contribute to the development and implementation of national energy policies and programs to help lead the United States in achieving its nuclear technology goals for the twenty-first century.

The NE Workforce Plan was updated in August 2007 to reflect mission changes and identify skills gaps. Like the rest of the Federal Government, NE is planning for workforce changes that are engendered by an aging workforce. The average age of the NE workforce is 49.6 years, higher than the 46.8 year average age of the Federal workforce overall. Currently 25 percent of the workforce is eligible for retirement and an additional 5 percent will be eligible by the end of FY 2009. Over the past several years, NE has been trying to address the issue of an aging workforce through the recruitment of entry-level engineering, scientific, and administrative positions. Continuation of this effort is essential.

Prior to FY 2007, the Idaho Operations Office Program Direction account was funded in the Other Defense Activities appropriations. Beginning in FY 2008 and beyond, funding for Idaho Operations Office is requested under the Nuclear Energy appropriation. Also beginning in FY 2008, the NE Program Direction account includes funding for16 FTEs associated with the Fissile Materials Disposition, MOX Fuel Fabrication Facilities program. In FY 2009, NE will transfer 6 FTEs at the Oak Ridge Operations Office associated with the management of the High Flux Isotope Reactor and 2 FTEs at headquarters associated with the Medical Isotope Program to the Office of Science.

Detailed Justification

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Salaries and Benefits	**21,917**	**58,004**	**60,102**

This account provides funding to support the salaries and benefits of the personnel associated with NE programs. Currently 25 percent of the workforce is eligible to retire and an additional 5 percent will be eligible by the end of FY 2009; therefore, it is essential that program direction resources are available to compete for needed skills. NE seeks to hire not only senior engineers and project managers for new and changing programs, but also to recruit junior staff for succession planning purposes; efforts to hire additional junior staff are ongoing. In addition to the Headquarters staff, NE funds field employees at the Idaho Operation Office (197), the Radiological and Environmental Sciences Laboratory (RESL) in Idaho (19), the Oak Ridge Operations Office (8), and three employees who support the U.S. Mission to the Organization for Economic Cooperation and Development (1); U.S. Mission to International Organization in Vienna (1); and the Department of Energy Tokyo Office (1). In FY 2007, due to the Continuing Resolution, the Idaho Operations Office was funded in the Other Defense Activities appropriation and RESL was funded under the former Office of Environment, Safety and Health. Beginning in FY 2008, this account includes funding for 16 FTEs associated with the MOX Fuel Fabrication Facilities/Fissile Materials Disposition program previously funded under the National Nuclear Security Administration (NNSA). Beginning in FY 2009, the Office of Science will fund 6 FTEs at the Oak Ridge Operations Office associated with the management of the High Flux Isotope Reactor and 2 FTEs associated with the Medical Isotope Program.

	(dollars in thousands)		
	FY 2007	FY 2008	FY 2009
Travel	**981**	**2,754**	**2,739**

Travel includes funding for transportation of Headquarters and Operations Office personnel associated with NE programs, their per diem allowances while in authorized travel status, and other expenses incidental to travel. The decrease in travel reflects the transfer of 6 FTEs at Oak Ridge and 2 FTEs at Headquarters to the Office of Science.

Support Services	**3,310**	**7,422**	**5,093**

Support Services includes funding for technical and management support services provided to NE Headquarters and the Operations Offices. The use of support services allows the Department to hire the best available industry experts to assist federal staff in managing the growing nuclear programs and complex activities. In addition to rapidly acquiring this expertise, using support services provides unlimited flexibility in team composition as the needs of NE evolve.

Other Related Expenses	**5,600**	**12,692**	**12,610**

The major expenditure in the Other Related Expenses category in FY 2009 is $4,275,000 million for the Headquarters Working Capital Fund (WFC). The Department's Chief Financial Officer established a WCF to provide funding for mandatory administrative costs, such as: building occupancy and telephone services; copying, printing and graphics; networking, desktop support; procurement management; payroll and personnel; corporate training services; and the project management career development program. The Other Related Expense category also includes support for NE's federal advisory committee, training, as well as the housing, office communications, supplies, miscellaneous expenses and International Cooperative Administrative Support Services (ICASS) expenses associated with the three employees assigned overseas. The increase in FY 2009 is primarily associated with the increase the WCF and escalation, offset by a reduction in other services at Idaho and by the transfer of other related expenses associated with the 6 FTEs at Oak Ridge and 2 FTEs at Headquarters to the Office of Science.

Total, Program Direction	**31,808**	**80,872**	**80,544**

Explanation of Funding Changes

	FY 2009 vs. FY 2008 ($000)
Salaries and Benefits	
The increase from $58,004,000 to $60,102,000 reflects a 3.4 percent escalation and funds for promotions, awards, and within-grade salary increases; (+$3,309,000) offset by the transfer to the Office of Science of 2 FTEs at Headquarters in support of the Medical Isotope Program and 6 FTEs at Oak Ridge Operation Office in support of the High Flux Isotope Reactor (-$1,211,000).	+2,098
Travel	
The decrease from $2,754,000 to $2,739,000 in travel reflects the transfer of travel funds associated with the 2 FTEs at Headquarters and 6 FTEs at Oak Ridge Operations Office	-15

FY 2009 vs. FY 2008 ($000)

to the Office of Science (-$15,000).

Support Services
The decrease from $7,422,000 to $5,093,000 is due to the decrease in support required for NE programs ($-2,059,000) and the transfer of support services associated with the 6 FTEs at Oak Ridge Operations Office and 2 FTEs at Headquarters transferred to the Office of Science (-$270,000). -2,329

Other Related Expenses
The decrease from $12,692,000 to $12,610,000 is due to an increase in Working Capital Fund costs (+$587,000); offset by reduction in services at Headquarters ($-284,000) and Idaho Operations Offices ($-330,000) and the other related expenses associated with the 6 FTEs at Oak Ridge Operations Office and 2 FTEs at Headquarters transferred to the Office of Science ($-55,000). -82

Total Funding Change, Program Direction **-328**

Support Services by Category

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Technical Support			
Feasibility of Design Considerations	0	1,000	1,000
Development of Specifications	175	800	390
Economic and Environmental Analyses	245	330	300
Surveys Or Reviews of Technical Operations	155	1,315	528
Total, Technical Support	575	3,445	2,218
Management Support			
Automated Data Processing	1,400	1,675	1,400
Manpower Systems Analyses	200	300	200
Preparation of Program Plans	125	300	150
Training and Education	0	250	125
Reports and Analyses Management and General Administrative Services	1,010	1,452	1,000
Total, Management Support	2,735	3,977	2,875
Total, Support Services	3,310	7,422	5,093

Other Related Expenses by Category

(dollars in thousands)

	FY 2007	FY 2008	FY 2009
Other Related Expenses			
Working Capital Fund	2,600	3,688	4,275
Advisory and Assistance Services	215	200	100
Operations and Maintenance of Equipment	510	1,627	1,479
Printing and Reproduction	24	52	53
Training	159	414	364
Rent and Utilities	8	971	910
Communications, Utilities, Misc.	51	2,251	2,036
Supplies and Materials	43	118	110
Other Services	1,990	3,371	3,283
Total, Other Related Expenses	5,600	12,692	12,610