Nuclear Energy

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The Department of Energy's FY 2007 Congressional Budget justification is available on the Office of Chief Financial Officer/CFO homepage at http://www.mbe.doe.gov/budget/

Energy Supply and Conservation
Office of Nuclear Energy, Science and Technology

Overview

Appropriation Summary by Program

(dollars in thousands)

	FY 2005 Current Appropriation	FY 2006 Original Appropriation	FY 2006 Adjustments	FY 2006 Current Appropriation	FY 2007 Request
Energy Supply and Conservation					
University Reactor Infrastructure and Education Assistance	23,810	27,000	-270[a]	26,730	0
Research and Development					
Nuclear Energy Plant Optimization	2,412	0	+0	0	0
Nuclear Energy Research Initiative	2,416	0	+0	0	0
Nuclear Power 2010	49,605	66,000	-660[b]	65,340	54,031
Generation IV Nuclear Energy Systems Initiative	38,828	55,000	-550[c]	54,450	31,436
Nuclear Hydrogen Initiative	8,682	25,000	-250[d]	24,750	18,665
Advanced Fuel Cycle Initiative	66,407	80,000	-800[e]	79,200	243,000
Total, Research and Development	168,350	226,000	-2,260	223,740	347,132
Infrastructure					
Radiological Facilities Management	68,563	54,595	-546[f]	54,049	49,722

[a] Includes a rescission of $270,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.
[b] Includes a rescission of $660,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.
[c] Includes a rescission of $550,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.
[d] Includes a rescission of $250,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.
[e] Includes a rescission of $800,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.
[f] Includes a rescission of $397,000 for Space and Defense Infrastructure, $143,950 for Medical Isotope Infrastructure, and $5,000 for Enrichment Facility Infrastructure in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.

(dollars in thousands)

	FY 2005 Current Appropriation	FY 2006 Original Appropriation	FY 2006 Adjustments	FY 2006 Current Appropriation	FY 2007 Request
Idaho Facilities Management	122,320	113,862	-1,139[a]	112,723	95,290
Idaho Sitewide Safeguards and Security	58,103	75,008	-720[b]	74,288	0
Total, Infrastructure	248,986	243,465	-2,405	241,060	145,012
Spent Nuclear Fuel Management	6,681	0	+0	0	0
Program Direction	60,076	61,109	-611[c]	60,498	67,608
Transfer from State Department	14,000	0	+0	0	0
Subtotal, Energy Supply and Conservation	521,903	557,574	-5,546	552,028	559,752
Use of Prior-Year Balances	-4,217	0	+0	0	0
Funding from Other Defense	-114,347	-123,873	+1,209[d]	-122,664	0
Funding from Naval Reactors	-10,000	-13,500	+135[e]	-13,365	0
Total, Energy Supply and Conservation	393,339	420,201	-4,202	415,999	559,752

Preface

The Office of Nuclear Energy, Science and Technology (NE) leads the 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 serves the present and future energy needs of the Nation by managing the safe operation and maintenance of the DOE critical nuclear infrastructure that provides nuclear technology goods and services.

[a] Includes a rescission of $826,000 for Idaho Facilities Management under the Energy Supply and Conservation Appropriation, $177,620 for Idaho Facilities Management under the Other Defense Activities Appropriation, and $135,000 from Naval Reactors in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.

[b] Includes a rescission of $720,050 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.

[c] Includes a rescission of $300,060 for Program Direction under the Energy Supply and Conservation Appropriation and $311,030 for Program Direction under the Other Defense Activities in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.

[d] Includes under Other Defense Activities the rescission of $177,620 for Idaho Facilities Management, $720,050 for Idaho Sitewide Safeguards and Security, and $311,030 for Program Direction in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.

[e] Includes the transfer of the rescission of $135,000 from Naval Reactors to Naval Reactors in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.

Within the Energy Supply and Conservation appropriation, NE has ten programs: University Reactor Infrastructure and Education Assistance, Nuclear Energy Plant Optimization, Nuclear Energy Research Initiative, Nuclear Power 2010, Generation IV Nuclear Energy Systems Initiative, Nuclear Hydrogen Initiative, Advanced Fuel Cycle Initiative, Radiological Facilities Management, Idaho Facilities Management, and Program Direction. In FY 2005 and FY 2006, NE has two programs that are partially funded within the Other Defense Activities appropriation—Idaho Facilities Management and Program Direction. Beginning in FY 2007 funds for these programs are solely requested in the Energy Supply and Conservation appropriation.

This Overview will describe Strategic Context, Mission, Benefits, Strategic Goals and Funding by General Goal. These items together put the appropriation in perspective. The Annual Performance Results and Targets, Means and Strategies, and Validation and Verification sections address how the goals will be achieved and how performance will be measured. Finally, this Overview will also address R&D Investment Criteria, Program Assessment Rating Tool (PART), and Significant Program Shifts.

Strategic Context

Following publication of the Administration's "National Energy Policy", the Department developed a Strategic Plan that defines its mission, four strategic goals for accomplishing that mission, and seven general goals to support the strategic goals. Each appropriation has developed quantifiable goals to support the general goals. Thus, the "goal cascade" is the following:

Department Mission → Strategic Goal (25 yrs) → General Goal (10-15 yrs) → Program Goal (GPRA Unit) (10-15 yrs)

To provide a concrete link between budget, performance, and reporting, the Department developed a "GPRA[a] unit" concept. Within DOE, a GPRA unit defines a major activity or group of activities that support the core mission and aligns resources with specific goals. Each GPRA unit has completed or will complete a Program Assessment Rating Tool (PART). A unique program goal was developed for each GPRA unit. A numbering scheme has been established for tracking performance and reporting.[b]

The goal cascade accomplishes two things. First, it ties major activities for each program to successive goals and, ultimately, to DOE's mission. This helps ensure the Department focuses its resources on fulfilling its mission. Second, the cascade allows DOE to track progress against quantifiable goals and to tie resources to each goal at any level in the cascade. Thus, the cascade facilitates the integration of budget and performance information in support of the GPRA and the President's Management Agenda (PMA).

Another important component of our strategic planning – and the President's Management Agenda – is use of the Administration's R&D investment criteria to plan and assess programs and projects. The criteria were developed in 2001 and further refined with input from agencies, Congressional staff, the National Academy of Sciences, and numerous private sector and nonprofit stakeholders.

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[a] Government Performance and Results Act of 1993

[b] The numbering scheme uses the following numbering convention: First two digits identify the General Goal (01 through 07); second two digits identify the GPRA Unit; last four digits are reserved for future use.

The chief elements of the R&D investment criteria are quality, relevance, and performance. Programs must demonstrate fulfillment of these elements. For example, to demonstrate relevance, programs are expected to have complete plans with clear goals and priorities. To demonstrate quality, programs are expected to commission periodic independent expert reviews. There are several other requirements, many of which R&D programs have and continue to undertake.

An additional set of criteria were established for R&D programs developing technologies that address industry issues. Some key elements of the criteria include: the ability of the programs to articulate the appropriateness and need for Federal assistance; relevance to the industry and the marketplace; identification of a transition point to industry commercialization (or of an off-ramp if progress does not meet expectations), and; the potential public benefits, compared to alternative investments, that may accrue if the technology is successfully deployed.

The OMB-OSTP guidance memo to agencies dated August 12, 2004, describes the R&D investment criteria fully and identifies steps agencies should take to fulfill them. (The memo is available online at www.ostp.gov/html/fy05developingpriority.pdf.) Where appropriate throughout these justification materials, especially in Significant Program Shifts and Explanation of Funding Changes subheadings, specific R&D investment criteria and requirements are cited to explain the Department's allocation of resources.

Mission

The mission of the Office of Nuclear Energy, Science and Technology is to lead the DOE investment in the development and exploration of advanced nuclear science and technology. NE leads the Government's efforts to develop new nuclear energy generation technologies; 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 aims to serve the present and future energy needs of the Nation by managing the safe operation and maintenance of the DOE nuclear infrastructure that provides nuclear technology goods and services. NE manages research laboratories and radiological facilities and is the Lead Program Secretarial Officer for the Idaho National Laboratory.

Benefits

The benefits of nuclear power as 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 U.S., 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. It builds on important work started over the last three years to deploy new nuclear plants in the U.S. by early in the next decade, and to develop advanced, next generation nuclear technology.

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 Advanced Fuel Cycle Initiative develops technologies that would enable the reduction of spent nuclear fuel waste requiring geologic disposal and the recovery of spent nuclear fuel's

valuable energy. 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.

This work will be accelerated under the Global Nuclear Energy Partnership (GNEP) which will further enable the expansion of greenhouse gas emissions-free nuclear power in the U.S. and around the world; promote nuclear nonproliferation goals; and help resolve nuclear waste disposal issues. GNEP will help meet the growing demand for electricity in the developing world through an international framework that will eliminate the need for foreign countries to build enrichment and recycling capabilities. In addition, GNEP will phase-out old recycling technologies that separate plutonium, thus eliminating a proliferation risk.

To facilitate the construction of new nuclear power plants in the U.S., the budget provides funds 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.

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 Nuclear Hydrogen Initiative 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 Generation IV Nuclear Energy Systems Initiative establishes a basis for expansive cooperation with our international partners to develop next generation reactor and fuel cycle systems that represent a significant leap in economic performance, safety, and proliferation resistance.

Strategic, General, and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Office of Nuclear Energy, Science and Technology supports the following goals:

Energy Strategic Goal: To protect our national and economic security by promoting a diverse supply of reliable, affordable, and environmentally sound energy.

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The programs funded by the Office of Nuclear Energy, Science and Technology have the following two Program Goals which contribute to General Goal 4 in the "goal cascade":

Program Goal 04.14.00.00: Develop new nuclear generation technologies - that foster the diversity of the domestic energy supply through public-private partnerships that are aimed in the near-term (2015) at

the deployment of advanced, proliferation-resistant light water reactor and fuel cycle technologies and in the longer-term (2025) at the development and deployment of next-generation advanced reactors and fuel cycles.

Program Goal 04.17.00.00: Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability - to meet the Nation's energy, environmental, medical research, space exploration, and national security needs.

Contribution to General Goal 4

As the United States 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 United States through 2015, the current "once-through" approach to spent fuel will require the United States to build additional repository space to assure the continued, safe management of nuclear waste 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 Advanced Fuel Cycle Initiative (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. Currently, the spent nuclear fuel at nuclear plant sites contains the potential energy equivalent of 6 billion barrels of oil, or about two full years of U.S. oil imports. The AFCI program will make it possible to establish an improved, optimized nuclear fuel cycle that will turn this waste into a huge source of energy and do so in a manner that improves the long-term proliferation-resistance of the civilian nuclear fuel cycle.

The Global Nuclear Energy Partnership (GNEP) will accelerate the work being done under the AFCI program. Advanced recycling technologies can extract highly radioactive elements of commercial spent nuclear fuel and use that material as fuel in fast spectrum reactors to generate additional electricity. The extracted material, which includes all transuranic elements (e.g., plutonium, neptunium, americium and curium), would be consumed by fast reactors to reduce significantly the quantity of material requiring disposal in a repository and to produce power. The plutonium would remain bound with other highly radioactive isotopes, thereby preserving its proliferation resistance and reducing security concerns. With the transuranic materials separated and used for fuel, the volume of waste that would require disposal in a repository would be reduced by 80 percent.

Improving the way spent nuclear fuel is managed in this manner will facilitate the expansion of civilian nuclear power in the United States and encourage civilian nuclear power in foreign countries to evolve in a more proliferation-resistant manner. Once these recycling technologies are proven, the United States 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 to process and store the waste.

The Nuclear Power 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 Research Advisory Committee (NERAC) report, "A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010." In order to support the "Nation Energy Policy" and the President's goal of reducing greenhouse gas intensity by 18 percent by 2012, the Nuclear Power 2010 program will help enable an industry decision to deploy at least one new advanced nuclear power plant in the U.S. early in 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 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. This insurance will provide additional certainty to the builders of new nuclear power plants and help lead to the construction of a new nuclear power plant by the 2014 timeframe.

For the longer-term future, the Department believes that new, next-generation technologies should be considered to enhance the prospects for a significant expansion in the use of nuclear energy in the United States. Engaging this area requires the kind of long-term, high-risk, high-pay-off research that only Government-sponsored research can address. As a prime example, the Department believes that the future energy picture of the United States can and should 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 this Nation to realize a primary objective of the "National Energy Policy"—to enhance the energy independence and security of the United States while making significant improvements in environmental quality. Hydrogen could someday be used to power our entire 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 what may prove to be an important answer: 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 gases—and do so at a cost that is very competitive with imported fossil fuels. The Nuclear Hydrogen Initiative 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, Science and Technology; 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. In the case of nuclear energy, the Department will conduct research and development into advanced thermochemical technologies which may, when used in tandem with next-generation nuclear energy systems, enable the United States to generate hydrogen at a scale and cost that would support a future, hydrogen-based economy.

Developing the next-generation nuclear systems to make hydrogen possible is one aspect of the Generation IV Nuclear Energy Systems. Through this effort, the United States will lead multi-national research and development projects to usher forth 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. After two years of detailed analysis by over 100 of the world's top scientists and engineers, the Nuclear Energy Research Advisory Committee (NERAC), working with the Generation IV International Forum (GIF), has identified six systems in pursuit of which the international community will collaborate and conduct joint research.

In addition to nuclear research and development programs, the Department has the responsibility to maintain and enhance the Nation's nuclear infrastructure currently in place. This includes one of the world's most comprehensive research infrastructures—most of which was constructed in the 1950s and 1960s. It is imperative that we maintain and enhance our national nuclear capabilities by managing these resources and capabilities to ensure that they continue to be operational and available for the fulfillment of important national research and security missions. Guided by invaluable input from NERAC, we seek efficient ways to preserve our national nuclear assets and make appropriate investments to enhance them before passing them on to future generations.

The Radiological Facilities Management program maintains irreplaceable DOE nuclear technology facilities in a safe, secure, environmentally compliant and cost-effective manner to support national priorities. Central to this infrastructure is the Nation's nuclear technology laboratory, the multi-program Idaho National Laboratory (INL). The Department is proceeding with plans to establish the INL as the world's finest nuclear technology laboratory within 10 years. NE also maintains the Department's vital resources and capabilities of NE-managed facilities at Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Sandia National Laboratory (SNL), and Brookhaven National Laboratory (BNL). The Radiological Facilities Management program also supports the oversight and planning required to assure that the Department's nuclear fuel cycle assets—principally the Paducah Gaseous Diffusion Plant—can respond, as required, to future national requirements. This program also supplies fresh reactor fuel to universities and disposes of spent fuel from university reactors across the country.

The Idaho Facilities Management program maintains the Department's facilities at Idaho in a safe, secure and environmentally compliant condition for a range of vital Federal missions.

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, and the U.S. mission to the Organization for Economic Cooperation and Development. 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, Science and Technology Workforce Plan; and continuing to recruit a well-qualified, diverse workforce.

Major FY 2005 Achievements

In FY 2005, the Department established two competitively selected, cost-shared cooperative agreements with industry consortia to obtain combined Construction and Operating Licenses (COLs). The COL process is a "one-step licensing" process established by the Energy Policy Act of 1992 and intended to resolve all public health and safety issues associated with the construction and operation of a new

nuclear power plant before construction begins. The work of the two utility-led consortia includes design certification and completion of state-of-the-art Generation III+ nuclear plant designs for Westinghouse's Advanced Pressurized Water Reactor, the AP1000, and General Electric's Economic and Simplified Boiling Water Reactor, the ESBWR; and site-specific analysis and engineering required to obtain COLs from the Nuclear Regulatory Commission.

In FY 2005, the Department created the Idaho National Laboratory (INL) to serve as the center for the Department's nuclear energy research and development efforts. The INL will play a lead role in Generation IV nuclear energy systems development, advanced fuel cycle development, testing of naval reactor fuels and reactor core components, and space nuclear power applications. While the laboratory has transitioned its research and development focus to 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.

Funding by General and Program Goal

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
General Goal 4, Energy Security			
Program Goal 04.14.00.00, Develop new nuclear generation technologies	163,522	223,740	347,132
Program Goal 04.17.00.00, Maintain, enhance, and safeguard the national nuclear infrastructure	183,807	162,553	145,012
Subtotal, General Goal 4 (Energy Supply and Conservation)	347,329	386,293	492,144
All Other			
Nuclear Energy Research Initiative	2,416	0	0
Nuclear Energy Plant Optimization	2,412	0	0
Program Direction	26,218	29,706	67,608
Transfer from State Department	14,000	0	0
Spent Nuclear Fuel Management	5,181	0	0
Use of Prior Year Balances	-4,217	0	0
Total, All Other	46,010	29,706	67,608
Total, General Goal 4 (Energy Supply and Conservation)	393,339	415,999	559,752

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 reduced atmospheric emissions. DOE has incorporated feedback from OMB into the FY 2007 Budget Request, and the Department will take the necessary steps to continue to improve performance.

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 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 is no longer necessary, and the 2007 Budget proposes termination of this program. This termination is also supported by the fact that the program lacks adequate performance measures and was unable to demonstrate results from its activities when reviewed using the PART. The 2007 Budget includes $2.9 million to provide fresh reactor fuel to universities and dispose of spent fuel from university reactors under Research Reactor Infrastructure, within Radiological Facilities Management.

NE has incorporated feedback from OMB during the FY 2006 assessment for National Nuclear Infrastructure, as well as the FY 2004-FY 2005 assessments for Nuclear Energy R&D into the FY 2007 Budget Request and has taken or will take the necessary steps to continue to improve performance.

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

Nuclear Power 2010 (NP 2010) received a rating of Adequate; Generation IV Nuclear Energy Systems Initiative and Advanced Fuel Cycle Initiative (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 perfect 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 four out of five. To address these findings, stronger links between program goals and funding requests are shown in this budget submission. In the program management area, NP 2010 needs to measure and achieve cost effectiveness in program execution. In the program results area, NP 2010 needs to establish on an annual basis an independent assessment of the overall program. Generation IV lacks periodic external review. AFCI needs to better demonstrate the cost effectiveness of the program.

In addition, the AFCI and Generation IV programs were found to rely upon process oriented, output based metrics that do not indicate whether the program is successful or demonstrating meaningful progress. These programs lack performance measures that capture progress made on its core elements. For example, AFCI should have metrics in place that demonstrate annual progress on its various components, such as separations, fuels, and transmutation. For the Generation IV program, metrics are needed to compare the key attributes of the various reactor designs (sustainability, proliferation resistance and security, safety and reliability, and economics) more objectively. Over the coming year, NE will work to develop meaningful, measurable outcome based performance metrics.

The National Nuclear Infrastructure assessment did find that the program is effectively targeted through the formal Idaho National Laboratory Ten Year Site Plan that identifies the mission-essential infrastructure and facilities, planned annual work scope, and performance measures for the laboratory. Findings from PART assessments are also addressed in the relevant sections of this budget submission.

Significant Policy or Program Shifts

- Beginning in FY 2007, the Advanced Fuel Cycle Initiative program will be refocused and accelerated toward near-term demonstration at engineering scale of the most promising technologies developed to date. In FY 2007, under the Global Nuclear Energy Partnership (GNEP), the Department will initiate work towards conducting an engineering scale demonstration of the UREX+ separations process (operational 2011) and developing an advanced fuel cycle facility capable of laboratory development of advanced separations and fuel manufacturing technologies (operational 2016). Over the coming year, NE will collaborate with international and private parties to refine the GNEP concept and gauge interest in a demonstration of the sodium cooled reactor technology, which would serve as the fast Advanced Burner Reactor component of GNEP (operational 2014).

- Enrollment target levels of the University Reactor Infrastructure and Education Assistance program have already been met and students no longer need to be encouraged to enter into nuclear related disciplines. In addition, the program lacks adequate performance measures and is unable to demonstrate results from its activities. Consequently, the Department has determined it no longer needs to fund this program. The 2007 Budget includes $2.9 million to provide fresh reactor fuel to universities and dispose of spent fuel from university reactors under Research Reactor Infrastructure, within Radiological Facilities Management.

- The Energy Policy Act of 2005 directs the Secretary to establish a program to provide standby support contracts for six new advanced nuclear energy reactors. The Department is implementing a new phase of the Nuclear Power 2010 program in FY 2007 to develop the regulations, criteria and process under which the Department would accept and approve applications for standby support contracts from industry for new nuclear plants in support of the deployment of such plants. The Department anticipates that sponsors may submit applications for standby support contracts as soon as FY 2008.

- The ^{233}U Disposition, Medical Isotope Production and Building 3019 Complex Shutdown project has been transferred to the Office of Environmental Management.

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 2005	FY 2006	FY 2007
Idaho National Laboratory	10,805	9,148	9,368
Oak Ridge National Laboratory	175	175	175
Total, Indirect-Funded Maintenance and Repair	10,980	9,323	9,543

Direct-Funded Maintenance and Repair

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Infrastructure			
Idaho Facilities Management			
Idaho National Laboratory[a]	11,947	7,871	9,636
Radiological Facilities Management			
Oak Ridge National Laboratory	1,825	1,880	1,936
Other			
Naval Reactors	7,314	7,504	7,684
Department of Army (Specific Manufacturing Capability)	2,064	2,118	2,168
Total, Direct-Funded Maintenance and Repair (Energy Supply and Conservation and Other Defense Activities)	23,150	19,373	21,424

[a] Includes $876,000 in FY2005 and $674,000 in FY 2006 funded under Other Defense Activities.

Office of Nuclear Energy, Science and Technology
Funding by Site by Program

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Argonne National Laboratory			
Advanced Fuel Cycle Initiative	6,913	9,800	4,250
Generation IV Nuclear Energy Systems Initiative	2,423	3,530	2,075
Nuclear Energy Plant Optimization	250	0	0
Nuclear Energy Research Initiative	60	0	0
Nuclear Hydrogen Initiative	716	1,260	1,000
Nuclear Power 2010	16	0	0
University Reactor Infrastructure and Education Assistance	105	110	0
Total, Argonne National Laboratory	10,483	14,700	7,325
Brookhaven National Laboratory			
Advanced Fuel Cycle Initiative	556	550	450
Generation IV Nuclear Energy Systems Initiative	320	295	200
Nuclear Hydrogen Initiative	60	0	0
Nuclear Power 2010	60	0	0
Radiological Facilities Management	2,673	2,650	2,905
University Reactor Infrastructure and Education Assistance	60	0	0
Total, Brookhaven National Laboratory	3,729	3,495	3,555
Chicago Operations Office			
Idaho Facilities Management	500	500	500
Nuclear Power 2010	15	0	0
Total, Chicago Operations Office	515	500	500
Idaho National Laboratory			
Advanced Fuel Cycle Initiative	25,961	28,433	15,500
Generation IV Nuclear Energy Systems Initiative	14,084	21,054	16,000
Idaho Facilities Management	90,934	81,274	94,790
Nuclear Energy Plant Optimization	1,697	0	0
Nuclear Energy Research Initiative	22	0	0

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Nuclear Hydrogen Initiative	2,285	5,385	4,165
Nuclear Power 2010	78	0	0
Radiological Facilities Management.	14,732	20,503	15,147
Spent Nuclear Fuel Management	5,181	0	0
University Reactor Infrastructure and Education Assistance	2,832	3,132	0
Total, Idaho National Laboratory	157,806	159,781	145,602
Idaho Operations Office			
Advanced Fuel Cycle Initiative	6,376	9,612	7,500
Generation IV Nuclear Energy Systems Initiative	9,531	9,225	2,915
Nuclear Energy Research Initiative	2,133	0	0
Nuclear Hydrogen Initiative	660	6,852	2,050
Nuclear Power 2010	47,808	63,340	50,276
Program Direction	0[a]	0[b]	31,361[c]
University Reactor Infrastructure and Education Assistance	20,054	23,123	0
Total, Idaho Operations Office	86,562	112,152	94,102
Lawrence Livermore National Laboratory			
Advanced Fuel Cycle Initiative	175	150	150
Generation IV Nuclear Energy Systems Initiative	410	475	160
Total, Lawrence Livermore National Laboratory	585	625	310
Los Alamos National Laboratory			
Advanced Fuel Cycle Initiative	13,300	6,930	6,250
Generation IV Nuclear Energy Systems Initiative	229	250	0
Radiological Facilities Management	16,960	16,722	17,014
Total, Los Alamos National Laboratory	30,489	23,902	23,264

[a] Excludes $33,587,000 for program direction expenses at the Idaho Operations Office appropriated under Other Defense Activities.
[b] Excludes $30,792,000 for program direction expenses at the Idaho Operations Office appropriated under Other Defense Activities.
[c] Beginning in FY 2007, funding for program direction expenses and Full Time Equivalents for the Idaho Operations Office is requested in the Energy Supply and Conservation appropriation.

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
National Energy Technology Laboratory			
University Reactor Infrastructure and Education Assistance	0	20	0
National Renewable Energy Laboratory			
Nuclear Hydrogen Initiative	0	700	700
NNSA Service Center			
Nuclear Power 2010	0	84	0
Oak Ridge National Laboratory			
Advanced Fuel Cycle Initiative	2,391	2,500	2,000
Generation IV Nuclear Energy Systems Initiative	10,110	14,335	7,270
Nuclear Hydrogen Initiative	180	550	550
Radiological Facilities Management	31,350	11,279	11,815
University Reactor Infrastructure and Education Assistance	64	25	0
Total, Oak Ridge National Laboratory	44,095	28,689	21,635
Oak Ridge Operations Office			
Program Direction	1,957	2,032	2,087
Radiological Facilities Management	496	495	491
Total, Oak Ridge Operations Office	2,453	2,527	2,578
Pacific Northwest National Laboratory			
Advanced Fuel Cycle Initiative	150	150	150
Nuclear Energy Research Initiative	59	0	0
Transfer from State Department	13,200	0	0
Total, Pacific Northwest National Laboratory	13,409	150	150
Sandia National Laboratories			
Advanced Fuel Cycle Initiative	1,700	1,575	1,250
Generation IV Nuclear Energy Systems Initiative	445	760	760
Nuclear Energy Plant Optimization	400	0	0
Nuclear Hydrogen Initiative	210	6,110	6,000

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Radiological Facilities Management	1,900	1,900	1,800
Total, Sandia National Laboratories	4,655	10,345	9,810
Savannah River National Laboratory			
Nuclear Hydrogen Initiative	300	800	800
Total, Savannah River National Laboratory	300	800	800
Savannah River Operations Office			
Advanced Fuel Cycle Initiative	583	13,500	500
Nuclear Power 2010	50	0	0
University Reactor Infrastructure and Education Assistance	300	300	0
Total, Savannah River Operations Office	933	13,800	500
University of Nevada, Las Vegas			
Advanced Fuel Cycle Initiative	6,944	4,950	4,000
Nuclear Hydrogen Initiative	3,860	1,900	1,900
Total, University of Nevada, Las Vegas	10,804	6,850	5,900
Washington Headquarters			
Advanced Fuel Cycle Initiative	1,358	1,050	1,000
Generation IV Nuclear Energy Systems Initiative	1,276	4,526	2,056
Nuclear Energy Plant Optimization	69	0	0
Nuclear Energy Research Initiative	138	0	0
Nuclear Hydrogen Initiative	411	1,193	1,500
Nuclear Power 2010	1,578	1,916	3,755
Program Direction	24,261	27,674	34,160
Radiological Facilities Mgmt	452	500	550
Transfer from State Department	800	0	0
University Reactor Infrastructure and Education Assistance	395	20	0
Total, Washington Headquarters	30,738	36,879	43,021

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Undesignated			
Advanced Fuel Cycle Initiative	0	0	200,000
Total, Energy Supply and Conservation	397,556[a]	415,999	559,752

Major Changes or Shifts by Site

Beginning in FY 2007, the Advanced Fuel Cycle Initiative program will be refocused and accelerated toward near-term demonstration at engineering scale of the most promising technologies developed to date. In FY 2007, under the Global Nuclear Energy Partnership (GNEP), the Department will initiate work towards conducting an engineering scale demonstration of the UREX+ separations process (operational 2011) and developing an advanced fuel cycle facility capable of laboratory development of advanced separations and fuel manufacturing technologies (operational 2016). Over the coming year, NE will collaborate with international and private parties to refine the GNEP concept and gauge interest in a demonstration of the sodium cooled reactor technology, which would serve as the fast Advanced Burner Reactor component of GNEP (operational 2014). In FY 2006, the Department will be reprioritizing activities to support these objectives. In support of the accelerated AFCI program, additional funding is requested in Program Direction for federal staff and contractor support. Because the locations of the demonstration projects have not been determined, funding to support this effort is shown in the undesignated line of the funding by site.

Site Description

Argonne National Laboratory

Introduction

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

Advanced Fuel Cycle Initiative

ANL staffs the AFCI National Technical Director position for separations technology development, providing leadership over multi-laboratory research activities in aqueous and pyroprocessing spent fuel treatment. ANL also supports the AFCI 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 also 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

[a] Funding totals for FY 2005 exclude the use of prior year reduction of $4,217,000.

several 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 is responsible for staffing the position of Generation IV National Technical Director for Design and Evaluation Methods, who coordinates the U.S. efforts on method development and validation. ANL provides one of two U.S. experts for the Generation IV International Forum (GIF) Experts Group.

Nuclear Energy Plant Optimization
ANL conducted joint government-industry research and development activities focused on the long term aging and degradation of Light Water Reactor materials

Nuclear Hydrogen Initiative
ANL supports the program by conducting laboratory analyses of thermochemical hydrogen production methods, specifically the calcium-bromine (Ca-Br) cycle.

University Reactor Infrastructure and Education Assistance
ANL administered the International Student Exchange Program (ISEP). This program provided for student exchanges between the United States and several other nations enabling nuclear engineering and science students the opportunity to work in another nation's national laboratories and increase their training opportunities. ANL also administered part of the university summer internship program.

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.

Advanced Fuel Cycle Initiative
BNL supports the AFCI program in the conduct of transmutation and fuel systems analyses.

Generation IV Nuclear Energy Systems Initiative
BNL is conducting probabilistic risk assessment tasks in support of the Generation IV proliferation resistance studies and conducting an international project on advanced gas-cooled reactors.

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. The BLIP facility operations have decreased from 20 weeks to 10 weeks per year. 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

Idaho Facilities Management
Chicago Operations Office administers a contract with BWXT Service, Inc. for continuing spent nuclear fuel and other related material storage at the BWXT Lynchburg Technology Center.

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. There are nine primary facilities at the INL as well as administrative, engineering, and research laboratories in Idaho Falls, Idaho. The Office of Nuclear Energy, Science and Technology (NE) has assumed Lead Program Secretarial Office (LPSO) responsibility for the Idaho Operations Office (ID). With the transfer of INL from EM to NE, INL will become the center for NE's strategic nuclear energy research and development enterprise, INL's revised mission will play a major role in Generation IV nuclear energy systems development, advanced fuel cycle development, and space nuclear power and propulsion applications. The INL will transition 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 INL will focus on its new role as the center for nuclear research and development as a multi-program national laboratory, the INL will continue to pursue appropriate roles in national security, environmental and other activities. Beginning in the second quarter of FY 2005, ANL-West became part of INL.

Advanced Fuel Cycle Initiative

INL staffs the AFCI National Technical Director 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 arenas. INL has the lead role for the design of the AFCI engineering scale demonstration (ESD) to establish the feasibility of advanced separations processes for spent nuclear fuel. 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 highly radioactive materials.

Generation IV Nuclear Energy Systems Initiative

INL is the lead laboratory for the Generation IV Nuclear Energy Systems Initiative and conducts the program's technical integration activities. INL provides the R&D leadership for the Very High Temperature Reactor (VHTR) and is responsible for the system integration aspects of the Gas Fast Reactor, the Supercritical-Water Reactor, and the Lead Fast Reactor (with LLNL). INL leads or participates in system design and evaluation activities for these systems, and makes important contributions to fuel, materials and energy conversion system efforts. 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 Generation IV International Forum (GIF) Secretariat and supporting staff, 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. INL provides chairs or co-chairs for several GIF System Steering Committees and GIF Project Management Boards.

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 Advanced Fuel Cycle Initiative, Generation IV nuclear energy systems, 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 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 and facilities and associated support structures; a full complement of site wide utilities, including power, communications and data transmission systems; 800 miles of roads; 61 miles of electrical transmission lines; and 14 miles of railroad track. Included are numerous nuclear and radiological facilities.

The INL consists of three main engineering and research campuses: (1) the Reactor Technology Center (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 and various site wide infrastructure systems and facilities that support all the compounds and campuses at the site.

Nuclear Energy Plant Optimization

INL conducted joint government-industry research and development activities focused on the long term aging and degradation of Light Water Reactor materials.

Nuclear Hydrogen Initiative

INL will provide leadership in executing the Nuclear Hydrogen Initiative. INL will cooperate with SNL, in its role as Generation IV National Technical Director for Energy Conversion Systems, to ensure efficient integration of Generation IV and Nuclear Hydrogen Initiative activities.

Nuclear Power 2010

INL completed work to assess the transportation and fuel cycle impacts of advanced reactor designs in support of the Early Site Permit applications to be submitted to NRC under the Nuclear Power 2010 program.

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.

University Reactor Infrastructure and Education Assistance

INL administered the University Reactor Infrastructure and Education Assistance Program to provide fuel for university research reactors including fuel for conversions from highly enriched uranium (HEU) to low enriched uranium (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 Energy Systems Initiative, Nuclear Energy Research Initiative, Nuclear Hydrogen Initiative, Nuclear Power 2010, and the Advanced Fuel Cycle Initiative 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.

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 geological repository.

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 INL 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. The primary mission for LANL is 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 the AFCI National Technical Director position for Transmutation Engineering. LANL also supports activities under the transmutation science education program related to nuclear science and engineering research at U.S. universities.

Generation IV Nuclear Energy Systems Initiative

LANL is working on the development of the Generation IV lead-cooled fast reactor and associated fuel cycle. A senior LANL scientist serves as the National Technical Director for fuels research.

Radiological Facilities Management
At LANL, a portion of the Plutonium Facility-4 at the Technical Area-55 is dedicated to Pu-238 activities. This capability is the only existing Pu-238 purification and encapsulation capability within the DOE complex 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 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 U.S. Department of Energy 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 light water and gas-cooled reactors and participates in the development and deployment planning of advanced aqueous spent fuel treatment technologies.

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 and conducts much of the materials testing in support of the Generation IV Nuclear Energy Systems Initiative.

Nuclear Hydrogen Initiative
ORNL conducts research on the potential for thermochemical process improvements using membranes, specifically those previously developed for the gaseous diffusion process.

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 Building 3047.

ORNL provides baseline operation and maintenance of Building 3019, which has 1.5 metric tons of uranium, containing 450 kilograms of U-233. FY 2005 funding funded the completion of the project engineering, design and analysis necessary to support a performance baseline. Beginning in FY 2006, this project is funded and managed by the Office of Environmental Management.

University Reactor Infrastructure and Education Assistance
ORNL administered part of the university summer internship program.

Oak Ridge Operations Office

Radiological Facilities Management
To assess USEC Inc.'s (USEC) performance, the Oak Ridge Operations Office will establish a baseline by evaluating and assessing the status of key systems required for plant viability and conduct quarterly status review meetings with USEC. The Oak Ridge Operations Office will also monitor (via an earned value management system) the DOE contractor supporting the Paducah Gaseous Diffusion Plant Operational Assurance Program.

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

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

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 serves as NE's technical integrator for AFCI, responsible for coordinating the participation of all laboratories in the development and conduct of the AFCI R&D program. SNL is also an integral part of the AFCI systems analysis effort.

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 Energy Plant Optimization
SNL evaluated alternative concepts to cost-effectively improve security at all nuclear power plants.

Nuclear Hydrogen Initiative
SNL serves as the technical integrator for the Nuclear Hydrogen Initiative, 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 complete an integrated demonstration in FY 2007.

Radiological Facilities Management
The Annular Core Research Reactor (ACRR) is a highly flexible facility 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 Programs no longer has a programmatic need for the Annular Core Research Reactor (ACRR). NNSA uses the ACRR for its weapons experiments and is currently the only user.

Savannah River National Laboratory
Introduction
Savannah River National Laboratory is a multiprogram laboratory located on approximately 34 acres in Aiken, South Carolina.

Nuclear Hydrogen Initiative
Savannah River assists with thermochemical cycle activities.

Savannah River Operations Office

Advanced Fuel Cycle Initiative
Savannah River assists with separations technology activities, advanced fuels development activities, and systems analysis activities.

University Reactor Infrastructure and Education Assistance
Savannah River administered the radiochemistry program.

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 with potential application to fast reactor systems. 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 has increased to include much of the complimentary materials development activities. UNLV actively involves other universities, industry, and national laboratories, making it an effective tool for developing the future work force and an important part of the NHI program.

Washington Headquarters
In FY 2005, funding for the use of prior year balances reduction and other small business initiatives is included in Washington Headquarters. FY 2006 and FY 2007 include funding for SBIR and other small business initiatives.

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 annual NRC certification for isotope shipping casks, independent financial audits of the revolving fund, and other related expenses.

University Reactor Infrastructure and Education Assistance
This program provided funding to Morgan State University for the continuation of the DOE/NE Nuclear Energy Bridge Program.

University Reactor Infrastructure and Education Assistance

Funding Profile by Subprogram

(dollars in thousands)

	FY 2005 Current Appropriation	FY 2006 Original Appropriation	FY 2006 Adjustments	FY 2006 Current Appropriation	FY 2007 Request
University Reactor Infrastructure and Education Assistance	23,810	27,000	-270[a]	26,730	0

Mission

The mission of the University Reactor Infrastructure and Education Assistance program was 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 target levels of the University Reactor Infrastructure and Education Assistance program have already been met and the program is no longer needed to encourage students to enter into nuclear related disciplines.

Benefits

The United States 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 succeeded in helping 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 United States 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.

Funding to support fuel for universities is requested in the Radiological Facilities Management budget under Research Reactor Infrastructure.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The University Reactor Infrastructure and Education Assistance program supported the following goal:

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[a] Includes a rescission of $270,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable, and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The University Reactor Infrastructure and Education Assistance program contributed to General Goal 4 in the "goal cascade:"

Program Goal 04.17.00.00: Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability - to meet the Nation's energy, environmental, medical research, space exploration, and national security needs.

Contribution to Program Goal 04.17.00.00 (Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability)

The University Reactor Infrastructure and Education Assistance Program was designed to address declining enrollment levels among U.S. nuclear engineering programs. Since the late 1990s, enrollment levels in nuclear education programs have tripled. In fact, enrollment levels for 2005 have reached upwards of 1,500 students, the program's target level for the year 2015. 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 proposes termination of the University Reactor Infrastructure and Education Assistance Program. The termination is also supported by the fact that the program was unable to demonstrate results from its activities when reviewed using the Program Assessment Rating Tool (PART), supporting the decision to spend taxpayer dollars on other priorities.

Funding by General and Program Goal

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
General Goal 4, Energy Security			
Program Goal 04.17.00.00: Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability.....	23,810	26,730	0
Total, General Goal 4 (University Reactor Infrastructure and Education Assistance).....	23,810	26,730	0

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Targets	FY 2006 Targets	FY 2007 Targets
Program Goal 04.17.00.00 (Energy Security) University Reactor Infrastructure and Education Assistance				<u>Percentage of grantees that provide itemized accomplishments that are directly correlated to their allocated level of funding.</u>	
Support U.S. universities' nuclear energy research and educational capabilities by: - Providing fresh fuel to university reactors requiring this service; - Funding all of the 23 universities with research reactors that apply for reactor upgrades and improvements; - Partnering with private companies to fund 20 to 25 DOE/Industry Matching Grants for universities; - Providing funding for Reactor Sharing with the goal of enabling all of the 28 eligible schools that apply for the program to improve the use of their reactors for teaching, training, and educating; and - Award two or more Innovations in Nuclear Infrastructure and Education awards. (MET TARGET)	Protect national nuclear research assets by funding 4 regional reactor centers; providing fuel to University Research Reactors; funding 20 to 25 DOE/Industry Matching Grants, 18 equipment and instrumentation upgrades, and 37 Nuclear Engineering Education Research grants; and providing 18 fellowships and 40 scholarships. (MET TARGET)	Fund the six existing regional reactor centers; provide fuel to University Research Reactors; fund 20 to 25 DOE/Industry Matching Grants, 20 equipment and instrumentation upgrades, and 50 Nuclear Engineering Education Research grants; and provide 18 fellowships and 47 scholarships. (MET TARGET)	Issue funding to the six existing Innovations in Nuclear Infrastructure and Education consortia; provide fuel to University Research Reactors; issue funding to 20 to 25 DOE/Industry Matching Grants, 20 equipment and instrumentation upgrades, and 50 Nuclear Engineering Education Research grants; and provide 25 fellowships and 75 scholarships. (MET TARGET)	Complete activities to enhance the nation's nuclear education infrastructure by providing financial support to universities for facility and reactor modernization and to students to enable the pursuit of careers in nuclear energy-related fields; through these activities, DOE is demonstrating its commitment to the development of nuclear technology for the Nation.	Enrollment target levels of the University Reactor Infrastructure and Education Assistance program have already been met and the program is no longer needed to encourage students to enter into nuclear related disciplines.

FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Targets	FY 2007 Targets
Program Goal 04.17.00.00 (Energy Security) University Reactor Infrastructure and Education Assistance (Cont.) Attract outstanding U.S. students to pursue nuclear engineering degrees by: - Providing 18 graduate student fellowships with higher stipends beginning in FY 2002; - Supporting 50 university Nuclear Engineering Education Research Grants to encourage creative and innovative research at U.S. universities; and - Providing scholarships and summer on-the-job training to approximately 40 sophomore, junior and senior nuclear engineering and science scholarship recipients. (MET TARGET)					

Means and Strategies

NE used various means and strategies, as indicated below, to achieve its program goals. NE 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.
- In FY 2005, the Department developed a nuclear science and technology pilot program with the Pittsburgh Public School System which introduced a new curriculum in nuclear science allowing educators to teach nuclear science to high school students. In FY 2006, the Department plans to partner with the private sector and other institutions to make this educational material available across the country.
- 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 American Nuclear Society 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 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 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.

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 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 is no longer necessary, and the 2007 Budget proposes termination of this program. This termination is also supported by the fact that the program lacks adequate performance measures and was unable to demonstrate results from its activities when reviewed using the PART. The 2007 Budget includes $2.9 million to provide fresh reactor fuel to universities and dispose of spent fuel from university reactors under Research Reactor Infrastructure, within Radiological Facilities Management.

Funding Schedule by Activity

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
University Reactor Infrastructure and Education Assistance			
University Nuclear Infrastructure	15,010	14,100	0[a]
DOE/Industry Matching Grants Program	1,000	1,000	0
Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities	2,000	2,350	0
Health Physics Fellowships & Scholarships	200	300	0
Nuclear Engineering Education Research (NEER) Grants	4,900	5,000	0
Nuclear Engineering Education Opportunities	400	600	0
Radiochemistry Awards	300	650	0
University Nuclear Education Infrastructure and Assistance	0	2,730	0
Total, University Reactor Infrastructure and Education Assistance	23,810	26,730	0

Detailed Justification

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
University Nuclear Infrastructure (UNI)	**15,010**	**14,100**	**0[a]**

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.

In FY 2005, the program awarded 22 grants permitting universities without research reactors to have access to reactors for training, educational, and research purposes. In FY 2006, the program is awarding 17-19 reactor sharing grants.

In FY 2005, the program supported 21 universities to address maintenance and upgrades to equipment required at university research reactors; provided new equipment to replace antiquated equipment; maintained reactor systems; and upgraded experimental capabilities. In FY 2006, the Department is awarding 17 reactor upgrade grants.

In FY 2005 Innovations in Nuclear Infrastructure and Education (INIE) grant initiative encompassed 33 universities aligned in six regional INIE consortia; this structure will remain intact for FY 2006. The INIE grants assist universities in continuing the integration of academics and reactor research, which enhances the quality of student education, and encourages universities to better work with the

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

Department's national laboratories, private industry and other universities. Promoting this collaborative effort expands the use of university facilities for research, education, and training of nuclear engineers and scientists by establishing regional research and training centers and strategic partnerships.

No funding is requested for these activities in FY 2007. Funding to provide fresh reactor fuel for universities is requested in the Radiological Facilities Management budget under Research Reactor Infrastructure.

DOE/Industry Matching Grants Program **1,000** **1,000** **0**

In FY 2005, the DOE/Industry Matching Grants program awarded grants to 25 universities for education, training, and innovative research. This program provided grants up to $60,000 that were matched by industry. In FY 2006, the DOE/Industry Matching Grants program is awarding grants to 18-20 universities.

No funding is being requested for this activity in FY 2007.

Fellowships/Scholarships to Nuclear Science and Engineering Programs at Universities **2,000** **2,350** **0**

In FY 2005, a total of 25 fellowships and 81 scholarships were awarded to students enrolled in nuclear science and engineering at U.S. universities. Fellowships are provided to M.S. and Ph.D. students and scholarships to undergraduate students. In FY 2006, up to 15 fellowships and approximately 67 scholarships are being awarded.

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. In FY 2005, the Department funded seven university partnerships. In FY 2006, the Department is establishing one additional partnership.

No funding is being requested for this activity in FY 2007.

Health Physics Fellowships & Scholarships **200** **300** **0**

In FY 2005, a combination of research grants, fellowships and scholarships were provided to graduate and undergraduate students enrolled in Health Physics programs at U.S. universities. Fellowships were provided to M.S. and PhD. students and scholarships to undergraduate students. Health physicists are responsible for ensuring the safety of workers, the general public, and the environment against the potentially harmful effects of radiation, while allowing for its beneficial uses in power production, industry, and medicine. In FY 2006, three fellowships will be provided to graduate students enrolled in Health Physics programs at U.S. universities.

No funding is being requested for this activity in FY 2007.

	(dollars in thousands)		
	FY 2005	FY 2006	FY 2007
Nuclear Engineering Education Research Grants	**4,900**	**5,000**	**0**

In FY 2005, existing and new NEER grants totaled 50. The NEER program provides grants allowing nuclear engineering faculty and students to conduct innovative research in nuclear engineering and related areas. In FY 2006, awards will be made under existing grants, but no new NEER grants are planned to be awarded.

No funding is being requested for this activity in FY 2007.

Nuclear Engineering Education Opportunities	**400**	**600**	**0**

The teacher workshops program was conducted in conjunction with the American Nuclear Society (ANS), which used qualified volunteers from its membership to train teachers and students, keeping costs down. In FY 2005, the teacher workshops reached over five hundred teachers enabling them to teach nuclear science and engineering principles to their students. In FY 2006, the number of workshops will remain constant with the FY 2005 level.

In FY 2005, a nuclear science and technology education pilot was established between the Department and the Pittsburgh Public School System to provide advanced placement high school students an intensive educational experience in the field of nuclear science and technology.

In FY 2006, the program is applying the model used in the Pittsburgh pilot to other programs across the country on a cost-share basis with regional sponsors.

No funding is being requested for this activity in FY 2007.

Radiochemistry Awards	**300**	**650**	**0**

The Department provided grants every three years to support faculty and graduate/post doctorate students in radiochemistry. In FY 2005, the radiochemistry program awarded three new grants at three universities offering faculty and graduate student support. In FY 2006, the program will continue to fund the existing three radiochemistry grants.

No funding is being requested for this activity in FY 2007.

University Nuclear Education Infrastructure and Assistance	**0**	**2,730**	**0**

The Department provided funding to support collaboration of the Institute of Nuclear Science and Engineering at Idaho National Laboratories with local universities and colleges.

No funding is being requested for this activity in FY 2007.

Total, University Reactor Infrastructure and Education Assistance	**23,810**	**26,730**	**0**

Explanation of Funding Changes

	FY 2007 vs. FY 2006 ($000)
University Reactor Infrastructure and Education Assistance	
Enrollment target levels of the University Reactor Infrastructure and Education Assistance program have already been met and the program is no longer needed to encourage students to enter into nuclear related disciplines. Consequently, the Department has determined it no longer requires funding for this program.....	-26,730
Total Funding Change, University Reactor Infrastructure and Education Assistance.....	**-26,730**

Research and Development
Funding Profile by Subprogram

(dollars in thousands)

	FY 2005 Current Appropriation	FY 2006 Original Appropriation	FY 2006 Adjustments	FY 2006 Current Appropriation	FY 2007 Request
Research and Development					
Nuclear Energy Plant Optimization	2,412	0	-0	0	0
Nuclear Energy Research Initiative	2,416	0	-0	0	0
Nuclear Power 2010	49,605	66,000	-660[a]	65,340	54,031
Generation IV Nuclear Energy Systems Initiative	38,828	55,000	-550[b]	54,450	31,436
Nuclear Hydrogen Initiative	8,682	25,000	-250[c]	24,750	18,665
Advanced Fuel Cycle Initiative	66,407	80,000	-800[d]	79,200	243,000
Total, Research and Development	168,350[e]	226,000	-2,260	223,740	347,132

Mission

The mission of the Research and Development program is to secure nuclear energy as a viable, long-term commercial energy option to provide diversity in the energy supply. In the short-term, governmental 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. In the longer-term, new nuclear technologies will be developed that can compete with advanced fossil and renewable technologies, enabling power providers to select from a diverse group of generation options that are economical, reliable, safe, secure, and environmentally acceptable.

[a] Includes a rescission of $660,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.
[b] Includes a rescission of $550,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006. .
[c] Includes a rescission of $250,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.
[d] Includes a rescission of $800,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.
[e] Includes $2,046,000, which was transferred to the SBIR program and $245,000, which was transferred to the STTR program.

Benefits

The benefits of nuclear science and technology to our society are numerous and increasingly important to the Nation's future. Nuclear energy presents some of our most promising solutions to the world's long-term energy challenges. Nuclear energy has the potential to generate electricity to drive our 21st century economy, to produce vast quantities of economical hydrogen for transportation use without emitting greenhouse gases, and to produce heat and clean water to support growing industry and populations all over the world. At the same time, nuclear energy presents challenges that must be met—some through excellence in its use, but many others such as nuclear waste and economics—through advances in technology. Fully realizing nuclear energy's potential requires investment in long-term research to address the issues hindering its worldwide expansion. Much of the research at issue is far beyond the province of private industry given its long-term, high-risk nature; thus, the role of government in establishing a long-term future for nuclear power is clear.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Nuclear Energy Research and Development program supports the following goal:

Energy Strategic Goal
General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Nuclear Energy Research and Development program has a program goal that contributes to General Goal 4 in the "goal cascade":

Program Goal 04.14.00.00: Develop new nuclear generation technologies that foster the diversity of the domestic energy supply through public-private partnerships that are aimed in the near-term (2015) at the deployment of advanced, proliferation-resistant light water reactor spent fuel treatment technologies and in the longer-term (2025) at the development and deployment of next-generation advanced reactors and fuel cycles.

Contribution to Program Goal 04.14.00.00 (Develop new nuclear generation technologies)

The Nuclear Power 2010 program supports intermediate-term technology development and demonstration activities that advance the "National Energy Policy" (NEP) goals of enhancing long-term U.S. energy independence and reliability and expanding the contribution of nuclear power to the Nation's energy portfolio. The Nuclear Power 2010 program supports this 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, and demonstrating untested regulatory processes leading to an industry decision in the next few years to seek Nuclear Regulatory Commission approval for building and operating new advanced light water reactor nuclear plants in the United States.

The Generation IV Nuclear Energy Systems Initiative supports this goal through the development of innovative, next-generation reactor and fuel cycle technologies. The FY 2007 Budget supports research and development that could help achieve the desired goals of sustainability, economics, and proliferation resistance. Further investigation of technical and economic challenges and risks, including waste products, will help inform a decision on whether to proceed with a demonstration of the Very-High-Temperature Reactor, which may operate at sufficient temperatures to economically produce both electricity and hydrogen gas. The Generation IV program will also invest in the development of next-generation fast neutron spectrum reactor technologies that hold significant promise for advancing sustainability goals and reducing nuclear waste generation.

The Nuclear Hydrogen Initiative 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 Advanced Fuel Cycle Initiative supports this goal by developing enabling technologies to reduce high level waste volume, separate and transmute long-lived, highly radiotoxic elements, and reclaim spent fuel's valuable energy.

Funding by General and Program Goal

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
General Goal 4, Energy Security			
Program Goal 04.14.00.00, Develop new nuclear generation technologies			
Nuclear Power 2010	49,605	65,340	54,031
Generation IV Nuclear Energy Systems Initiative	38,828	54,450	31,436
Nuclear Hydrogen Initiative	8,682	24,750	18,665
Advanced Fuel Cycle Initiative	66,407	79,200	243,000
Total, Program Goal 04.14.00.00, Develop new nuclear generation technologies	163,522	223,740	347,132
All Other			
Nuclear Energy Plant Optimization	2,412	0	0
Nuclear Energy Research Initiative	2,416	0	0
Total, All Other	4,828	0	0
Total General Goal 4 (Research and Development)	168,350	223,740	347,132

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Targets	FY 2007 Targets
Program Goal 04.14.00.00 (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. [a]	Maintain total administrative overhead costs in relation to total program costs of less than 8 percent.
Nuclear Power 2010					
Complete and issue the government/industry roadmap to build new nuclear plants in the United States by 2010. (MET TARGET)	Under the cooperative agreements with U.S. power generation companies, support the preparation and submittal of at least two Early Site Permit applications for commercial sites to NRC. (MET TARGET)	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 Construction and Operating Licensing (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.	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.
Complete at least two cooperative agreements with U.S. power generating companies to jointly proceed with at least two Nuclear Regulatory Commission (NRC) Early Site Permit applications for specific DOE and/or commercial sites. (MET TARGET)					
Generation IV Nuclear Energy Systems Initiative					
Complete the draft Generation IV Technology Roadmap for development of the next generation nuclear energy systems. (MET TARGET)				Complete Generation IV research and development activities to inform a design selection for the next generation nuclear power plant by FY 2011.	Complete Generation IV research and development activities to inform a design selection for the next generation nuclear power plant by FY 2011.

[a] Baseline for administrative overhead rate is currently being validated.

FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Targets	FY 2007 Targets
Program Goal 04.14.00.00 (Develop new nuclear generation technologies)					
Generation IV Nuclear Energy Systems Initiative (Cont.)					
	Develop preliminary functional requirements for the Generation IV Very-High-Temperature Reactor. (MET TARGET)	Award one or more contracts for the Next Generation Nuclear Plant (NGNP) 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)		
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 NHI research and development activities that support the commercialization decision in 2015, as required in the Department's Hydrogen Posture Plan (a presidential initiative).	Complete NHI research and development activities that support the commercialization decision in 2015, as required in the Department's Hydrogen Posture Plan (a presidential initiative).
Advanced Fuel Cycle Initiative					
Successfully manufacture advanced transmutation non-fertile fuels and testing containers for irradiation testing in the Advanced Test Reactor. (MET TARGET)	Complete fabrication of test articles containing proliferation resistant transmutation fuels for irradiation in the ATR beginning in FY 2004. (MET TARGET)	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) Achieve variance of less than 10 percent from cost and schedule baselines for Advanced Fuel Cycle Initiative (AFCI) activities. (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)		

FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Targets	FY 2007 Targets
Program Goal 04.14.00.00 (Develop new nuclear generation technologies)					
Advanced Fuel Cycle Initiative (Cont.)					
Demonstrate separation of uranium from spent nuclear fuel at a level of 99.9 percent using the Uranium Extraction (UREX) process to support the development of advanced fuel cycles for enhanced repository performance. (MET TARGET)	Demonstrate a laboratory scale extraction of plutonium/neptunium as well as cesium/strontium from other actinides and fission products to support the development of advanced fuel cycles for enhanced repository performance. MET TARGET)	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)	Conduct laboratory-scale test of group actinide separation process (plutonium, neptunium, americium and curium extracted together) with actual light water reactor (LWR) spent fuel and report preliminary results. (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.	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.

Means and Strategies

NE is using various means and strategies to achieve its program goals. However, various external factors may impact the ability to achieve these goals. Collaborative activities with other organizations and countries contribute to achieving NE's goals.

The Department is using the following means to achieve its program goals:

- 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 leading to an industry decision in the next few years to seek the Nuclear Regulatory Commission's approval to build and operate at least one new advanced nuclear power plant in the United States.

- Hydrogen production technologies compatible with nuclear energy systems are being developed by the Nuclear Hydrogen Initiative. This program includes participation of the Nation's 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 Generation IV Nuclear Energy Systems Initiative. The program includes participation by the Nation's laboratories, industry, and university research communities as well as the international research community represented by the Generation IV International Forum. Industrial and international cost sharing will be pursued where practical during the research and development on these intermediate- and long-term reactor technologies.

- Research and development on advanced, proliferation-resistant fuels and fuel cycle technologies that support current operating reactors, Generation III+ advanced light water reactors and Generation IV reactor concepts are being developed by the Advanced Fuel Cycle Initiative. These fuels and fuel cycle technologies aim to maximize the extraction of useful energy from spent nuclear fuel, reduce civilian plutonium inventories in light water reactor spent fuel, and reduce volume and radiotoxicity of waste requiring geologic disposal. The program includes participation by the Nation's laboratories, industry, and university research communities as well as the international research community. Industrial and international cost sharing will be pursued during the research and development on these intermediate- and long-term fuel cycle technologies.

The Department is deploying 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 United States.

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

- Conducting international cost-shared R&D in the Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative, and Nuclear Hydrogen Initiative.

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 research and development 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 towards implementation of advanced spent fuel reprocessing technologies.

- 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 Nuclear Regulatory Commission (NRC) coordinate program planning to assure that their research and development activities are complimentary, cost-effective, and without duplication.

- 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 Generation IV Nuclear Energy Systems Initiative is receiving broad international cooperation and support, consistent with the objectives of the program. The Generation IV International Forum (GIF), composed of representatives from ten governments and the European Union, provides guidance for executing the research and development 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 the objectives of the Advanced Fuel Cycle Initiative.

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

Validation and Verification

To validate and verify program performance, the Office of Nuclear Energy, Science and Technology (NE) conducts various internal and external reviews and audits. NE's programmatic activities are subject to continuing review by the Congress, the General Accounting Office, the Department's Inspector General, the Nuclear Regulatory Commission, 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 research and development programs—the Nuclear Power 2010

program, the Generation IV Nuclear Energy Systems Initiative, the Nuclear Hydrogen Initiative, and the Advanced Fuel Cycle Initiative. 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 Research Advisory Committee (NERAC). NERAC, 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 the Office of Nuclear Energy, Science and Technology (NE). NERAC 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", and "A Technology Roadmap for Generation IV Nuclear Energy Systems". In FY 2005, NERAC issued the "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". The former report identified what will be needed to develop the Idaho National Laboratory into a world-class nuclear laboratory within a decade, and the latter report provided expert advice to help guide the development of new technology approaches to proliferation-resistant civilian nuclear fuel cycles.

NERAC's Subcommittee on Evaluations, formed in FY 2004, conducted independent program evaluations of NE's Generation IV Nuclear Energy Systems Initiative, Nuclear Power 2010 program, and the Advanced Fuel Cycle Initiative. The Subcommittee submitted its findings to the full NERAC in FY 2005, and the findings contributed to the formulation of this budget request. The Subcommittee will continue independently to evaluate and report on key NE programs at least annually. The Subcommittee on Generation IV Nuclear Energy Systems, also formed in FY 2004, submitted its first report on the development of the Generation IV program to the full NERAC in FY 2005.

Program Assessment Rating Tool (PART)

The Department implemented a tool to evaluate selected programs. PART was developed by the 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 Nuclear Energy R&D program has incorporated feedback from OMB during the FY 2004-FY 2005 PART assessments into the FY 2007 Budget Request and has taken the necessary steps to continue to improve performance.

The results of the FY 2005 review are reflected as follows: For the Nuclear Power 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 needs 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 is a relatively new program with limited progress in achieving its long-term goals. To address these findings, the Department has established an annual assessment process for the program, which will address the appropriateness, adequacy and completeness of current and planned activities for achieving the program goals and objectives.

For the Generation IV Nuclear Energy Systems Initiative, 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 NERAC Subcommittee on Evaluations.

For the Advanced Fuel Cycle Initiative (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 research and development costs through expanded collaborations.

In addition, the AFCI and Generation IV programs were found to rely upon process oriented, output based metrics that do not indicate whether the program is successful or demonstrating meaningful progress. These programs lack performance measures that capture progress made on its core elements. For example, AFCI should have metrics in place that demonstrate annual progress on its various components, such as separations, fuels, and transmutation. For the Generation IV program, metrics are needed to compare the key attributes of the various reactor designs (sustainability, proliferation resistance and security, safety and reliability, and economics) more objectively. Over the coming year, NE will work to develop meaningful, measurable outcome based performance metrics.

Nuclear Energy Plant Optimization

Funding Schedule by Activity

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Nuclear Energy Plant Optimization			
Nuclear Energy Plant Optimization	2,412	0	0
Small Business Innovative Research/Small Business Technology Transfer Program	0	0	0
Total, Nuclear Energy Plant Optimization	2,412	0	0

Description

The Nuclear Energy Plant Optimization (NEPO) program was started by the Department of Energy in FY 2000 to address the technical issues that may prevent the continued operation of existing nuclear power plants. Such technical issues include plant aging and improving plant reliability, availability, and productivity. No funding is request for this activity in FY 2007. Congress did not provide funding for this program in the FY 2006 Energy and Water Development Appropriations Act.

Benefits

NEPO research and development has made progress toward addressing material aging and generation optimization issues which have been identified by the industry as the long-term issues facing current operating plants. Currently, 30 of the 104 operating U.S. nuclear plants have received approval from the Nuclear Regulatory Commission to extend the operation of the nuclear plant for an additional 20 years for a total plant life expectancy of 60 years. Nearly all the U.S. nuclear plants are expected to seek and gain license renewal for this additional 20-year period of operation. As these nuclear plants mature, material aging and equipment degradation issues are being identified that affect continued operation of these plants. Examples of recent results from the NEPO program include new electrical cable monitoring techniques for improved prediction of cable lifetimes; development of techniques to qualify digital instrumentation transmitters to replace existing analog transmitters which are less accurate, difficult to maintain, or no longer available from the vendors; and the development of guidelines for the implementation of hybrid and digital control room technology. Further information about current projects and recent results of the NEPO program can be obtained at the NEPO web site (http://www.nuclear.gov).

The Nuclear Energy Research Advisory Committee (NERAC) provides the Department independent expert advice on the planning and execution of the NEPO program. NEPO research is coordinated with industry and R&D projects have been awarded on a competitive basis. Non-competitive awards are made when the R&D requires a unique facility or unique knowledge of and experience with the R&D being conducted.

Detailed Justification

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Nuclear Energy Plant Optimization	**2,412**	**0**	**0**

In FY 2005, activities focused on addressing the affects of aging on material in nuclear plants. The program used and further developed the capabilities on the newly formed Idaho National Laboratory to help resolve nuclear industry issues in this area. In particular, R&D activities related to commercial Light Water Reactor fuel degradation continued.

No funding is requested for this activity in FY 2006 and FY 2007. Congress did not provide funding for this program in the FY 2006 Energy and Water Development Appropriations Act.

Total, Nuclear Energy Plant Optimization	**2,412**	**0**	**0**

Explanation of Funding Changes

	FY2007 vs. FY 2006 ($000)
Nuclear Energy Plant Optimization	
There are no funding changes from FY 2006 to FY 2007	0

Nuclear Energy Research Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Nuclear Energy Research Initiative			
Nuclear Energy Research Initiative	2,416	0	0
Total, Nuclear Energy Research Initiative	2,416	0	0

Description

The Nuclear Energy Research Initiative (NERI), started in 1999, has conducted research to advance the state of nuclear science and technology in the United States by addressing technical issues impacting the expanded use of nuclear energy. Specifically, the NERI program has focused on research and development on next-generation nuclear energy systems, proliferation resistant nuclear fuel cycle technologies, generation of hydrogen using nuclear power, improvements in light water reactor technology, and fundamental areas of nuclear science that directly impact the long-term success of nuclear energy. In FY 2004, the Department integrated the Nuclear Energy Research Initiative (NERI) activity directly into its mainline nuclear R&D programs - the Generation IV Nuclear Energy Systems Initiative (Generation IV), the Advanced Fuel Cycle Initiative (AFCI), and the Nuclear Hydrogen Initiative (NHI) - to achieve greater participation of the Nation's universities in these National R&D programs.

Benefits

NERI featured a competitive, investigator-initiated, peer-reviewed selection process to fund innovative nuclear energy-related research. Modeled after successful research programs such as those conducted by the National Science Foundation and DOE's Office of Science, the NERI program solicited proposals from the U.S. scientific and engineering community for research at universities, national laboratories, and industry. NERI encouraged collaborative research and development activities among these different research organizations, as well as participation of research organizations funded by other nations. The Nuclear Energy Research Advisory Committee (NERAC) provided oversight and advice on the planning and implementation of the NERI program.

The NERI research effort, conducted by the Nation's university, laboratory and industry partners, has helped to maintain the nuclear research infrastructure in this country and has focused attention on the United States as a nuclear research and development leader. Research accomplishments include: reactor system and plant infrastructure concepts that utilize nuclear energy to produce hydrogen; new advanced controls, diagnostic techniques and information systems for potential use in automating future nuclear plants; high temperature ceramic materials that could allow higher burn-ups resulting in maximized energy production and improved plant economics; evaluation of direct energy conversion technologies for advanced nuclear power plants; and reactor physics data for advanced nuclear power systems. By funding innovative nuclear research at the Nation's universities, the NERI program has

stimulated student enrollment in nuclear fields of study. Further highlights of the NERI program are contained in the "Nuclear Energy Research Initiative 2004 Annual Report" (see http://neri.ne.doe.gov/).

Beginning in FY 2004, the Department integrated the Nuclear Energy Research Initiative (NERI) activity directly into its mainline nuclear R&D programs to achieve greater participation of the Nation's university research community in these programs. The competitive solicitations for NERI research seek universities to conduct research that is focused specifically on programmatic issues for Generation IV Nuclear Energy Systems Initiative, Advanced Fuel Cycle Initiative and Nuclear Hydrogen Initiative. Funding for these research projects comes directly from the budgets of these programs and is devoted to research conducted at universities and colleges throughout the United States. The new approach to executing NERI research retains the independent peer review critical to ensuring the pursuit of leading-edge technologies, and integrates the Nation's universities into the Department's mainline nuclear R&D programs.

Detailed Justification

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Nuclear Energy Research Initiative	**2,416**	**0**	**0**

The NERI program conducts research and development on next-generation nuclear energy systems, proliferation resistant nuclear fuel cycle technologies, generation of hydrogen using nuclear power, improvements in light water reactor technology, and fundamental areas of nuclear science that directly impact the long-term success of nuclear energy.

Funds appropriated in FY 2005 for the NERI program were used in conjunction with FY 2004 and FY 2005 funds provided by the mainline R&D programs to award 35 cooperative agreements to U.S. universities to conduct research on the Generation IV, AFCI, and the NHI programs.

No funding is requested for this activity in FY 2006 and FY 2007.

Total, Nuclear Energy Research Initiative	**2,416**	**0**	**0**

Explanation of Funding Changes

	FY 2007 vs. FY 2006 ($000)
Nuclear Energy Research Initiative	
There are no funding changes from FY 2006 to FY 2007	0

Nuclear Power 2010

Funding Schedule by Activity

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Nuclear Power 2010			
Cost-shared Program with Industry	49,605	65,340	52,276
Standby Support Program	0	0	1,755
Total, Nuclear Power 2010	49,605	65,340	54,031

Description

The Nuclear Power 2010 program supports intermediate-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 and expanded contribution of nuclear power to the Nation's energy portfolio. Because nuclear energy is the only 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 are vital to meeting the country's energy and environmental goals.

Nuclear Power 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.

Benefits

Electricity demand in the United States over the next 25 years is expected to keep growing at approximately the same rate as in the past, requiring significant new electricity generating capacity to meet the new demand and retain adequate capacity margins, which are as low as 13 percent in one region and average 21 percent across the contiguous United States. Projections contained in the Energy Information Administration's "Annual Energy Outlook 2006" indicate that the United States will need to construct more than 345 gigawatts of new generating capacity by 2030 at a rate of between 8 and 12 gigawatts per year, even while assuming ambitious implementation of energy efficiency technologies and practices. The expectation is that demand for electricity will grow at an average annual rate of 1.6 percent; if demand for electricity grows at a higher rate, even more new capacity will be needed.

The deployment of new nuclear plants supports the "National Energy Policy" objectives for energy supply diversity and energy security, as well as the Global Nuclear Energy Partnership (GNEP). With about 20 percent of our Nation's current electricity production generated by nuclear power plants, it is important to deploy new baseload, nuclear generating capacity to maintain nuclear power's contribution to the national electricity production portfolio at 20 percent as the Nation's demand for electricity increases. To achieve the objective of new nuclear plant deployment, the technical, regulatory, and institutional barriers that currently exist must be addressed successfully and cooperatively by

government and industry. More specifically, these obstacles include the uncertainties associated with new nuclear plant designs, the Federal regulatory and licensing processes, and the business risks resulting from these uncertainties. The Nuclear Power 2010 program was designed to address these obstacles through partnership with industry.

The technology focus of the Nuclear Power 2010 program is on Generation III+ advanced, light water reactor designs, 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 development and NRC certification of these near-term Generation III+ advanced reactor concepts is needed to reduce the high initial capital costs of the first new plants so that these new technologies can be competitive in the deregulated electricity market and deployable within the next decade.

To demonstrate the untested regulatory process for obtaining NRC approval for siting new nuclear power plants, the Department established competitively selected, cost-shared cooperative agreements in FY 2002 with three nuclear power generating companies to obtain Early Site Permits (ESP) for three commercial sites. The ESP process includes resolution of site safety, environmental, and emergency planning issues in advance of a power company's decision to build a new nuclear power plant. Currently, the three ESP applications are in various stages of review by NRC staff and the NRC's Advisory Committee on Reactor Safety (ACRS). The Atomic Safety and Licensing Board (ASLB) hearing for the final ESP and NRC approval of the three ESP applications are expected in FY 2007.

To demonstrate the untested regulatory process for obtaining NRC approval for constructing and operating a new nuclear power plant, the Department established competitively selected, cost-shared cooperative agreements in FY 2005 with industry to obtain combined Construction and Operating Licenses (COLs). The COL process is a "one-step licensing" process established by the Energy Policy Act of 1992 intended to resolve all public health and safety issues associated with the construction and operation of a new nuclear power plant before construction begins. The Department selected two power company-led consortia to conduct New Nuclear Plant Licensing Demonstration Projects to obtain NRC licenses to construct and operate two new nuclear power plants in the United States. The two new nuclear plant licensing projects include design certification and completion of state-of-the-art Generation III+ nuclear plant designs for Westinghouse's Advanced Passive Pressurized Water Reactor, the AP 1000, and General Electric's Economic Simplified Boiling Water Reactor, the ESBWR, and site-specific analysis and engineering required to obtain COLs from the NRC. The two project teams involved in these two licensing demonstration projects represent power generation companies that operate more than two-thirds of all the U.S. nuclear power plants in operation today. Already this approach has encouraged nine power companies to announce their intention to apply for combined construction and operating licenses. Several have specifically stated that they are building on work being done in the Nuclear Power 2010 program as the basis for their applications. The licensing and engineering activities necessary to finish the preparation of the first COL application for submittal to the NRC will be completed in FY 2007.

Title VI, Section 638, "Standby Support for Certain Nuclear Plant Delays," of the Energy Policy Act of 2005 allows the Secretary to pay covered costs to project sponsors if full power operation of an advanced nuclear facility is delayed. The Secretary is permitted to enter into contracts covering a total

of six reactors to insure against certain delays. In FY 2006, the Department will issue a notice of final rulemaking regulating these contracts in accordance with the requirements of the Energy Policy Act of 2005. In FY 2007, the Department will develop the process to accept and approve applications for agreements that will later convert into standby support contracts once plant construction is commenced. Prior to entering into contracts, the Secretary must deposit funds into accounts sufficient to pay covered costs of delays under the Standby Support regulations. The Department anticipates that sponsors may submit applications for standby support contracts as soon as FY 2008.

Detailed Justification

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Cost-shared Program with Industry	**49,605**	**65,340**	**52,276**

In FY 2005, the Department made significant progress toward obtaining NRC approval of potential sites for building new nuclear power plants and in completing activities to enable power generation company decisions to proceed with preparing COL applications. Specifically, the Department:

- Continued resolution of site-specific issues arising from the NRC review of the Early Site Permit (ESP) applications. The Final NRC Safety Evaluation Report was issued for one of the three ESP projects.
- Continued the industry cost-shared project to develop generic COL application preparation and submittal guidance and to resolve generic COL regulatory issues. A draft guidance document was provided to the NRC for review and comment resolution was initiated.
- Initiated two New Nuclear Plant Licensing Demonstration Projects to demonstrate the COL process. DOE and the two project teams developed preliminary detailed project baseline budgets and schedules, established DOE interface/project oversight agreements, and supported industry applications for NRC design certification for two advanced Generation III+ reactor designs. Both project teams also initiated the COL application preparation in FY 2005.

In FY 2006, the Department is:

- Continuing activities under Early Site Permits demonstration projects focusing on completing Safety Evaluation Reports, Environmental Impact Statements, and ASLB hearings for the three ESPs.
- Continuing the industry cost-shared project to develop generic COL application preparation and submittal guidance and to resolve generic COL regulatory issues. Complete resolution of NRC comments on the COL application preparation guidance document.
- Continuing the two New Nuclear Plant Licensing Demonstration Projects. Specifically:
    - Final detailed baseline budgets and schedules will be established based on a work breakdown structure for the entire project leading up to the receipt of approved COLs and power company decisions to build.
    - Design certification for AP 1000 will be obtained by Westinghouse, and General Electric will respond to NRC inquiries on the ESBWR design certification application.
    - Continuing preparation of the first-ever COL applications under the new licensing process.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

- Continuing engineering and design activities to support COL application preparation including the reactor vendor engineering activities to address open items that are unresolved from the design certification.

In FY 2007, the Department will:

- Complete the final ASLB hearings and issuance of Early Site Permits by the NRC for the three ESP demonstration projects. This will make three NRC-approved sites available for building new nuclear power plants. Final project reports documenting lessons learned and recommendations for future ESP applicants will also be issued for the three ESP projects.
- Continue the two New Nuclear Plant Licensing Demonstration Projects. Specifically:
  - Preparation of the Dominion and the NuStart COL applications will continue including pre-application licensing interactions with the NRC. Preparation and licensing activities on the Dominion COL application is expected to be completed.
  - Evaluation of the reactor vendor bids and down-selection of the reactor technology will occur for the NuStart COL application.
  - Open items in the ESBWR design certification draft safety evaluation report will be resolved.
  - The first-of-a-kind engineering required to prepare COL applications for the ESBWR and AP 1000 reactor designs, and close all design certification COL action items will be completed.
  - Design finalization activities will be initiated for the standardized designs for ESBWR and AP 1000. This includes the engineering analyses and calculations, design criteria documents, and design technical information necessary to purchase and construct a nuclear plant.

Standby Support Program	**0**	**0**	**1,755**

The Energy Policy Act of 2005 authorizes the Secretary to create standby support contracts for six new advanced nuclear reactors. In FY 2006, the Department will implement this provision by issuing regulations for contracts governing standby support, which is designed to protect sponsors of the first 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.

In FY 2007, the Department will:

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

Total, Nuclear Power 2010	**49,605**	**65,340**	**54,031**

Explanation of Funding Changes

	FY 2007 vs. FY 2006 ($000)
Cost-shared Program with Industry	
The decrease of $13,064,000 represents a change to COL Project baselines resulting from later than planned project starts and additional appropriations received in FY 2006.....	**-13,064**
Standby Support Program	
The increase of $1,755,000 funds a new phase of the Nuclear Power 2010 program to develop the regulations, criteria, and process under which the Department would accept and approve applications for standby support contracts from sponsors of new nuclear power plants. This program is in accordance with the Energy Policy Act of 2005, Title VI (Nuclear Matters), Section 638, Standby Support for Certain Nuclear Plant Delays....	**+1,755**
Total Funding Change, Nuclear Power 2010	**-11,309**

Generation IV Nuclear Energy Systems Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Generation IV Nuclear Energy Systems Initiative			
Generation IV R&D	9,768	10,243	6,139
Next Generation Nuclear Plant R&D	25,000	40,000	23,436
International Nuclear Energy Research Initiative	4,060	3,020	1,000
Small Business Innovative Research and Small Business Technology Transfer Programs	0	1,187	861
Total, Generation IV Nuclear Energy Systems Initiative	38,828	54,450	31,436

Description

The goal of the Generation IV Nuclear Energy Systems Initiative is to address the fundamental research and development issues necessary to establish the viability of next-generation nuclear energy system concepts. Successfully addressing the fundamental research and development issues of Generation IV system concepts that excel in safety, sustainability, cost-effectiveness and proliferation-resistance will allow these advanced systems to be considered for future commercial development and deployment by the private sector. The Generation IV Nuclear Energy Systems Initiative is the program that implements Energy Policy Act guidance for next-generation reactors.

Benefits

The Department's strategic plan lays the ground work of the ambitious, long-term vision of a zero-emission future, free of the reliance on imported energy. The Generation IV Nuclear Energy Systems Initiative is a vital component of this vision and takes up the mission of securing nuclear energy as a viable, long-term commercial energy option to provide diversity in the energy supply. The Generation IV Nuclear Energy Systems Initiative will develop new nuclear energy systems that can compete 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.

Electricity demand in the United States over the next 25 years is expected to keep growing at approximately the same rate as in the past, requiring significant new electricity generating capacity to meet the new demand and retain adequate capacity margins, which are as low as 13 percent in one region and average 21 percent across the contiguous United States. Projections contained in the Energy Information Administration's "Annual Energy Outlook 2006" indicate that the United States will have needed to construct more than 345 gigawatts of new capacity by 2030 at a rate of between 8 and 12 gigawatts per year, even while assuming ambitious implementation of energy efficiency technologies and practices. The expectation is that demand for electricity will grow at an average annual rate of 1.6%; if demand for electricity grows at a higher rate, even more new capacity will be needed.

To help meet this need for new electricity generation, the "National Energy Policy" (NEP) has recommended expansion of nuclear energy in the United States as a major component of our Nation's energy supply picture. As new power plants are built and older ones are retired, there will be a shift to technologies that have fewer air emissions than those presently deployed. In the President's Clear Skies and Climate Change Initiatives, nuclear energy is highlighted as a greenhouse-gas-free source of power for our Nation.

While current nuclear power plant technology has proven to be an efficient means to produce baseload quantities of emissions-free energy, new technologies will be needed to enable an expansion in the use of nuclear energy over the long-term future. Over the coming decades, the Department believes that Generation IV nuclear energy systems can play a vital role in fulfilling the Nation's needs for low cost and efficient electricity and commercial quantities of hydrogen. Generation IV systems represent a new generation of nuclear energy technologies that can be made available in the 2020-2030 timeframe, and offer significant advances in the areas of sustainability, proliferation resistance and physical protection, safety, and economics.

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

Growing concerns for the environment favor energy sources that can satisfy the need for electricity and other energy-intensive products on a sustainable basis with minimal environmental impact. Like all nuclear power plants, Generation IV nuclear energy systems will produce their energy products without the release of greenhouse gasses or other air pollutants during operation. Generation IV nuclear energy systems will not only be safer, more economic, and more secure, but will also include energy conversion systems that produce non-electricity products such as hydrogen, desalinated water, and process heat. These features make Generation IV reactors ideal for meeting the President's energy and environmental objectives.

To guide the development of Generation IV reactor designs, a "Technology Roadmap for Generation IV Nuclear Energy Systems" ("The Roadmap") was prepared under the auspices of the Department's independent Nuclear Energy Research Advisory Committee (NERAC) and the Generation IV International Forum (GIF). GIF is a formal, chartered organization of governments with representatives from Argentina, Brazil, Canada, France, Japan, the Republic of Korea, the Republic of South Africa, Switzerland, the United Kingdom, EURATOM, and the United States. The Organization for Economic Cooperation and Development – Nuclear Energy Agency (OECD-NEA) acts as the Technical Secretariat to GIF and serves as the repository for GIF publications such as "The Roadmap". "The Roadmap," prepared by nearly one hundred experts from GIF countries and international organizations,

was issued in March 2003 and outlines the benefits, the technical and institutional barriers, and the research needs for the most promising nuclear energy system concepts. "The Roadmap" identified six promising nuclear energy systems, complete with fuel cycle, power conversion, waste management, and other nuclear infrastructure elements. "The Roadmap" also serves as the organizing basis for national, bilateral, and multilateral research and development activities for the development of Generation IV systems.

The FY 2007 budget request maintains critical research and development that could help achieve the desired goals of sustainability, economics, and proliferation resistance. Further investigation of technical and economical challenges and risks, including waste products, is needed before a decision can be made to proceed with a demonstration of a next generation reactor. Key to the strategy for conducting all Generation IV research and development 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 2005	FY 2006	FY 2007
Generation IV R&D	**9,768**	**10,243**	**6,139**

The United States will continue to collaborate with the international community via the Generation IV International Forum (GIF) to support developments in the Sodium-Cooled Fast Reactor (SFR). Fast reactors have potential for acting in concert with Advanced Fuel Cycle Initiative (AFCI) technologies to transmute the actinide components of spent nuclear fuel into far shorter-lived, less toxic species. The emphasis of the Generation IV R&D program will be on supporting the SFR, GIF activities, and cross-cutting activities applicable to more than one of the Generation IV concepts.

Sodium-Cooled Fast Reactor (SFR): The Sodium-Cooled Fast Reactor (SFR) system features a liquid metal fast-spectrum reactor and recycling of spent fuel. The primary mission for the SFR is the management of high-level wastes, and in particular, management of plutonium and other actinides. A range of plant size options is available for the SFR, ranging from small modular systems of less than 100 MWe to large monolithic reactors of about 1500 MWe. The primary coolant system in a SFR can either be arranged in a pool layout (all primary system components are housed in a single vessel), or in a compact loop layout, which is similar that of today's commercial Light Water Reactors. 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. Generation IV International Forum (GIF) partner countries including France, Euratom, Japan, Korea, and the United Kingdom, have expressed interest in exploring this concept in cooperation with the United States. A GIF R&D Plan defines the R&D to resolve viability and performance questions to complete the development of the SFR system.

In FY 2005, SFR R&D activities focused on:

- Co-chairing the GIF SFR Steering Committee and preparing joint GIF R&D Plans for the SFR.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

In FY 2006, SFR R&D activities focus on:

- Co-chairing the GIF SFR Steering Committee and preparing joint GIF R&D Plans for the SFR.
- Participating in the GIF System Arrangement and Project Arrangement negotiations for SFR.

In FY 2007, SFR R&D activities will focus on:

- Commissioning a public/private study comparing existing and advanced SFR designs in terms of economics, safety & reliability, fuel cycle flexibility ("sustainability"), and proliferation resistance and physical protection. The study will also address development risk, licensability, and manufacturability.
- Recovering the U.S. SFR design, engineering, licensing, and construction knowledge base to improve options to make a prompt down-select on fast-reactor technology and SFR design, should the need present itself.
- Re-evaluating transmutation of spent fuel from light water reactors using SFR technology.
- Co-chairing the GIF SFR Steering Committee and preparing joint GIF R&D Plans for the SFR.

Lead-Cooled Fast Reactor: The Lead-Cooled Fast Reactor (LFR) concept is a lead 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 and/or production of hydrogen using high-temperature processes. Efficiency improvements with either lead or LBE might be obtained through the use of an innovative energy conversion system with supercritical carbon-dioxide as the working fluid. 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 Japan, Switzerland, and Korea have expressed interest in exploring this concept in cooperation with the United States.

In FY 2005, research and development in LFR focused on the following activities:

- Completing a point design of the reference LFR reactor and associated system components to sufficient level of detail to permit the start of pre-conceptual design in FY 2006.
- Completing the analysis of materials test specimens which have completed 1000 hours of corrosion testing in the lead-bismuth DELTA loop, and continuing the testing of additional test specimens.
- Completing the design of a new liquid-lead high-temperature, natural-circulation test loop. LFR materials research and development will be closely coordinated with the Office of Science research on materials to accelerate advancement of this technology.

In FY 2006, LFR research and development will focus on the following activities:

- LFR materials testing and analysis will continue with the objective of selecting key structural materials and cladding for lead-bismuth compatibility. Lead and lead-bismuth research will be expanded and will include the design of a high-temperature liquid-lead experiment at the Idaho National Laboratory. LFR materials research and development will be closely coordinated with the Office of Science to leverage and accelerate the understanding of materials corrosion,

particularly in the area of irradiation testing.
- Complete 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.

In FY 2007, LFR activities will focus on monitoring international research and development and participation in GIF LFR forums.

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. Like thermal-spectrum helium-cooled reactors, the high outlet temperature of the helium coolant makes it possible to deliver electricity, hydrogen, or process heat with high conversion efficiency. 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 France and Japan.

In FY 2005, research and development for the GFR focused on the following activities:
- Continuing material characterization and fabrication, including the preparation of candidate materials for irradiation testing in FY 2006.
- Performing preliminary pre-conceptual design of the GFR core and safety systems.
- Continuing the analysis of off-normal accident analysis to optimize safety systems and support the overall reactor design.

In FY 2006, research and development activities for the GFR include:
- Fabricating structural material test samples and initiate irradiation testing. Initiate thermal-hydraulic experiments using the Matched-Index-Refraction flow test system developed by the Idaho National Laboratory (INL).
- Continuing to perform preliminary concept design of the core and safety systems based on the optimized safety systems studies completed in FY 2005.

In FY 2007, GFR activities will focus on monitoring international research and development and participation in GIF GFR forums.

Supercritical-Water-Cooled Reactor (SCWR): 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 Generation IV International Forum from Japan, Korea, Canada, and EURATOM.

In FY 2005, SCWR research and development focused on the following activities:

- Completing the design of a test section to perform supercritical-water heat transfer studies in an existing supercritical-water facility (the Benson Experimental Loop in Erlangen, Germany).
- Establishing experimental capability for measuring corrosion in supercritical-water loops and improve the characterization of test variables like dissolved oxygen, conductivity and pH. The supported experiments will develop corrosion rates of candidate materials under various prototypical temperature, oxygen, and conductivity conditions.

In FY 2006, SCWR research and development activities include:

- Design of laboratory-scale, multi-sample, stress-corrosion cracking, supercritical-water loop experiments for investigating candidate materials.
- Design of a high-pressure facility for critical-flow experiments. Data on basic critical flow and heat transfer for nuclear fuel configurations are lacking for prototypical supercritical water conditions and are needed to evaluate the safety and performance characteristics of candidate fuel cladding and structural materials.

In FY 2007, SCWR activities will focus on monitoring international research and development and participating in GIF SCWR forums.

Crosscutting Research and Development: Crosscutting research activities are being conducted where results will have applicability to two or more of the Generation IV concepts.

In FY 2005, the following crosscutting research activities were conducted:

- Design and Evaluation – computer model validations for use in design and safety analysis applications; methodology development for evaluating the economics of Generation IV systems including associated hydrogen production; methods development for evaluating proliferation resistance and physical protection metrics and developing a framework for computerization of the methodology; and participation in Generation IV International Forum activities.
- Materials – initiated mechanical tests and irradiation tests on commercially available and advanced materials; coordinated the specific materials needs of each reactor type; coordinated the specific materials needs of power conversion systems; initiated the development of a comprehensive radiation-effects database for materials needed for radiation service; and initiated the development of a comprehensive high-temperature materials properties database to support the design, use, and codification of materials needed.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

- Energy Conversion – developed a preliminary system and turbo machinery design for a 300 megawatt–electric supercritical-carbondioxide commercial cycle; and developed a preliminary design for a scaled supercritical-carbondioxide demonstration experiment.

In FY 2006, crosscutting research activities include:

- Design and Evaluation - modify and validate computer models for the use in design and safety analyses; validate the methodology for evaluating the economics of hydrogen production with Generation IV systems; validate methods for evaluating proliferation resistance and physical protection metrics, and complete the development of a computer program to apply the methodology to Generation IV systems; and ongoing U.S. participation in GIF activities.
- Materials - continue mechanical scoping tests of high-temperature materials; initiate the development of the rules for the use of low-temperature design criteria for reactor pressure vessels in limited high-temperature service, initiate creep-fatigue tests and the development of creep-fatigue damage models for modified 9Cr-1Mo steel and Alloy 617, and complete the design of facilities for low and high flux, high-temperature irradiations.
- Energy Conversion – develop the system and turbo-machinery design for a 300 megawatt-electric supercritical-carbondioxide commercial cycle; and initiate the fabrication of components for a scaled supercritical-carbondioxide demonstration experiment.

In FY 2007, the following crosscutting research activities will be conducted:

- Design and Evaluation – issue report on improved reactor physics and fuel cycle analysis tools; transmit revised codes to the national software center for use by organizations involved in Generation IV R&D and system design. These analysis tools will be used in the evaluation of all Generation IV reactor concepts.

- Materials – complete initial scoping irradiation of candidate high-temperature metallic internals. Continue initial population of Generation IV Materials Handbook with historical data and new data developed in the Generation IV Program.

- Energy Conversion - complete engineering design of a selected interstage heated and cooled (IH/IC) high-temperature Brayton cycle for Generation IV reactors. Complete assessment of supercritical-carbon dioxide cycle to confirm viability for intermediate temperature Generation IV reactor systems. Initiate fabrication of small-scale experiment for main compressor evaluation. Design control simulation and validation experiment. Initiate preliminary design(s) for intermediate-loop heat transport system for direct and indirect Process Control System configurations, and hydrogen production process configurations (with Nuclear Hydrogen Initiative). Interface with primary and process heat exchanger design activities and integrate results with intermediate-loop design and analysis activities.

Next Generation Nuclear Plant R&D **25,000** **40,000** **23,436**

Very-High-Temperature Reactor (VHTR): Because of its potential for both enhanced safety and economical production of energy products such as electricity and hydrogen, the United States is pursuing R&D of the VHTR within the Generation IV Nuclear Energy Systems Initiative.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

The Department plans to work closely with both the international community and the U.S. private sector to continue research on the VHTR. The DOE is continuing its efforts to investigate the challenges and risks of VHTR technology, including costs and waste products. The ongoing R&D activities will continue to analyze VHTR enabling technologies such as high-temperature materials and graphite particle fuels. The Department is focused on developing a high-burnup VHTR particle fuel that can withstand postulated accident conditions while maintaining the integrity of the fuel and retaining the fission products within the kernel. Work progresses in developing design data needs for such key components as the reactor vessel and intermediate heat exchanger. The Department remains optimistic about the potential for future collaboration on this technology with countries such as France, Japan, South Africa and the Republic of Korea.

In FY 2005, the Department focused on VHTR test fuel fabrication and qualification testing, systems integration studies, materials development and testing, and program planning. Specifically, the Department:

- Published an R&D plan to guide the materials, fuel, and codes and methods R&D that is broadly applicable across VHTR candidate technologies.
- Analyzed candidate materials that meet the requirements for ultra-long-life power conversion components in high-temperature helium and salt environments. Because of the exposure to extreme heat, pressure and irradiation, these candidate materials will require extremely high performance and consist of novel high-temperature metals, ceramics, and composites for critical structural, heat and radiation attenuation, and intermediate heat exchange components.
- Completed fabrication of irradiation test fuel specimens and the multi-cell capsule and test train for the initial irradiation tests.
- Initiated development of advanced TRISO fuel characterization techniques.

In FY 2006, the Department will:

- Initiate the irradiation of TRISO fuel in the new Advanced Test Reactor multi-cell capsule and test train to provide shakedown test information.
- Complete an assessment of the need for a low flux irradiation fixture to investigate reactor vessel materials.
- Initiate, in accordance with the Energy Policy Act of 2005, a collaborative effort with the U.S. Nuclear Regulatory Commission to develop a licensing plan for a VHTR to be built in Idaho.
- Complete preliminary high-flux irradiations and initiate post-irradiation examination of potential metallic alloys for reactor internals and initiate mechanical testing of candidate materials in the VHTR coolant environment.
- Purchase pre-production lots of candidate graphite materials and support specification standards development for VHTR graphite with the American Society for the Testing of Materials.
- Develop models to predict the behavior of candidate VHTR pressure boundary materials and very-high-temperature component materials under expected operating conditions.
- Investigate the use of liquid salt as a coolant in a VHTR.
- Engage with industry to help guide our R&D investments.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

In FY 2007, the Department will:

- Initiate graphite-creep irradiation experiments in the Advanced Test Reactor at INL.
- Continue initial fuel specimen irradiation testing (AGR-1) in the Advanced Test Reactor at INL.
- Complete the irradiation test capsule design for follow-on fuel tests (AGR 3/4) in the Advanced Test Reactor at INL.
- Prepare the post-irradiation examination facility to receive and test AGR-1 test specimens.
- Continue the support of industry code committees in qualifying high-temperature materials and analytical methods.
- Continue composite material irradiation in the High Flux Isotope Reactor at the Oak Ridge National laboratory.
- Continue the development of the licensing plan for a VHTR demonstration plant.
- Develop a robust suite of deterministic computer programs, including spectrum codes, a lattice physics code, and nodal diffusion codes, that can be used for efficient and accurate design of the VHTR and begin the validation and verification testing of these complex programs.
- Initiate post-irradiation examination design and procure equipment needed to evaluate the results of the initial fuel specimen irradiation testing (AGR-1).

International Nuclear Energy Research Initiative (I-NERI) **4,060** **3,020** **1,000**

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 NERAC and GIF allow the U.S. to engage the international community in bi-lateral fashion beyond the six Generation IV concepts. International, cost-shared research and development enhances the Department's ability to leverage its limited research funding with nuclear technology research funding from other countries while also providing the United States greater credibility and influence in international activities associated with the application of nuclear technologies. The Department currently has in place bilateral International Nuclear Energy Initiative agreements with France, the Republic of Korea, OECD-NEA, the European Union, Canada, Brazil, and Japan. Negotiations to establish new agreements are underway with the Republic of South Africa and the United Kingdom.

In FY 2005, the Department initiated new collaborations with Japan and Brazil and continued to use its existing bilateral International Nuclear Energy Research Initiative agreements to conduct international cost-shared R&D.

In FY 2006, the Department plans to use the requested funding to initiate new INTD research and development projects under the bilateral agreements with GIF member countries.

In FY 2007, the Department plans to use the requested funding to complete INTD research and development projects initiated in FY 2005.

	(dollars in thousands)		
	FY 2005	FY 2006	FY 2007
Small Business Innovative Research and Small Business Technology Transfer Programs (SBIR/STTR)	**0**	**1,187**	**861**
The FY 2006 and FY 2007 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.			
Total, Generation IV Nuclear Energy Systems Initiative	**38,828**	**54,450**	**31,436**

Explanation of Funding Changes

	FY 2007 vs. FY 2006 ($000)
Generation IV R&D	
The decrease of $4,104,000 reflects a reduction in R&D activities due to a change in focus to emphasize other research and development activities such as near-term deployment of new nuclear plants and enhanced waste minimization efforts	-4,104
Next Generation Nuclear Plant R&D	
The decrease of $16,564,000 reflects a reduction in R&D activities due to a change in focus to emphasize other research and development activities such as near-term deployment of new nuclear plants and enhanced waste minimization efforts	-16,564
International Nuclear Energy Research Initiative	
The decrease of $2,020,000 reflects a reduction in R&D activities due to a change in focus to emphasize other research and development activities such as near-term deployment of new nuclear plants and enhanced waste minimization efforts	-2,020
Small Business Innovative Research and Small Business Technology Transfer (SBIR/STTR) Programs	
The decrease of $326,000 reflects a reduction in R&D activities	-326
Total Funding Change, Generation IV Nuclear Energy Systems Initiative	**-23,014**

Nuclear Hydrogen Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Nuclear Hydrogen Initiative			
Nuclear Hydrogen Initiative	8,682	24,057	18,142
Small Business Innovative Research/Small Business Technology Transfer Program	0	693	523
Total, Nuclear Hydrogen Initiative	8,682	24,750	18,665

Description

The Nuclear Hydrogen Initiative (NHI) will conduct research and development of enabling technologies, demonstrate nuclear-based hydrogen production technologies, and study potential hydrogen production strategies to support the President's vision for a future Hydrogen economy. The objective of the Nuclear Hydrogen Initiative 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.

Benefits

With increased international concern about global climate change and greenhouse gases, there is an ongoing global effort to reduce carbon dioxide emissions and to develop carbon-free fuels. Currently, the most promising non-carbon fuel is hydrogen. Hydrogen is the most abundant element and makes up about 90 percent of the universe by weight. On earth, most hydrogen is bound up in molecules like water and methane. Hydrogen can be produced by splitting water into hydrogen and oxygen. However, the economic feasibility of large-scale production of hydrogen from water is as yet unproven.

Hydrogen offers significant promise as a future domestic energy source, particularly for the transportation sector. Hydrogen can be combusted in a traditional internal combustion engine, or can produce electricity in a fuel cell. Significant progress in hydrogen combustion engines and fuel cells is bringing the day closer when transportation using hydrogen fuel will be a reality. Before hydrogen can become a significant part of the Nation's energy infrastructure, the cost associated with the production, storage, and delivery of hydrogen must be reduced considerably.

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 greenhouse gases for every kilogram of hydrogen, defeating a primary advantage of using hydrogen—its environmental benefits. Another existing method, electrolysis, converts water into hydrogen using electricity. Electrolysis is typically used for small production quantities but is inherently less efficient because electricity must first be produced to run the equipment used to

convert the water into hydrogen. Additionally, the environmental benefits of electrolysis are negated unless a non-emitting technology, such as nuclear or renewable energy, is used to produce the electricity.

The NHI is part of the Department's Hydrogen Program, which is made up of programs within the Offices of Nuclear Energy, Science and Technology (NE), Energy Efficiency and Renewable Energy (EE), Fossil Energy (FE), and Science (SC). The Department created the "Hydrogen Posture Plan" (http://www.eere.energy.gov/hydrogenandfuelcells/posture_plan04.html) to describe its plan for successfully integrating and implementing technology research, development, and demonstration activities needed to cost-effectively produce, store, and distribute hydrogen for use in fuel cell vehicles and electricity generation. The Posture Plan describes the interface of the Department's hydrogen activities with those of other federal agencies. The Department pursues an integrated approach to hydrogen R&D, with EE, NE, and SC conducting coordinated research activities related to thermochemical hydrogen production cycles. NE has primary responsibility for processes that operate across a range of temperatures for the various advanced reactors being researched by the Generation IV Nuclear Energy Systems Initiative.

NE has built upon the "Hydrogen Posture Plan" and the "National Hydrogen Energy Roadmap" (http://www.eere.energy.gov/hydrogenandfuelcells/pdfs/national_h2_roadmap.pdf) released by the Secretary of Energy in November 2002, to develop the "Nuclear Hydrogen R&D Plan" (http://nuclear.gov/hydrogen/RandDPlan.pdf). The "Nuclear Hydrogen R&D Plan" describes major research areas required to support the development of these technologies, such as high-temperature materials, separation membranes, advanced heat exchangers and supporting systems. The plan presents the approach that the NHI program is using to achieve its overall objective, including priorities and technology selection, development and potentially demonstration.

Detailed Justification

(dollars in thousands)

FY 2005	FY 2006	FY 2007
Nuclear Hydrogen Initiative **8,682**	**24,057**	**18,142**

The program will conduct research and development on processes that operate across a range of temperatures for various advanced reactors being researched by the Generation IV Nuclear Energy Systems Initiative. Much of the program's focus is vested in the most promising technologies—the sulfur-iodine (S-I) thermochemical cycle and high-temperature electrolysis. However, alternative processes with significant potential continue to be evaluated.

Based on their level of 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. The S-I thermochemical cycle is a series of chemical reactions that convert water to hydrogen and oxygen. This process offers the potential for high-efficiency hydrogen production at large-scale production rates, but has several technical issues that must be resolved to make the process technically and economically feasible. To better leverage this research and increase the probability of achieving the program objective, the hybrid sulfur cycle will be investigated, which is similar to the

S-I cycle, but replaces two challenging chemical steps with a single electrolytic step.

High-temperature electrolysis (HTE) produces hydrogen from steam using electricity. This method has the potential for higher efficiencies than commercially-available electrolysis processes and can operate across a range of temperatures. Because of the modular nature of the high-temperature electrolysis process, the Department has already been able to realize positive research results. In July 2005, the Idaho National Laboratory successfully operated a stack of high-temperature electrolysis cells, which produced hydrogen at a rate of over 100 liters per hour. This test achieved the highest throughput to date in the NHI program and produced the data required to take the next process development step.

In addition, research on alternative processes, which operate over a range of temperatures, will include focused small-scale experiments to verify process potential. The alternative cycles involve significantly more technical risk because less is known about them, but their lower temperature requirements and, in some cases, reduced complexity, make them worthy of continued research—particularly since they could provide a pathway for future fast reactor systems to produce hydrogen on a sustainable economic basis. The supporting technologies required at these temperatures and the overall objective to improve process performance will involve overcoming many technical challenges, including the development of advanced materials, advanced heat exchanger technologies and separation membranes. As some alternative hydrogen production technologies may also be pursued by other DOE offices, all such work is coordinated carefully to avoid duplication of effort.

In FY 2005, the Department:

- Continued laboratory-scale research, experimental design, and fabrication on S-I and HTE hydrogen production technologies.
- Continued screening and testing of component materials to determine compatibility with process working fluids.
- Continued research on candidate high-temperature process heat exchanger concepts and materials for baseline technologies; initiated engineering design of selected heat exchanger designs to be tested before pilot and engineering-scale technology experiment operations; conducted thermal hydraulic and structural analyses of heat exchanger concepts for use with alternative hydrogen production technologies.
- Completed conceptual design documents for the pilot-scale experiments (200 kilowatt HTE experiment and the 500 kilowatt S-I thermochemical process experiment).
- Continued flowsheet analysis of alternative cycles.

In FY 2006, the Department will:

- Construct major components for the S-I cycle reaction sections in preparation for integrated laboratory-scale system operation in FY 2008.
- Complete facility preparations for the S-I integrated laboratory-scale experiment at Sandia National Laboratory (including facility selection, facility modifications, and safety analysis documentation).
- Identify requirements for process interfaces, control systems approach, and diagnostics for the

(dollars in thousands)

integrated laboratory-scale S-I thermochemical experiment.
- Characterize and analyze multiple H2O/SO2 electrolyzer configurations and select the most promising for connection to the S-I laboratory-scale experiment.
- Make a GO/NO GO Decision on the feasibility of the Calcium-Bromine Thermochemical Cycle for Nuclear Hydrogen Production.
- Complete flowsheet analysis for most promising alternative thermochemical cycles.
- Operate 20-25 cell HTE stack at 100 Normal liters per hour for 1000 hours.
- Complete testing of high temperature inorganic membranes for the separation of hydrogen and steam, at 800 C and for duration of approximately 1000 hours.
- Complete initial assessment of codes and standards applicable to a hydrogen production facility coupled to a nuclear reactor.
- Continuing research on candidate high-temperature process heat exchanger concepts and materials for baseline technologies; continuing engineering design of heat exchanger designs to be tested before pilot and engineering-scale technology experiment.
  operations; continuing thermal hydraulic and structural analyses of heat exchanger concepts for use with alternative hydrogen production technologies.

In FY 2007, the Department will:
- Complete assembly of integrated laboratory-scale S-I thermochemical system and pre-operational testing consisting of system operation using water as a surrogate fluid.
- Complete initial longevity testing for materials for pilot-scale sulfur-based thermochemical process equipment.
- Construct multi-cell electrolyzer for integrated hybrid sulfur laboratory-scale closed loop system.
- Conduct component reaction tests and design laboratory-scale experiments for most promising alternative cycles.
- Complete assembly and pre-operational testing of integrated laboratory-scale HTE system consisting of verification of individual component performance.
- Perform feasibility studies to determine whether the use of existing nuclear power plants is a cost-effective means of producing hydrogen.
- Incorporate materials and heat exchanger test data into the system interface model for integrating nuclear and hydrogen plant.
- Perform laboratory-scale tests on heat exchangers and materials.
- Identify high-level functional design and safety requirements for baseline pilot-scale experiments.

Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**693**	**523**

The FY 2006 and FY 2007 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.

Total, Nuclear Hydrogen Initiative	**8,682**	**24,750**	**18,665**

Explanation of Funding Changes

	FY 2007 vs. FY 2006 ($000)
Nuclear Hydrogen Initiative	
The decrease of $5,915,000 is due to reduced development costs for the S-I thermochemical and high-temperature electrolysis hydrogen production methods as the laboratory-scale experiments move out of the construction phase into the testing phase.....	-5,915
Small Business Innovative Research and Small Business Technology Transfer Programs	
The decrease of $170,000 reflects a reduction in the R&D activities.	-170
Total Funding Change, Nuclear Hydrogen Initiative.....	**-6,085**

Advanced Fuel Cycle Initiative

Funding Schedule by Activity

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Advanced Fuel Cycle Initiative			
Separations Technology Development	26,400	16,137	11,000
Advanced Fuels Development	12,151	8,187	9,000
Transmutation Engineering	11,835	5,316	6,000
Systems Analysis	4,736	5,940	10,000
Transmutation Education	4,285	13,365	6,000
Advanced Fuel Cycle Facility	0	6,930	20,000
UREX+ Engineering Scale Demonstration (ESD)	0	13,860	155,000
Advanced Burner Reactor (ABR)	0	4,950	25,000
Materials Test Station	7,000	3,465	0
Small Business Innovative Research and Small Business Technology Transfer Programs	0	1,050	1,000
Total, Advanced Fuel Cycle Initiative	66,407	79,200	243,000

Description

The mission of the Advanced Fuel Cycle Initiative (AFCI) is to develop fuel cycle technologies that will meet the need for economic and sustained nuclear energy production while satisfying requirements for a controlled, proliferation-resistant nuclear materials management system. AFCI is designed to develop these new technologies so that they may be deployed to support the operation of current nuclear power plants, Generation III+ advanced light water reactors, and Generation IV advanced reactors in order to achieve a significant reduction in the amount of high-level radioactive waste requiring geologic disposal, to reduce significantly accumulated plutonium in civilian spent fuel, and to extract more useful energy from nuclear fuel.

AFCI's primary near-term goal has been to develop and demonstrate advanced, proliferation-resistant fuel cycle technologies for treatment of commercial light water reactor spent fuel, to develop an integrated spent fuel recycling plan, and inform a recommendation by the Secretary of Energy regarding the need for an additional geologic repository. Current legislation requires the Secretary to make a recommendation to Congress regarding the need for a second repository as early as January 1, 2007, but before January 1, 2010. AFCI provides spent fuel treatment technologies to support an expanding role for nuclear power in the United States.

In the longer term, AFCI's development of a system involving spent-fuel partitioning and recycling of actinides and other long-lived radioactive components in fast reactors for destruction through transmutation could result in a de facto fifty-fold increase in the technical capacity of the planned Yucca Mountain repository. This increase would come principally from the destruction of actinides that generate the heat that limits repository capacity. Such a capacity increase would be more than enough to accommodate all the spent fuel generated in the U.S. this century from any conceivable nuclear energy deployment scenario.

A U.S. spent fuel treatment and recycling capability is a critical element in the U.S. initiative to support the expansion of nuclear power generation worldwide in a proliferation resistant manner. The demonstration of spent fuel recycle technology and the Advanced Burner Reactor (ABR) technology is part of a multifaceted program that involves recycling spent fuel, fabricating fuel assemblies that contain long-lived actinides and other transuranics removed from the spent fuel, burning the assemblies in a demonstration fast reactor, and developing more benign waste disposal technologies for the remaining radioisotopes and process wastes.

In FY 2007, as part of the Global Nuclear Energy Partnership (GNEP), the Department will focus its AFCI research and development toward engineering-scale demonstration of the most promising technologies, such as UREX+ and pyroprocessing. Successful laboratory-scale experimentation of the UREX+ aqueous spent fuel separations technology has been conducted, as a precursor to an engineering-scale demonstration of the technology to treat spent nuclear fuel from commercial light water reactors.

In addition, the Department will focus its transmutation development activities on a sodium-cooled fast transmutation (or "burner") reactor demonstration facility. This concept was selected because of its technical maturity and U.S. and international experience in operating sodium-cooled fast reactors. A sodium-cooled demonstration fast reactor would provide a platform for demonstrating transmutation of spent light water reactor fuel and fast reactor recycle fuel. Over the coming year, NE will collaborate with international and private parties to refine the GNEP concept and gauge interest in demonstration of the sodium cooled reactor technology as the fast Advanced Burner Reactor component of GNEP. R&D into advanced pyroprocessing technologies, waste and storage forms, and both metal and oxide transmutation fuels will continue to support this near-term objective.

An advanced fuel cycle facility will be designed and constructed to provide advanced separations and fuels research, fabrication, safeguards instrumentation and scale-up capabilities to support this aggressive program. In cooperation with the Office of Science, the Office of Nuclear Energy, Science and Technology will develop advanced, powerful simulation and modeling tools to accurately predict reactor and fuel performance behavior in order to reduce the need for lengthy irradiation campaigns in test reactors. Environmental analyses to comply with the National Environmental Policy Act will also be carried out in support of the program objectives. Finally, industry and international collaborations will continue and expand where appropriate in pursuit of this objective.

Benefits

Of the challenges that must be addressed to enable a future expansion in the use of nuclear energy in the United States and worldwide, none is more important or more difficult than that of dealing effectively

with spent nuclear fuel and high level waste. Compared to other industrial waste, the spent nuclear fuel generated per unit of electricity generated is relatively small in mass. However, it is toxic for many thousands of years, and its disposal requires that many political, societal, technical, and regulatory issues be addressed. For many years, several countries around the world have pursued advanced technologies that could treat and transmute spent nuclear fuel from nuclear power plants. These technologies have the potential to significantly reduce the quantity and toxicity of waste requiring geologic disposal.

In addition to supporting optimal use of the first U.S. repository and reducing the technical need for additional repositories, these technologies can also enhance national security by reducing proliferation risk through the reduction of inventories of commercially-generated plutonium (which is contained in all commercial spent fuel) throughout the world and enhancing national energy security by recovering the significant energy value contained in spent nuclear fuel.

Over the near term, the AFCI program will demonstrate technologies that could reduce the volume and near-term heat generation of spent nuclear fuel waste requiring repository disposal. The AFCI program, in cooperation with the Department's Office of Civilian Radioactive Waste Management (RW) and international partners, is developing proliferation-resistant separations processes for the treatment of spent nuclear fuel from current light water reactor and advanced light water reactor systems. In collaboration with the National Nuclear Security Administration (NNSA), AFCI can help enhance the international non-proliferation regime by the demonstration of advanced materials accountability and control techniques that will contribute to enhancing inherent proliferation resistance of processing systems.

While plutonium burning and transmutation of some of the other transuranic elements that impact repository performance can be accomplished in thermal reactors, more complete transmutation of transuranic elements is achievable in fast reactors with a much larger improvement in repository performance as a result. The AFCI program is geared toward developing advanced fuels and associated reprocessing technologies for sodium-cooled fast reactors to enable the recovered energy value of spent fuel to be enhanced by up to100 times, while destroying contained transuranics.

The advanced technologies emerging from the AFCI program could build upon the benefits described above by enabling the destruction of minor actinides, greatly reducing the long-term radiotoxicity and long-term heat load of high-level waste sent to a geologic repository. This could be accomplished through the development of sodium-cooled fast burner reactors. Implementation of fast reactor technologies could significantly delay or eliminate the need for additional repositories.

The AFCI program is pursuing a research agenda that supports the "National Energy Policy" 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-share and collaboration is very high. The Department is currently collaborating with France, Switzerland, the European Union, Canada, Japan and the Republic of Korea in separations, fuels, transmutation engineering and test facilities.

Detailed Justification

(dollars in thousands)

FY 2005	FY 2006	FY 2007

Separations Technology Development **26,400** **16,137** **11,000**

The primary goal of the separations activity is to develop and demonstrate advanced aqueous and pyrochemical separations technologies capable of treating the existing and projected inventory of spent nuclear fuel and fast reactor recycle fuel in a proliferation-resistant manner and to inform a recommendation by the Secretary of Energy on the technical need for a second repository. The Uranium Extraction Plus (UREX+) suite of advanced aqueous processes (particularly UREX+1A, which extracts all transuranics as a single group) has potential for meeting proliferation-resistant separations objectives while minimizing the waste generation associated with current aqueous separations technologies. While UREX+ has potential to address the spent fuel challenge associated with today's light water reactors, pyroprocessing may be better suited to address the requirements of sodium-cooled fast reactor fuels. The Department's separations research program will lead to a selection of a preferred technology for partitioning commercial light water reactor spent fuel in FY 2007.

- **Proliferation-Resistant Fuel Treatment**..... **8,400** **9,355** **6,500**

  Laboratory-scale experiments completed by the AFCI program have proven the advanced, aqueous-based Uranium Extraction (UREX) technology to be capable of removing uranium from spent fuel at purity levels of 99.999 percent and free of high-level radioactive contaminants. The resulting material could possibly be disposed of as low-level waste or reused as reactor fuel, significantly reducing the volume of materials to be stored in a geologic repository. 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 storing the remaining high-level waste.

  UREX+ is an extension of the UREX technology and is a key element of the AFCI program. Additional research is underway to evaluate aqueous chemical treatment methods to separate selected actinide and fission product isotopes from the UREX stream after the uranium has been removed. Long-lived fission products, iodine-129 and technicium-99, which are significant contributors to the long-term radiotoxicity of spent fuel, could also be separated for transmutation or incorporation into new waste forms for safe disposal. The next step in the development of these processes is an engineering-scale demonstration.

  In FY 2005, the Department continued laboratory-scale hot testing of advanced aqueous processes which include plutonium/neptunium, cesium/strontium and americium/curium extractions. A group separation test of all transuranics from fission products was completed at Argonne National Laboratory. The resulting data is being used to develop an optimized UREX+ flowsheet and to provide further verification of the AMUSE computer code (used to predict performance of various flowsheets and reagent flows). Additional work was performed on development of adequate dry storage and waste forms for the separated products, helping to reach the objective of only dry product streams of minimum volume.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

In FY 2006, final hot tests at a laboratory scale of various UREX+ flowsheet variations will be conducted to allow a final selection of the optimum flowsheet in FY 2007. The Department will also complete the necessary tests to allow the scale-up of hot laboratory testing to an engineering-scale experiment. The scale-up tests will include cold testing of centrifugal contactors, advanced dissolvers, precipitators, and calciners. Waste qualification experiments and data analysis will be conducted on spent fuel processing to provide data to the Office of Civilian Radioactive Waste Management. Conceptual design of a modular Advanced Fuel Cycle Facility will be initiated, with one module dedicated to scale-up research, process improvements, and advanced monitoring and safeguards technologies for UREX+ and other advanced aqueous spent fuel treatment technologies. Collaboration will be pursued with the French Atomic Energy Commission, Commissariat à l'Energie Atomique (CEA), to conduct joint group actinide extraction tests at laboratory scale at U.S. laboratories as well as at the CEA Atalante facility, where the French group actinide extraction (GANEX) will be studied.

In FY 2007, the Department will select the baseline UREX+ flowsheet consisting of multiple integrated modules for scale-up to full engineering-scale operations. The AMUSE code will be used to further inform separations modeling. The specialized requirements for on-line instrumentation and monitoring equipment associated with the baseline UREX+ flowsheet will be further defined and detailed. This will be a particularly significant effort involving, among other things, initiation of component testing that is capable of covering a broad range of approaches. Critical issues involved in the isolation and integration of individual modules will be examined and appropriate testing will be extended as required. Work will be continued on product and waste storage forms, particularly for transuranics, strontium/cesium, iodine and technetium.

- **Generation IV Fuel Treatment Process Development** **18,000** **6,782** **4,500**

Pyroprocessing is a proliferation-resistant non-aqueous approach to separate the actinides in spent fuel from fission products. The AFCI pyroprocessing activities support the reduction of the radiotoxicity of nuclear waste through the separation of minor actinides from spent fuel in certain designs of liquid metal-cooled fast reactors for recycle back into fast reactors or to dedicated transmuter devices. While using pyroprocessing to treat spent fuel from the Experimental Breeder Reactor-II (EBR-II), pyrochemical process improvements have been made which increase its applicability to other advanced reactor fuels.

In FY 2005, advanced alternative separations experiments applying the Actinide Crystallization Process (ACP) technology were investigated. The Department continued development and testing of methods to separate lanthanides from trivalent actinides and americium from curium. The feasibility of ACP was tested with cold spent fuel surrogates dissolved in nitric acid, and work commenced on the use of a carbonate-based crystallization process. Development of security systems for materials accountability within batch and continuous separations processes was initiated. The Department continued pyrochemical treatment of EBR-II spent driver fuel and investigated more cost-effective alternative technologies for processing the blanket fuel. Based on experience in the treatment of EBR-II spent fuel, advanced pyrochemical process development continued in support of certain designs of sodium-cooled fast reactor fuels. These processes include molten salt dissolution and electrochemical oxidation-reduction steps.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

In FY 2006, the Department will conduct research into alternative advanced separation technologies, involving combined aqueous/pyrochemical hybrid processes. These processes offer increased versatility compared with either aqueous or pyrochemical processes operated separately. Pyrochemical tests on the separation of cesium and strontium from molten salts will also be initiated along with tests of the separation of individual and group transuranic elements, including americium/curium from other actinides and americium from curium. A new separations activity will also be initiated involving the use of continuous, countercurrent extraction systems based on molten salts and metals flowing in opposite directions through a multistage separations unit. Development of high-throughput electrorefiners and metal waste forms will continue. The Department will also continue pyrochemical treatment of EBR-II spent driver fuel and investigate more cost-effective alternative technologies for processing the blanket fuel.

In FY 2007, pyrochemical treatment of EBR-II spent driver fuel and testing of high-throughput electrorefiners will continue as will the testing of processes involving the combined use of both aqueous and pyrochemical separations technologies. Within the aqueous portion of the process development, there will be an extension of process instrumentation development for on-line, real-time accountability measurements applied to separations facilities for increased proliferation resistance. Studies will continue on the applicability of pyrochemistry to the separation of cesium and strontium from spent fuels. The most promising approaches to the application of pyrochemistry to the separation of americium and curium will be evaluated, and the process with the highest promise will be studied in greater detail for its application to the preparation of long-term storage forms. Efforts to improve sampling and other monitoring activities will be conducted in order to increase proliferation resistance.

Advanced Fuels Development **12,151** **8,187** **9,000**

The AFCI fuels development activity is fabricating and irradiating proliferation-resistant reactor fuels that will enable the consumption of significant quantities of plutonium and minor actinides from accumulated spent fuel while simultaneously extracting more useful energy from the spent fuel materials. While analysis has shown that recycle in light water reactors (LWR) has some value in reducing proliferation risk from accumulated plutonium and can modestly enhance repository performance, fast reactors could be used to complete the transmutation mission of the AFCI program and impart the maximum benefit to repository loading capability. Development priority for this effort will be transitioned in FY 2006 to focus on advanced fast "burner" reactor transmutation fuel. The LWR recycle fuel-oriented research and development activity will be tabled in FY 2006 and the fuels R&D effort focused on oxide and metal driver and transmutation fuel variants that can be used in an Advanced Burner Reactor (ABR). Supporting international cooperation in the advanced fuels development area will be pursued as appropriate.

In FY 2005, the Department initiated the post-irradiation examination (PIE) of the first mixed-oxide LWR-oriented transmutation test fuel and completed PIE of actinide-bearing metal and nitride fuel forms irradiated in the Advanced Test Reactor (ATR) in Idaho in support of safety data collection for a similar test to be conducted in the Phenix fast reactor in France (FUTURIX-FTA). In addition, high burnup ATR irradiation tests containing metal and nitride actinide-bearing transmutation fuels were initiated.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

In FY 2006, the Department will issue the final report on the PIE of the first mixed-oxide LWR recycle fuel irradiation test, and then table, with appropriate documentation, the LWR mixed-oxide and inert matrix recycle fuel development program. The final report of the PIE of the initial actinide-bearing metal and nitride fuel irradiation tests will also be issued.

High burnup transmutation fuel tests will continue in the ATR. The Department will continue its international cooperation that supports development of advanced transmutation fuels, including: shipping to France U.S. origin advanced transmutation fuel test pins for irradiation in the Phenix fast test reactor; seeking international fuel supply sources for the initial ABR demonstration reactor core; and continuing fast reactor fuel irradiations in the JOYO reactor in Japan or other foreign reactors.

In FY 2007, irradiation tests of high burnup transmutation fuels in the ATR will be completed and PIE initiated. Final documentation of LWR transmutation fuel irradiations performed in 2004 will be completed. Fast reactor transmutation fuel irradiation tests will be initiated in the Phenix reactor, and an international arrangement for irradiations in the JOYO fast reactor will be finalized.

Transmutation Engineering **11,835** **5,316** **6,000**

Transmutation is a process by which certain long-lived radioactive species are converted to short-lived and lower radiotoxicity species. Transmutation can convert the most significant long-lived species such that radiotoxicity can be reduced to below that of natural uranium in centuries instead of hundreds of millennia.

AFCI transmutation engineering activities are developing the engineering and science for the transmutation of minor actinides and long-lived fission products from spent fuel. This includes nuclear cross-section data, nuclear physics data and codes, coolants and corrosion, structural materials, and pursuit of international collaborations to support technology decisions on reactor-and accelerator-assisted transmutation systems.

In FY 2005, the Department continued transmutation physics measurement and analysis work to reduce uncertainties in minor actinide cross sections required for advanced transmutation reactor designs. This included the completion of americium measurements initiated in FY 2004. University of Nevada, Las Vegas (UNLV) and the Idaho Accelerator center (IAC) conducted experiments on lead alloy coolants and targets in accelerator-based systems, which also have potential application to fast reactor systems. The Department continued to engage in international collaborations with France, Switzerland, and the European Union on accelerator-driven system spallation target (MEGAPIE) tests and reactor-accelerator coupling experiments (EUROTRANS).

In FY 2006, the Department will refine physics cross sections for advanced transmutation and fast reactor designs and provide design support for advanced fast burner reactors. Additionally, the Department will perform mechanical testing of structural material samples previously irradiated in the Fast Flux Test Facility, and update the AFCI Materials Handbook. Transmutation engineering research will continue at UNLV and IAC.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

In FY 2007, the Department will continue to evaluate and refine cross sections for plutonium isotopes to support advanced transmutation reactor designs. Mechanical testing and analysis of structural materials irradiated in the Fast Flux Test Facility will be continued which will assist in the selection of structural materials for use in fast spectrum transmutation systems.

Systems Analysis **4,736** **5,940** **10,000**

The AFCI systems analysis activity is developing and applying evaluation tools to formulate, assess, and guide program activities to meet programmatic goals and objectives. Proliferation resistance analysis is a high-priority, ongoing activity, especially in the area of advanced separations technologies. The focus of the systems analysis activity is the evaluation and down-selection of the most promising spent fuel treatment technologies, fuels technologies, and advanced fuel cycle deployment strategies in light of the steadily-increasing knowledge acquired from AFCI and Generation IV research and development activities. Additionally, the systems analysis activity is investigating optimal systems to reduce the burden on geologic repositories by removing the uranium and major heat-generating components of spent nuclear fuel, and optimizing the destruction of actinides to reduce the radiotoxicity of the waste from 300,000 years to less than 1,000 years when compared with the radiotoxicity of uranium ore. Cost-benefit, proliferation resistance, safety and sustainability analyses are being performed for each promising option. The systems analysis activity, by determining the optimum mix of facilities and systems, is enabling the Department to effectively prioritize program research and development.

The systems analysis activity is closely involved with similar efforts in the Department's Office of Civilian Radioactive Waste Management (RW). Joint efforts are focused on establishing consistent cost bases for use in evaluating the potential impact of advanced fuel cycles on repository performance and costs. To this end, the systems analysis activity issued in 2005 the first annual cost basis report providing a comprehensive set of cost data for use in evaluating impacts and benefits of a wide range of AFCI and Generation IV technology deployment options. The report and its associated modeling efforts are intended to aid analysts in evaluating the elements that dominate nuclear fuel cycle costs, and helping to develop more efficient and less costly fuel cycle systems.

The systems analysis activity also produces the annual "AFCI Comparison Report" which provides a snapshot of the current state of knowledge and the progress of AFCI research and development activities. This annual report compares various separations, fuels and reactor technologies being researched by the AFCI and Generation IV programs against the goals and objectives of those programs. In FY 2005, the Department issued the 2005 update to the annual "AFCI Comparison Report", which quantitatively identifies the respective advantages and disadvantages of the strategies and separations, fuels and reactor technologies explored by the AFCI and Generation IV programs as well as the additional research and development knowledge gained during the previous year. Simultaneously, it issued the Congressionally-mandated report, "Advanced Fuel Cycle Initiative: Objectives, Approach and Technology Summary". Systems analysis activities also included evaluation of cost/benefits to the program with regard to the development of proliferation-resistant, economic nuclear energy for the remainder of the century and the extent to which program technologies can help optimize the use of the Yucca Mountain repository and postpone the technical need for additional repositories.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

In FY 2006, the Department will focus its systems analysis efforts on evaluating the integrated fuel cycle system it has chosen to demonstrate at engineering scale. It will develop a plan for integrating a spent fuel recycle capability with interim storage of commercial spent nuclear fuel and complete an assessment of the proliferation resistance of certain aqueous separations technologies. This "Spent Fuel Recycling Plan" will be submitted to Congress as requested in the FY 2006 Appropriations language. The Department will also expand its cost-benefit analyses by conducting integrated nuclear fuel cycle system studies, transmutation system studies and technology and facility assessments. A Simulations Laboratory, that would support a robust research, simulation and visualization program modeling advanced integrated fuel cycles, will be developed in conjunction with the Office of Science (SC). It would be a virtual laboratory utilizing the advanced high-performance computing capabilities of the DOE complex in close coordination with academia and industry. It would advance applied nuclear sciences, as well as state of the art computing and visualization tools to expedite the design, construction, and operation of advanced spent fuel treatment, fuel fabrication, and reactor facilities. To support the preparation of a 2007-2010 Secretarial recommendation on the technical need for a second repository, the Department will complete analyses regarding the optimum mix of facilities and systems and associated R&D priorities. An updated edition of the annual "AFCI Comparison Report" will be submitted to Congress. Collaboration will continue with the Office of Civilian Radioactive Waste Management (RW), particularly to establish and assure consistency of data used in computer models, in supporting the economic and technical analyses that will inform the Secretary's recommendation to Congress on the technical need for an additional repository.

In FY 2007, the AFCI program will provide key technical and economic analyses to support the Secretary's recommendation to Congress on the technical need for a second repository. These analyses will compare direct disposal of spent fuel with disposal after recycle and "burning" actinides in Advanced Burner Reactors. The Office of Nuclear Energy, Science and Technology, in cooperation with the Office of Science, will begin to develop modern, efficient reactor and safety software to enable merit-reviewed access to the suite of state-of-the-art supercomputers operated by the Office of Science. These programs must be placed under configuration control, with compliance to QA standards. An integrated model will be initiated within the Simulations Laboratory to analyze all elements of the fuel cycle including economics, safety and environmental issues, proliferation issues and sustainability. The program will update the "AFCI Comparison Report" and the "AFCI Cost Basis Report". Business studies of the accelerated demonstration program will also be initiated to obtain inputs from the business and academic communities on implementation of a large scale advanced fuel cycle complex in the United States and across the globe.

Transmutation Education **4,285** **13,365** **6,000**

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 2005	FY 2006	FY 2007

In FY 2005, directed university research to support advanced fuel cycles was funded by the technical program areas – separations, fuels development, transmutation engineering, and systems analysis. 19 NERI university grants were awarded in support of AFCI research. The university student research programs at UNLV and IAC continued. Eight new Masters fellowships were awarded.
In FY 2006, the Department will continue its NERI university grant program. The AFCI fellowship program will award fewer fellowships this year than in previous years. Directed university research to support advanced fuel cycles will continue within the technical program areas. University student research programs will continue at UNLV, IAC and the University of Nevada Reno.

In FY 2007, the Department will continue to fund previously awarded NERI grants.

Advanced Fuel Cycle Facility..... **0** **6,930** **20,000**
An Advanced Fuel Cycle Facility (AFCF) will provide the capability to test and improve advanced separations and fuel fabrication technologies in an integrated development facility leading to demonstrations up through engineering-scale. Such testing is necessary to provide the technical basis for the final design of commercial scale fuel cycle facilities, including separations plants with capacities on the order of 2,000 metric tons per year and fuel fabrication capabilities of at least 400 metric tons per year. Integrated modules are envisioned for the advanced fuel cycle facility, including an aqueous separations module, fuel fabrication module, an advanced R&D module for advanced separations process development, waste and storage form development and advanced instrumentation, control, and monitoring for advanced safeguards systems, and a pyroprocessing development module. Design activities will be conducted on all modules as an integrated project through preliminary design. Final design and construction of each module can then be completed sequentially based on need date. Such laboratory capabilities do not exist in the United States today and are vital to the Nation's expanded use of nuclear energy.

The AFCF will have the capability for remote fabrication of minor actinide bearing transmutation fuel pellets, pins and lead test assemblies. It will be used to provide test articles needed to qualify the transmutation fuel for a commercial ABR.

Approval of the mission-need statement and initiation of conceptual design of the AFCF will occur in FY 2006. An environmental impact statement and regulatory analysis will also be initiated.

In FY 2007, the AFCF conceptual design will be completed, as well as the environmental impact statement. A record of decision will be issued specifying the location selected for construction of the AFCF.

UREX+ Engineering Scale Demonstration (ESD) **0** **13,860** **155,000**
Research conducted at laboratory scale over the past five years has demonstrated the UREX+ spent fuel separations process as a viable technology. The UREX+ separations process, which separates all transuranics as a group from spent fuel, is ready for scale up to engineering scale to further demonstrate the technology and to develop scope, cost and schedule for future commercialization. The UREX+ process produces a product that can readily be fabricated into a transmutation fuel for fast reactors. Because the plutonium is not separated from the other transuranics, UREX+ offers improved

proliferation resistance over other processes.

In FY 2006, approval of the mission-need statement and authorization to proceed with conceptual design of the UREX+ Engineering-Scale Demonstration will occur. An environmental impact analysis of the engineering scale demonstration will be initiated.

In FY 2007, the conceptual design of the UREX+ Engineering-Scale Demonstration will be completed, including an integrated safety management plan. The program will prepare a bid solicitation for construction of the facility, and place procurement orders for standard, commercially available, fuel handling and shearer equipment. In addition, work will begin on the fabrication of standard equipment such as centrifugal contactors, pumps and storage tanks. A detailed Functional and Operational Requirements document will also be completed. The environmental impact statement and record of decision will be completed.

Advanced Burner Reactor (ABR)..... **0** **4,950** **25,000**

This activity involves pre-conceptual design activities for a fast spectrum sodium-cooled ABR demonstration/test reactor which would be used to effect qualification of advanced burner reactor fuel to consume transuranic elements (TRU) from spent light water reactor fuel and spent fast reactor fuel. The strategy to build and operate a demonstration/test ABR will be developed as part of a programmatic environmental impact statement, as well as a comprehensive technical and economic systems analysis.

In FY 2006, the Department expects to complete an evaluation of demonstration ABR fuel types and select the reference fuel for the reactor. Functions and Operating Requirements for the ABR demonstration/test reactor will be developed. Preconceptual design activities will commence and a Mission Need Statement will be developed. Industry and international collaborations will be sought to assist in this effort. In addition, the Department will collaborate with international and private parties to refine the Global Nuclear Energy Partnership (GNEP) concept and gauge interest in demonstration of the sodium cooled reactor technology as the fast Advanced Burner Reactor component of GNEP.

In FY 2007, the Department will:

- Establish international cooperation plans (cost sharing and intellectual property provisions).
- Identify international partners and suppliers for the design and procurement of major reactor components.
- Initiate conceptual design including the development and execution of a Mission Need Statement in compliance with DOE Order 413.
- Begin to establish fuel fabrication capability at INL and perform a comprehensive study on oxide, metal, and nitride fuels to determine viability of each.
- Initiate NEPA/EIS process and site selection.
- Prepare solicitation for commercial vendor and AE firm to support Secretarial requirement for cost and schedule development by FY 2008.
- Develop QA plan and implement selected provisions (e.g., training).
- Compile data for qualification of computer codes and validation of models; place computer

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
codes and data under configuration control in conformance with QA plan.			
Materials Test Station	**7,000**	**3,465**	**0**
This project includes the design, fabrication and installation of a spallation neutron source into an existing experimental area at an operating linear accelerator national user facility (the Los Alamos Neutron Science Center, LANSCE). This project is being managed as the acquisition of a major item of equipment (MIE).			
In FY 2005 and FY 2006, Congress provided funding to develop the Materials Test Station (MTS). No funding is requested for the MTS in FY 2007.			
Small Business Innovative Research and Small Business Technology Transfer Programs	**0**	**1,050**	**1,000**
The FY 2006 and FY 2007 amounts shown are estimated requirements for the continuation of the SBIR and STTR program.			
Total, Advanced Fuel Cycle Initiative	**66,407**	**79,200**	**243,000**

Explanation of Funding Changes

	FY 2007 vs. FY 2006 ($000)
Separations Technology Development	
▪ **Proliferation Resistant Fuel Treatment**	
The decrease of $2,855,000 is based on a shift in emphasis from exploring multiple advanced technologies to preparing for an engineering scale demonstration of the UREX + flowsheet to treat LWR spent fuel	-2,855
▪ **Generation IV Fuel Treatment Process Development**	
The decrease of $2,282,000 is to focus on research in the application of hybrid and pyrochemical processes for application to advanced fast reactor concepts. It also permits 1) an extension of process instrumentation development for on-line, real-time accountability measurements applied to aqueous separations used in hybrid processes, 2) to initiate tests on pyrochemical treatment of advanced Generation IV fuels for which current processes are not applicable, particularly involving the separation of americium and curium, while continuing to study the applicability of pyrochemistry to the separation of cesium and strontium from spent fuels, and 3) to improve sampling and other monitoring activities	-2,282
Total Funding Change, Separations Technology Development	**-5,137**

	FY 2007 vs. FY 2006 ($000)
Advanced Fuels Development	
The increase of $813,000 reflects a shift in program emphasis from development of recycle fuels for thermal reactors to fast reactors. Advanced burner reactor fuel development support will be increased in response to design related needs of the Advanced Burner Reactor (e.g. enrichments up to 50%)	+813
Transmutation Engineering	
The increase of $684,000 is to focus the Transmutation Engineering activities on physics and structural materials evaluations in support of the acceleration of engineering scale demonstrations of spent fuel separations and fast reactor transmutation. Lead alloy coolant research and lead corrosion research is being terminated in order to focus on sodium-cooled fast reactor transmutation…….....	+684
Systems Analysis	
The increase of $4,060,000 is for the development of an Advanced Simulations Laboratory in collaboration with the Office of Science that would support a robust research, simulation and visualization program. It would be a virtual laboratory utilizing the advanced high-performance computing capabilities of the DOE complex in close coordination with academia and industry. It would advance applied nuclear sciences, as well as state of the art computing and visualization tools to expedite NRC licensing and safety analysis of advanced spent fuel treatment, fuel fabrication, and reactor facilities. In addition, business studies of the accelerated program will be conducted in order to obtain inputs from the business and academic communities on implementation of a large scale advanced fuel cycle complex in the United States and across the globe.	+4,060
Transmutation Education	
The decrease of $7,365,000 reflects a shifting of funds to higher priority separations and fuels activities	-7,365
Advanced Fuel Cycle Facility (AFCF)	
The increase of $13,070,000 is for completing the AFCF conceptual design and the environmental impact statement for the facility	+13,070
UREX+ Engineering Scale Demonstration (ESD)	
The increase of $141,140,000 is to complete ESD conceptual design and to accelerate preliminary design activities for the ESD. The environmental impact statement for the facility will also be completed	+141,140

	FY 2007 vs. FY 2006 ($000)
Advanced Burner Reactor (ABR)	
The increase of $20,050,000 is for initiating conceptual design of the demonstration ABR, and planning for the manufacture of the ABR demonstration plant initial core driver fuel and associated fuel assembly fabrication capability	+20,050
Materials Test Station	
The decrease of $3,465,000 reflects that no funds are requested for the MTS in FY 2007	-3,465
Small Business Innovative Research and Small Business Technology Transfer (SBIR/STTR) Programs	
The decrease of $50,000 reflects a reduction in work scope that is considered R&D activities	-50
Total Funding Change, Advanced Fuel Cycle Initiative	**+163,800**

Infrastructure

Funding Profile by Subprogram

(dollars in thousands)

	FY 2005 Current Appropriation	FY 2006 Original Appropriation	FY 2006 Adjustments	FY 2006 Current Appropriation	FY 2007 Request
Infrastructure					
Radiological Facilities Management	68,563	54,595	-546[a]	54,049	49,722
Idaho Facilities Management	91,434[b]	82,600[c]	-826[d]	81,774[e]	95,290[f]
Total, Infrastructure	159,997	137,195	-1,372	135,823	145,012

Mission

The mission of the Infrastructure program within Energy Supply and Conservation is to manage the planning, acquisition, operation, maintenance, and disposition of nuclear facilities and infrastructure to conduct advanced nuclear energy research; to meet the growing demand for isotopes used in medicine, scientific research and homeland security; to provide radioisotope power systems for space exploration and national security; and to ensure the long term future of the domestic nuclear fuel supply.

The Infrastructure program includes Radiological Facilities Management and Idaho Facilities Management. The Radiological Facilities Management core program is funded under the Energy Supply and Conservation appropriation. In FY 2005 and FY 2006, the Idaho Facilities Management program was funded in both the Energy Supply and Conservation and the Other Defense Activities appropriations. Beginning in FY 2007, the Idaho Facilities Management program is requested only under the Energy Supply and Conservation appropriation.

Beginning in FY 2005, the cost of conducting External Independent Reviews (EIRs) for Capital Asset Projects greater than $5 million with the Infrastructure Program, have been funded by this program. Examples of EIRs include conducting Performance Baseline EIRs prior to Critical Decision-2 (CD-2) to verify the accuracy of cost and schedule baseline estimates and conducting Construction/Execution Readiness EIRs, which are done for all Major System projects prior to CD-3. These funds, which are managed by the Office of Engineering and Construction Management, are exclusively used for EIRs directly related to these projects funded within the Infrastructure Program. Beginning in FY 2007, the EIR business line will be financed via the Working Capital Fund to achieve parity on how EIRs are funded and to standardize the administration of these critical activities.

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[a] Includes a rescission of $545,950 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.

[b] Excludes $20,719,000 appropriated under Other Defense Activities, a $167,000 0.8% rescission in Other Defense Activities, and $10,000,000 from Naval Reactors.

[c] Excludes $17,762,000 appropriated under Other Defense Activities and $13,500,000 from Naval Reactors.

[d] Includes a rescission of $826,000 in accordance with P.L. 109-148, Emergency Supplemental Appropriations to Address Hurricanes in the Gulf of Mexico and Pandemic Influenza, 2006.

[e] Excludes $17,584,000 appropriated under Other Defense Activities and $13,365,000 from Naval Reactors.

[f] Beginning in FY 2007, all funding for Idaho Facilities Management is requested under Energy Supply and Conservation appropriation.

Benefits

The Infrastructure program keeps unique DOE facilities and supporting infrastructure in a user-ready status. Facilities supported by this program include reactors, hot cells, and other vital infrastructure needed to carry out advanced nuclear energy technology research and development; construct power systems essential for important national security missions and space exploration; produce, package, and ship radioisotopes for medical and scientific applications; and test new fuels and core components for the Naval Nuclear Propulsion Program. DOE stimulates great advances in science by making its nuclear facilities available to a large user base. The Department does not subsidize direct operational costs related to users, but it does maintain and safeguard unique radiological facilities and capabilities in a manner that supports their application to missions from various governmental and scientific users.

In FY 2005, the Department created the Idaho National Laboratory (INL) to serve as the center for the Department's nuclear energy research and development efforts. The INL will play a lead role in Generation IV nuclear energy systems development, advanced fuel cycle development, testing of naval reactor fuels and reactor core components, and space nuclear power applications. While the laboratory has transitioned its research and development focus to 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. It will be a crucial facility in the development of the Generation IV reactor and the Advanced Fuel Cycle Initiative. In addition, ATR currently conducts virtually all irradiation testing of Navy reactor fuels and core components and is vital to achieving the Department's 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.

The Infrastructure program supports "National Energy Policy" goals by maintaining and operating important landlord infrastructure required for the support of facilities dedicated both to advanced nuclear energy technology research and development and multi-program use. The Landlord manages common-use equipment, facilities, land, and support services that are not directly funded by programs. 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 the disposition of DOE waste materials under NE ownership.

In November 2003, a Nuclear Energy Research Advisory Committee (NERAC) task force completed an examination of the nuclear R&D infrastructure at the INL to identify the maintenance and upgrades required to meet the Department's nuclear R&D activities planned at Idaho. Building on this assessment, NERAC created a Subcommittee on Nuclear Laboratory Requirements to identify what characteristics, capabilities, and attributes to make INL the leading nuclear energy research laboratory in the world within ten years of its inception. DOE and INL are now working to implement the recommendations of NERAC.

Strategic and Program Goals

The Department's Strategic Plan identifies four strategic goals (one each for defense, energy, science, and environmental aspects of the mission) plus seven general goals that tie to the strategic goals. The Infrastructure program supports the following goal:

Energy Strategic Goal

General Goal 4, Energy Security: Improve energy security by developing technologies that foster a diverse supply of reliable, affordable and environmentally sound energy by providing for reliable delivery of energy, guarding against energy emergencies, exploring advanced technologies that make a fundamental improvement in our mix of energy options, and improving energy efficiency.

The Infrastructure program has one program goal that contributes to General Goal 4 in the "goal cascade":

Program Goal 04.17.00.00: Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability - to meet the Nation's energy, environmental, medical research, space exploration, and national security needs.

Contribution to Program Goal 04.17.00.00 (Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability)

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. The program manages site equipment, facilities, land, and supporting services that are not directly supported by other programs. 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 General and Program Goal

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
General Goal 4, Energy Security Program Goal 04.17.00.00: Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability			
Radiological Facilities Management	68,563	54,049	49,722
Idaho Facilities Management	91,434[a]	81,774[b]	95,290[c]
Total General Goal 4 (Infrastructure)	159,997	135,823	145,012

[a] Excludes $20,719,000 appropriated under Other Defense Activities, a $167,000 0.8% rescission in Other Defense Activities, and $10,000,000 from Naval Reactors.
[b] Excludes $17,584,000 appropriated under Other Defense Activities and $13,365,000 from Naval Reactors.
[c] Beginning in FY 2007, all funding for Idaho Facilities Management is requested under Energy Supply and Conservation appropriation.

Annual Performance Results and Targets

FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Targets	FY 2007 Targets
Program Goal 04.17.00.00 (Maintain, enhance, and safeguard the Nation's nuclear infrastructure capability)					
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.	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.
Radiological Facilities Management					
Complete 80 percent of the construction of the Los Alamos Isotope Production Facility, which is needed for the production of short-lived radioisotopes essential for U.S. medical research. (MET TARGET)	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)			
	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 power systems infrastructure by fabricating 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). (MET TARGET)	Demonstrate the operational capability of radioisotope 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	Maintain and operate radioisotope power systems facilities with less than 10 percent unscheduled downtime from approved baseline. (MET TARGET)			
Bring the full-scale scrap					

FY 2002 Results	FY 2003 Results	FY 2004 Results	FY 2005 Results	FY 2006 Targets	FY 2007 Targets
recovery line to full operation and begin processing Pu-238 scrap for reuse in ongoing and future missions requiring use of radioisotope power systems. (MIXED RESULTS)	LANL. (MET TARGET)				
Idaho Facilities Management					
Meet the milestones for legacy waste cleanup at Test Reactor Area (TRA) in the Voluntary Consent Order between the State of Idaho and DOE, and efficiently manage resources to limit growth in backlog of maintenance to no more than 10 percent. (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 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.	Maintain operability of 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.

Means and Strategies

NE will use various means and strategies to achieve its program goals. However, various external factors may impact the ability to achieve these goals. NE 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 isotope production facilities in a ready, safe and environmentally compliant condition and maintain the unique infrastructure and capability to deliver advanced radioisotope power systems for space and national security missions.

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.

- Efficient use of existing facilities and staff, backup supply agreements, upgrade of present facilities, purchase of needed equipment, and investing in new facilities as warranted by demand. The challenges to the program will continue as scientific and medical research result in increased demand for new isotope products.

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

- Medical Isotope Infrastructure Key External Factors: The Department is working to fully address its customers' requirements and to forecast future trends. This is being done through frequent interactions between customers and Program staff; data obtained from site visits and attendance at society exhibitions (e.g., the Society of Nuclear Medicine); and coordination of isotope activities with stakeholders in the isotope community including other Federal agencies. Research on market sizes, pricing pressures, competition, and customer feedback also is being obtained through independent surveys and studies, as well as Program management assessments.

- Idaho Facilities Management Key External Factors: Energy policy changes related to the emphasis on future nuclear energy R&D would impact the focus and direction of the Idaho Facilities Management Program, but not necessarily its overall cost and long-term liabilities. Increased nuclear energy R&D needs resulting from new mission initiatives could require accelerated recapitalization to support enhanced use of research facilities and earlier enhancement of the existing infrastructure. On the other hand, reduced nuclear energy R&D could generate a larger near-term inventory of excess facilities and shift funding needs from upgrades and improvements to disposition (e.g., clean-up and dismantlement).

  With the award of the new Idaho National Laboratory contract, Idaho will become a truly multi-program national laboratory with NE being the lead program. Through the Idaho Operations Office, NE will integrate and oversee program activities and manage the Department of Energy and Work

for Others contracts. The Office of Environmental Management (EM), in executing the Idaho Cleanup Project (ICP), will initially be the largest program at the site, but that will change rapidly over time as the clean-up progresses.

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.

- The Department finances all isotope production and distribution expenses through cash collections from both Federal and non-Federal customers. The program is working to fully address its customers' requirements and to forecast future trends. This is being done through frequent interactions between customers and program staff, data obtained from customer site visits and attendance at society conferences (*e.g.*, the Society of Nuclear Medicine), and coordination of isotope activities with stakeholders in the isotope community, including other Federal agencies.

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 continuing 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 (including DOE Real Property Management Order). 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.

NERAC subcommittees evaluate progress of NE's research and development programs. NERAC similarly reviews specific program plans as they are being formulated. In early FY 2004, NERAC established a Subcommittee on Evaluations. The full NERAC and its subcommittees have provided independent evaluations in the past, but these evaluations never comprehensively covered the entire nuclear energy program. The new Subcommittee engages appropriate experts to monitor, on a continual basis designated NE programs and evaluate the progress of these programs against (a) direction and guidance provided by the full NERAC and (b) program plans and performance measures developed by the program under evaluation. This Subcommittee provides arm's length, independent assessments that are critical to the evaluation of NE programs.

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. The Infrastructure program has incorporated feedback from OMB during the FY 2006 assessment into the FY 2007 Budget Request and has taken or will take 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 Idaho National Laboratory 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. 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 cost, schedule, and other baselines for its new performance metrics in 2006.

Radiological Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Radiological Facilities Management			
Space and Defense Infrastructure	33,532	39,303	30,650
Medical Isotopes Infrastructure	34,535	14,251	15,634
Enrichment Facility Infrastructure	496	495	491
Research Reactor Infrastructure	0	0	2,947
Total, Radiological Facilities Management	68,563	54,049	49,722

Description

The mission of the Radiological Facilities Management program is to maintain critical nuclear 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, Science and Technology (NE) managed facilities at Idaho National Laboratory (INL), Oak Ridge National Laboratory (ORNL), Los Alamos National Laboratory (LANL), Sandia National Laboratories (SNL), and Brookhaven National Laboratory (BNL). In addition, the Radiological Facilities Management program assures appropriate oversight of the operations and maintenance of the Department's Paducah Gaseous Diffusion Plant (Paducah GDP) uranium enrichment facilities to assure that USEC Inc. (USEC) meets its commitments under the 2002 DOE-USEC Agreement for the maintenance of a domestic enriched uranium fuel supply.

Benefits

These funds assure that NE nuclear facilities meet essential safety and environmental requirements and are maintained at user-ready levels. Actual operations, production, research, or other additional activities are funded either by other DOE programs, by the private sector, or by other Federal agency users.

Specifically, the Department maintains the unique facilities at the Idaho, Oak Ridge, and Los Alamos National Laboratories for the production of radioisotope power systems. Such facilities are not available in the private sector nor in any other Federal agency. These facilities enable the Department to provide the radioisotope power systems that can generate electrical power in remote harsh environments for space exploration and to support critical national security applications that are important to homeland security. The Department funding maintains the basic facilities whereas mission specific development or hardware fabrication costs are provided by the user agencies.

In addition, the Department maintains one-of-a-kind facilities at the Idaho, Oak Ridge, Sandia, Brookhaven, and Los Alamos National Laboratories for isotope production and processing. These

isotope facilities are unique and produce isotopes not available from the private sector. The Isotopes produced at the Department improve the accuracy and effectiveness of medical diagnoses and therapy, enhance homeland security, improve the efficiency of industrial processes, and provide precise measurement and investigative tools for materials, biomedical, environmental, archeological, and other research. Actual operations, production, research or other activities are funded either by other DOE programs, by the private sector, or by other Federal agency users.

The Department is also responsible for oversight and monitoring of the maintenance of its leased assets at the Paducah Gaseous Diffusion Plant. The DOE-owned Paducah GDP is the only operating domestic enriched uranium production facility. Its continued operation is essential to assure an adequate supply of nuclear fuel for the Nation's electric utilities.

Finally, the Department is responsible for providing fresh reactor fuel to universities and disposing of spent fuel from university reactors.

Detailed Justification

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Space and Defense Infrastructure	**33,532**	**39,303**	**30,650**
▪ **Idaho National Laboratory (INL)**	**14,732**	**20,503**	**12,200**
• **Radioisotope Power Systems Assembly Operations**	**9,432**	**16,380**	**8,000**

The Department has completed the transfer of the radioisotope heat source and power system assembly and testing program from the Mound Plant in Ohio to INL. Following the events of September 11, 2001, the Department identified the need to enhance security at the Mound Site or to transfer operations to another site where security was already in place. The components and systems at Mound containing Plutonium-238 (Pu-238) were transferred to the Materials and Fuels Complex and became operational in early 2005 and will be fully functioning throughout FY 2006. The Department funding maintains the facilities at INL in an operational status and the user agencies fund mission specific assembly or testing operations. Fueling operations for the New Horizons/Pluto mission began in mid-FY 2005. These efforts will be completed in early FY 2006 and the focus will then shift to support assembly and testing of generators for two national security applications and the qualification of an advanced multi-mission thermoelectric generator and a Stirling radioisotope power system for the National Aeronautics and Space Administration. In addition, the Department is in the process of transferring its inventory of neptunium-237 (Np-237) from the Savannah River Site to the INL during FY 2005 and FY 2006. The Np-237 would be required if the Department proceeds to reestablish a domestic capability to produce new Pu-238.

Congress appropriated funds in FY 2006 to conduct activities for the relocation of plutonium-238 (Pu-238) operations. In FY 2006, these funds will be used to perform environmental and planning work. No funds are requested for these activities in FY 2007 because customer agencies have not indicated sufficient demand for Pu-238 to justify an extensive transformation of the Pu-238 infrastructure.

(dollars in thousands)

FY 2005	FY 2006	FY 2007

- **Capital Equipment for Radioisotope Power System Assembly Operations** **800** **200** **200**

  In order to sustain the facility in an operational status, a continuing level of capital equipment funding is required for routine maintenance and infrastructure support. The lower funding level in FY 2006 and FY 2007 reflects the facility going operational in FY 2005.

- **Safety/Program Analysis and Testing Infrastructure** **4,500** **3,923** **4,000**

  The Department maintains an analytical and testing infrastructure at INL and other sites 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 basic 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 2006 and FY 2007, analysis techniques and computer codes will be updated to incorporate more advanced capabilities that can provide more accurate and detailed projections in support of future missions.

▪ **Los Alamos National Laboratory (LANL)** **13,800** **13,800** **13,800**

- **Pu-238 Encapsulation and Scrap Recovery Facilities** **12,500** **12,500** **12,500**

  The Department maintains and operates dedicated Pu-238 processing, encapsulation, and scrap recovery facilities within the Plutonium Facility (PF-4) at Technical Area 55 at LANL. These 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 operational at least through FY 2012 and thus available to help meet agency missions. The focus in FY 2006 and FY 2007 will be on two national security applications. The Department funding request maintains the basic capabilities and infrastructure in operational status and produces some qualified product as part of this process. 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. In addition, priority is being given to removing and repackaging waste residues from the storage facility where there was a contamination incident in 2003. The material will be put in a form suitable for long term storage or disposal or in a form that it can be recycled for use. The removal and repackaging effort will be completed during late 2006 or early 2007.

- **Capital Equipment for the Pu-238 Facilities** **1,300** **1,300** **1,300**

  Maintenance of the Pu-238 facilities requires regular upgrades and replacement of gloveboxes and equipment in the processing, encapsulation, and scrap recovery lines. Installation of new gloveboxes and upgrading or maintenance of other gloveboxes will continue during FYs 2005, 2006 and 2007. This may include the establishment of isotopic analysis capabilities within the plutonium facility, TA-55.

	(dollars in thousands)		
	FY 2005	FY 2006	FY 2007
▪ **Oak Ridge National Laboratory (ORNL)**	**5,000**	**5,000**	**4,650**
• **Iridium Fabrication Facilities for Radioisotope Power Systems**	**4,500**	**4,500**	**4,150**

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 2006 funding will continue to ensure the operational capability of this facility; FY 2007 funding will allow continued operation of the facility, although at a reduced capability.

• **Capital Equipment for Iridium Fabrication Facilities**	**500**	**500**	**500**

In FY 2007, ORNL will continue to upgrade and replace rolling mills and other equipment to support iridium processing and fabrication at ORNL.

Medical Isotopes Infrastructure	**34,535**	**14,251**	**15,634**
▪ **Oak Ridge National Laboratory (ORNL)**	**26,350**	**6,279**	**7,165**
• **Building 3047 Hot Cells**	**2,664**	**2,866**	**3,100**

Maintain facility 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 maintenance, radiological monitoring, and facility inspections. Isotope customers will pay the full cost of isotope processing in this facility.

• **Building 5500 – Chemical and Materials Laboratories**	**1,675**	**1,800**	**2,060**

Maintain 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 maintenance, radiological monitoring, and facility inspections.

• **Building 9204-3, Calutron Building Y-12**	**973**	**963**	**940**

The Department plans to phase out the Calutrons, in Building 9204-3 at Y-12 over the next five years. The Calutrons (a type of electromagnetic separator) can no longer economically produce commercial or research stable isotopes. The Calutrons have been in a cold standby condition since 1998.

• **Isotope Production**	**600**	**650**	**715**

Funding provides 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

(dollars in thousands)

FY 2005	FY 2006	FY 2007

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.

- **Uranium-233 (U-233) Program** **6,929** **0** **0**

  The Department maintains a stockpile of U-233 at Oak Ridge National Laboratory. The storage containers for this material require close inspection to verify their integrity that is not possible in the current storage configuration. Further, the storage of this fissile material requires expensive security precautions. The Department, therefore, launched the Uranium-233 Disposition, Medical Isotope Production, and Building 3019 Complex Shutdown Preliminary Project (U-233 Project) to down-blend this material into a form not useable for weapons (thereby reducing the danger posed by excess fissile materials and reducing security costs) and resolve the safety issues associated with its storage. Beginning in FY 2006, this program is funded and managed by the Office of Environmental Management.

- **05-E-203, Facility Modification for ^{233}U Disposition** **13,509** **0** **0**

  FY 2005 funding will fund the completion of the project engineering, design and analysis necessary to support a performance baseline. Beginning in FY 2006, this project is funded and managed by the Office of Environmental Management.

- **Capital Equipment/Shipping Container**..... **0** **0** **350**

  In FY 2007, upgrade the NRC 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)**..... **3,160** **2,922** **3,214**

- **Isotope Production Facility/TA-48 Hot Cell, Building RC-1**..... **2,850** **2,922** **3,214**

  Maintain 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.

- **Capital Equipment**..... **310** **0** **0**

  In FY 2005, completed purchase of type A and type B shipping containers needed to transport isotopes between the IPF and the hot cells and to customers.

	(dollars in thousands)		
	FY 2005	FY 2006	FY 2007
▪ **Sandia National Laboratories (SNL)**	**1,900**	**1,900**	**1,800**
• **TA-5 ACRR & Hot Cells**	**1,900**	**1,900**	**1,800**

The Isotope Programs no longer has a programmatic need for the Annular Core Research Reactor (ACRR). NNSA uses the ACRR for its weapons experiments and is currently the only user. In FY 2006, NE will identify their intention to shut down the reactor subject to the management agreement between NE and NNSA. If NNSA has continuing programmatic use for the reactor, the ACRR will be transferred to NNSA. If no use is identified, NE will use the requested FY 2006 and FY 2007 funding to initiate work on shutdown of the reactor.

▪ **Brookhaven National Laboratory (BNL)**	**2,673**	**2,650**	**2,905**
• **Brookhaven Linear Isotope Producer (BLIP) Building 931 and Hot Cell Building 801**	**2,558**	**2,650**	**2,905**

Maintain 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.

• **Capital Equipment**	**115**	**0**	**0**

The program completed installation of capital equipment purchased in FY 2005.

▪ **Other Activities**	**452**	**500**	**550**
• **Associated Nuclear Support**	**452**	**500**	**550**

This funding provides for requirements applicable to isotope producing sites. Such items include annual Nuclear Regulatory Commission certification of isotope shipping casks, independent financial audits of the revolving fund, and other related expenses.

Enrichment Facility Infrastructure	**496**	**495**	**491**
▪ **Oak Ridge Operations Office**	**496**	**495**	**491**

Funding provides for oversight and monitoring of the maintenance of DOE leased assets at the Paducah Gaseous Diffusion Plant site. The DOE-owned Paducah site is the only operating domestic enriched uranium production facility. Its continued operation is essential to assure an adequate supply of nuclear fuel for the Nation's electric utilities. The Paducah GDP lessee, USEC, committed, in a DOE-USEC Memorandum of Agreement on June 17, 2002, to maintain the long-term operability of the Department-owned Paducah GDP until new centrifuge enrichment technology is deployed by the end of this decade. This program will inspect and analyze operating and maintenance data, and observe industrial activities at the Paducah GDP, and validate GDP maintenance each year, to assure that USEC Inc. meets its MOA commitments and that the Government's rights and options are preserved.

	(dollars in thousands)		
	FY 2005	FY 2006	FY 2007
Research Reactor Infrastructure	**0**	**0**	**2,947**
▪ **Idaho Operations Office**	**0**	**0**	**2,947**
The Department is responsible for providing fresh reactor fuel to universities and disposing of spent fuel from university reactors.			
Total, Radiological Facilities Management	**68,563**	**54,049**	**49,722**

Explanation of Funding Changes

	FY 2007 vs. FY 2006 ($000)
Space and Defense Infrastructure	
▪ **Idaho National Laboratory (INL)**	
• **Radioisotope Power Systems Assembly Operations**	
The decrease of $8,380,000 will discontinue work toward the consolidation of nuclear activities related to the production of radioisotope power sources	-8,380
• **Safety/Program Analysis and Testing Infrastructure**	
The increase of $77,000 will allow the Department to partially address impacts to the update of analytical and testing capabilities caused by the FY 2006 reduction of $277,000	+77
• **Oak Ridge National Laboratory**	
The decrease of $350,000 will reduce the Department's capability to maintain the infrastructure necessary to support iridium fuel clad fabrication by slowing production of required feed material	-350
Total, Space and Defense Infrastructure	**-8,653**
Medical Isotopes Infrastructure	
▪ **Oak Ridge National Laboratory (ORNL)**	
• **Building 3047 Hot Cells**	
The increase of $234,000 will permit needed repairs and keep the maintenance schedule current	+234

	FY 2007 vs. FY 2006 ($000)
• **Building 5500 – Chemical and Materials Laboratories** The increase of $260,000 will permit keeping the maintenance schedule current and purchasing minor lab equipment and supplies needed for converting and processing stable isotopes	+260
• **Building 9204-3, Calutron Bldg, Y-12** The decrease of $23,000 is due to the planned phase-out of the Calutrons	-23
• **Isotope Production** The increase of $65,000 will permit upgrades for a centralized automated inventory from all isotope producing laboratories and meet new accounting system requirements regarding advance payments, cash collections, and inter-site transfers	+65
• **Capital Equipment/Shipping Container** The increase of $350,000 will be used to upgrade the NRC license for one type of shipping container to BU-96 shipping container to enable shipment of a larger number of isotope products to customers and between isotope producing sites	+350
▪ **Total, ORNL**	**+886**
▪ **Los Alamos National Laboratory (LANL)**	
• **Isotope Production Facility/TA-48 Hot Cell, Building RC-1** The increase of $292,000 will be used to maintain the facility consistent with the FY 2006 funding level. Isotope customers will pay the full cost of isotope processing in these facilities	+292
▪ **Total, LANL**	**+292**
▪ **Sandia National Laboratories (SNL)**	
• **TA-5 ACRR and Hot Cells** The decrease of $100,000 reflects reduction in activities in anticipation of transfer to NNSA or shutdown of the reactor. Currently, no mission needs or isotope program activities are conducted at ACRR	-100
▪ **Total, SNL**	**-100**

	FY 2007 vs. FY 2006 ($000)
▪ **Brookhaven National Laboratory (BNL)**	
• **Brookhaven Linear Isotope Producer Building 931 & Hot Cell Building 801** The increase of $255,000 will be used to address additional maintenance requirements	+255
▪ **Total, BNL**	**+255**
▪ **Other Activities**	
• **Associated Nuclear Support** The increase of $50,000 provides level of funding for requirements applicable to isotope producing sites such as external (e.g. U.S. Food and Drug Administration) and internal audits and reviews	+50
▪ **Total, Other Activities**	**+50**
Total, Medical Isotopes Infrastructure	**+1,383**
Enrichment Facility Infrastructure	
▪ **Oak Ridge Operations Office**	
• **Enrichment Facility Infrastructure** The decrease of $4,000 reflects a reprioritization and reallocation of resources among the various Radiological Facility Management subprograms	-4
Total, Enrichment Facility Infrastructure	**-4**
Research Reactor Infrastructure	
▪ **Idaho Operations Office**	
• **Research Reactor Infrastructure** The increase of $2,947,000 will allow the Department to provide fresh reactor fuel to universities and dispose of spent fuel from university reactors	+2,947
▪ **Total, Idaho Operations Office**	+2,947
Total, Research Reactor Infrastructure	+2,947
Total Funding Change, Radiological Facilities Management	**-4,327**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Capital Equipment	3,025	2,000	2,350
Total, Capital Operating Expenses	3,025	2,000	2,350

Construction Projects

(dollars in thousands)

	Total Estimated Cost (TEC)	Prior-Year Appro-priations	FY 2005	FY 2006	FY 2007	Unappro-priated Balance
05-E-203, Facility Modification for ^{233}U Disposition, ORNL[a]	114,184	–	13,509[b]	–[c]	–	100,675

[a] Planning and Design activities performed in FY 2003 and 2004 were funded from budgeted amounts ($9,408,000) for Building 3019 Complex operations as noted in the Preliminary Project Execution Plan (PEP).
[b] Reflects a rescission reduction in the amount of $107,393.
[c] Project is appropriated to EM in FY 2006 per Conference Report 109-275.

Isotope Production and Distribution Program Fund

Funding Schedule by Activity

No funds are requested for the Isotope Production and Distribution Fund. Isotopes are currently produced and processed at three facilities: LANL, BNL and ORNL. Each of the sites' production expenses for processing and distributing isotopes will be offset by revenue generated from sales. See the Radiological Facilities Management section for justification of the direct appropriations requested.

Description

The Isotope Programs (Isotope Production and Distribution Program Fund) produces and sells radioactive and stable isotopes, byproducts, surplus materials, and related isotope services world wide. The Isotope Programs 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 will be priced such that the customer pays cost of production. The DOE will continue to sell commercial isotopes at full-cost recovery.

The Program's fiscal year appropriation is received via transfer from the Radiological Facilities Management Unit. The appropriation is 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 will be 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.

Benefits

The Department has supplied isotopes and related services to the public for more than 50 years. As the range of available isotopes and recognized uses have grown, isotope applications have become vital to continued progress in medical research and practice, new industrial processes, 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 many 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. The Department will make new capital investments to

replace, or enhance processing equipment and infrastructure in order to improve production and processing of isotopes to meet current and anticipated future increases in demand as the need is identified.

Idaho Facilities Management

Funding Schedule by Activity

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Idaho Facilities Management			
Idaho National Laboratory (INL) Infrastructure			
INL Operations and Infrastructure	89,923	70,929	89,260
INL Construction	1,511	10,845	6,030
Total, Idaho Facilities Management	91,434[a]	81,774[b]	95,290[c]

Description

The INL is a multi-program national laboratory that pursues a wide range of nuclear power research and development and other national energy security activities. The purpose of the Idaho Facilities Management (IFM) Program is to ensure that the infrastructure required to support these efforts is maintained and operated to meet programmatic requirements in compliance with environment, safety and health rules and regulations.

The IFM Program manages and operates the three main engineering and research campuses at the INL: (1) the Reactor Technology Center (RTC) at the site, an 890 square mile reservation west of Idaho Falls, (2) the Materials and Fuels Complex (MFC) at the site, and (3) the Science and Technology Complex (STC) in Idaho Falls. As INL landlord, the IFM Program also manages and operates the Central Facilities Area (CFA) at the site and various sitewide infrastructure systems and facilities, such as electrical utility distribution.

Benefits

The IFM program supports "National Energy Policy" goals by maintaining and operating INL basic infrastructure that is required to support facilities dedicated to advanced nuclear energy technology research and many other Federal government activities. Additional activities include managing special nuclear materials contained in these facilities and the disposition of DOE legacy waste materials under NE ownership.

NE has developed an INL Ten Year Site Plan (TYSP) that establishes the annual budget requirements for the IFM Program, provides a mission needs analysis of facilities and infrastructure, and identifies the maintenance and recapitalization investments needed at the site to support projected missions such as the Advanced Fuel Cycle Initiative, the Generation IV Nuclear Energy Systems Initiative, a range of national security technology programs, and the Idaho Cleanup Project (ICP) under the Office of

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[a] Funding excludes $20,719,000 appropriated under Other Defense Activities, a $167,000 0.8% rescission in Other Defense Activities, and $10,000,000 from Naval Reactors.

[b] Funding excludes $17,584,000 appropriated under Other Defense Activities and $13,365,000 from Naval Reactors.

[c] Beginning in FY 2007, all funding for Idaho Facilities Management is requested under Energy Supply and Conservation appropriation.

Environmental Management. The plan meets the requirements of DOE Order 430.1B, Real Property Asset Management (RPAM).

In FY 2005 and FY 2006, the IFM Program was funded in both the Energy Supply and Conservation and the Other Defense Activities appropriations. Beginning in FY 2007, the IFM Program is requested only under the Energy Supply and Conservation appropriation.

Detailed Justification

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
INL Operations and Infrastructure	**89,923**	**70,929**	**89,260**
▪ **Laboratory Transition and Restructuring**.....	**43,453**	**0**	**0**

The $43.8M requested for FY 2005 covered the one-time costs associated with workforce restructuring as the Idaho National Engineering and Environmental Laboratory contract was divided into separate laboratory and clean-up contracts. All transition activities associated with the establishment of the INL were completed in FY 2005.

▪ **Base Operations**.....	**27,369**	**44,239**	**55,088**

IFM Base Operations provides funding to support the RTC, the MFC, and the Sitewide Infrastructure Base Operations. In FY 2005 and FY 2006, funding to support the Sitewide Infrastructure Base Operations is included in the Other Defense Activities appropriation. Beginning in FY 2007, this activity is requested in the Energy Supply and Conservation appropriation along with base operations for RTC and MFC. For FY 2007, Routine Maintenance and Repair has been broken out from the previous "Operations" activities in the FY 2006 Congressional Budget Request and is listed separately. This aligns the budget request with key infrastructure asset management activities in the INL TYSP and DOE Order 430.1B, Real Property Asset Management.

The RTC Base Operations provides landlord services and infrastructure support, including environmental services, to the Advanced Test Reactor (ATR) and other INL activities located at the RTC. The RTC occupies about 104 acres and includes 80 facilities and 70 major structures including the RTC Hot Cells.

The MFC Base Operations provides infrastructure support, including environmental services, to all MFC facilities and laboratories. It also maintains and operates ten major nuclear and radiological facilities and associated support systems. The MFC occupies about 100 acres and includes 50 major buildings and 19 major support structures.

Sitewide Infrastructure Base Operations manages and maintains the Center for Advanced Energy Studies (CAES), the STC in Idaho Falls, the CFA at the site, and the INL common-use facilities, utilities, equipment, and land. The CFA consists of 72 buildings and 60 major support structures. The STC includes 30 DOE owned and leased buildings consisting of office space and extensive

(dollars in thousands)

FY 2005	FY 2006	FY 2007

laboratory facilities. The Sitewide Infrastructure outside NE campuses and the ICP work complexes consists of 34 buildings and 35 major utility systems and structures.

- **Routine Maintenance and Repair**..... **11,071** **7,197** **9,636**

  The IFM Program addresses the routine maintenance and repair of property and facilities at RTC, MFC, and Sitewide Infrastructure. The goal of this program is to fund routine maintenance and repair within the target industry range of 2% to 4% of Replacement Plant Value (RPV). The use of this industry benchmark was recommended by the National Research Council's Congressionally-sponsored 1998 study, "Stewardship of Federal Facilities". The amount of funding being requested in FY 2007 represents the current best estimate of maintenance required that the INL can accomplish during FY 2007 within current resources.

- **ATR Life Extension Program (LEP)** **0** **6,564** **20,200**

  The ATR is essential to ongoing and planned national security and energy research programs at the Idaho National Laboratory. Independent review teams from DOE and the commercial nuclear industry have found that the ATR, while currently safe to operate, requires recapitalization of systems to remain a safe and productive research tool into the middle of the century, which is the planned mission life. The NE ATR LEP will plan and accomplish the needed upgrades, it will fund the reconstitution of the Nuclear Safety Design Basis for the reactor, it will replenish spare parts inventories and restore systems to their originally designed condition, and it will replace systems and equipment with modern, more reliable components that are carefully integrated into the reactor's operation and safety basis. The current estimated cost of the ATR LEP is about $200 million over a ten year period. In comparison, the cost to replace the reactor is estimated at about $2 billion, and replacement would take about ten years.

- **IT Investments**..... **0** **4,356** **0**

  This is one time funding for FY 2006. It will provide the connectivity and high performance computing (HPC) capabilities at INL that are required for research under the new NE nuclear energy research and national security mission areas. Additionally, external connectivity will be improved to facilitate collaborative research and file transfer between other DOE complex labs involved in the mission research.

- **General Plant Projects (GPP) – INL Facilities and Infrastructure Recapitalization Program (IFIRP)**..... **3,621** **3,465** **0**

  The IFIRP is a program to fund GPPs necessary to recapitalize the INL in accordance with DOE Order 430.1B, Real Property Asset Management and the TYSP. It is modeled on the FIRP Program initiated by the National Nuclear Security Agency. These projects will provide necessary infrastructure to support the current and projected INL missions.

- **Capital Equipment**..... **195** **653** **0**

  Purchase equipment in accordance with the INL TYSP. This funding primarily provides replacements for aged, deteriorated equipment and procurement of new equipment to meet emerging requirements. This includes such things as shop and miscellaneous maintenance equipment, vehicles and heavy equipment, and laboratory equipment.

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
▪ **Gas Test Loop Upgrade (GTL) at the ATR (Other Project Costs – Operating)**	**4,214**	**1,980**	**4,336**

This upgrade will provide a fast neutron flux gas test loop in the ATR. This capability will have broad application to next generation reactor designs and the Advanced Fuel Cycle Initiative. Critical Decision (CD) 0, Approval of Mission Need, was completed on June 30, 2004. During conceptual design after CD-0, two significant technical risks were identified involving the booster fuel and the gas delivery system. Resolving these risks prior to moving to system design is necessary to ensure that the required fast flux is achieved. This funding was used in FY 2005 and will be used in FY 2006 and FY 2007 to resolve these technical risks in order to achieve CD-1, Approval of Alternative Selection and Cost Range, at the end of FY 2007.

▪ **Science and Technology Complex Utility Corridor** ...	**0**	**2,475**	**0**

This project will provide utility services for planned new facilities at the Center for Advanced Energy Studies within the Science and Technology Complex. Continuation of the project after FY 2006 has been deferred to FY 2008.

IFM Construction.....	**1,511**	**10,845**	**6,030**
▪ **99-E-201, Former Test Reactor Area (now RTC) Electrical Utility Upgrade**.....	**1,511**	**0**	**0**

Completed the Electrical Utility Upgrade Line Item Capital Project in FY 2005, which replaced most of the obsolete RTC high voltage electrical distribution system that had become inadequate for current tenant needs and unreliable due to age and dwindling availability of spare parts.

▪ **06-E-200, Nuclear Energy Project Engineering and Design (PED)**	**0**	**7,791**	**6,030**

FY 2007 PED funding for the Gas Test Loop Project in the ATR will provide for the design of a gas test loop to support the irradiation testing requirements of the Generation IV and Advanced Fuel Cycle Initiative Programs.

FY 2006/2007 PED funding for the Remote Treatment Project (RTP) at the MFC provides for the design of the RTP building and the waste processing equipment to carry out the near-term waste management needs stemming from the nuclear research legacy waste at the Idaho National Laboratory. This project is designed to characterize, segregate, treat, repackage, and ship remote-handled wastes in accordance with agreements with the State of Idaho.

	(dollars in thousands)		
	FY 2005	FY 2006	FY 2007
▪ **06-E-201, GTL in the ATR**	**0**	**3,054**	**0**

This project is described above. Capital funding is not requested in FY 2007 in order to resolve emerging technical issues during the conceptual design phase as noted above. Eliminating these technical risks before proceeding to system design will assure project success. Achieving CD-1, Approval of Alternative Selection and Cost Range, is anticipated at the end of FY 2007. Capital funding appropriated in FY 2006 will be carried over until approval for start of construction.

Total, Idaho Facilities Management Program	**91,434[a]**	**81,774[b]**	**95,290[c]**

Explanation of Funding Changes

	FY 2007 vs. FY 2006 ($000)
INL Operations and Infrastructure	
▪ **Base Operations**	
The increase of $10,849,000 reflects the transfer of Other Defense Sitewide Infrastructure activities to the Energy Supply and Conservation appropriation and the increased costs for environmental monitoring required by DOE, state and federal regulations. Sitewide Infrastructure Monitoring and Reporting is a new LPSO requirement in the FY 2007 budget	+10,849
▪ **Routine Maintenance and Repair**	
The increase of $2,439,000 reflects working towards increasing the Routine Maintenance and Repair to 2% to 4% of RPV per Departmental directives	+2,439
▪ **ATR LEP**	
The increase of $13,636,000 will meet the current estimated cost of the ATR LEP of about $200,000,000 over a ten year period. This is a top priority funding requirement at the INL. These funds will replenish spare parts inventories and restore systems to their originally designed condition, and most importantly it will replace outdated, worn-out systems and equipment with modern, reliable components that are carefully integrated into the reactor's operation and safety basis	+13,636

[a] Funding excludes $20,719,000 appropriated under Other Defense Activities, a $167,000 0.8% rescission in Other Defense Activities, and $10,000,000 from Naval Reactors.
[b] Funding excludes $17,584,000 appropriated under Other Defense Activities and $13,365,000 from Naval Reactors.
[c] Beginning in FY 2007, all funding for Idaho Facilities Management is requested under Energy Supply and Conservation appropriation.

	FY 2007 vs. FY 2006 ($000)
▪ **IT Investments**	
The decrease of $4,356,000 reflects one time IT Investments for FY 2006	-4,356
▪ **General Plant Projects – INL Facilities and Infrastructure Recapitalization Program (IFIRP)**	
The decrease of $3,465,000 is due to deferral of planned projects as a result of higher priorities	-3,465
▪ **Capital Equipment**	
The decrease of $653,000 is due to deferral of planned equipment purchases as a result of higher priorities	-653
▪ **GTL Upgrade at the ATR (Other Project Costs – Operating)**	
The increase of $2,356,000 supports resolution of technical risks identified during conceptual design that preclude proceeding to system design until resolved. Completion of conceptual design is anticipated at the end of FY 2007	+2,356
▪ **STC Utility Corridor**	
The decrease of $2,475,000 reflects deferral of continuation of the project due to higher priorities	-2,475
Total, INL Operations and Infrastructure	**+18,331**
INL Construction	
▪ **06-E-200, Nuclear Energy Project Engineering and Design (PED)**	
The decrease of $1,761,000 for PED funding defers preliminary design for the ATR Gas Test Loop Project to allow for resolution of technical issues identified during the conceptual design phase	-1,761
▪ **06-E-201, Gas Test Loop in the ATR**	
The decrease of $3,054,000 defers construction of the ATR Gas Test Loop to allow for resolution of technical issues identified during the conceptual design phase	-3,054
Total, INL Construction	**-4,815**
Total Funding Change, Idaho Facilities Management	**+13,516**

Capital Operating Expenses and Construction Summary

Capital Operating Expenses

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Capital Equipment	195	653	0
General Plant Projects	3,621	3,465	0
Total, Capital Operating Expenses	3,816	4,118	0

Construction Projects

	Total Estimated Cost (TEC)	Prior-Year Appro-priations	FY 2005	FY 2006	FY 2007	Unappro-priated Balance
06-E-201, Gas Test Loop in the Advanced Test Reactor, Idaho	45,000-60,000[a]	_	_	3,054	–	–
06-E-200, Nuclear Energy Project Engineering and Design. Idaho	24,670	_	_	7,791[a]	6,030	–
99-E-200, TRA Electrical Utility Upgrade, Idaho	7,720	6,209	1,511	–	–	–
Total, Construction			1,511	10,845	6,030	

[a] This outyear funding profile for the ATR Gas Test Loop (GTL) is based on a current estimate that is not preliminary or performance baseline. Due to technical complexities with the booster fuel and gas delivery systems discovered during preparation of CD-1 a final estimate will not be available until 4th quarter FY 2007. Therefore, there is no PED funding appropriated for the ATR GTL in FY 2006. The FY 2006 PED funding of $7,791,000 is for the MFC Remote Treatment Project.

06-E-200, Nuclear Energy, Project Engineering and Design (PED), Idaho National Laboratory (INL), Idaho

Significant Changes

A decision was made to delay the Gas Test Loop project because technical risks discovered in the conceptual design stage will need to be resolved before full system design begins. These risks involve the certification of the booster fuel that will dramatically increase the fast neutron flux and the design of the bulk gas delivery system. By eliminating these two risk factors prior to the start of system design, the project has a significantly higher probability of success. Therefore, construction will not begin in FY 2006 or FY 2007. Additional funds are projected in FY 2008 to complete preliminary and final design.

Project Engineering and Design funds originally for the Gas Test Loop in FY 2006 ($4,770,000) are directed to the Remote Treatment Project (RTP), a subproject within this datasheet for a combined total of $7,791,000 for the RTP in FY 2006.

The Total Estimated Cost (TEC) for the Gas Test Loop has increased from $22,400,000, to a range of $45,000,000 to $65,000,000. This increase and the uncertainty in the range is due to technical complexities associated with the booster fuel and gas delivery systems that were discovered and assessed as part of the preparations for Critical Decision 1. This current estimate is not a preliminary or performance baseline. The Total Project Cost (TPC) is estimated to be $80,000,000 to $100,000,000 and will depend largely upon the booster fuel qualification effort. The decision to delay the project two years will allow ample time to fully resolve the technical uncertainties of both of these critical elements of the system. It will also permit a more refined cost estimate. Options remain to select a lower cost system design and accelerate the project, but with significant loss in fast flux capability. Fast flux test capability is important to the AFCI and Generation IV programs. The booster fuel design, although technically challenging, is not an extreme departure from previous advanced fuel element designs and is believed to be achievable.

1. Construction Schedule

	Fiscal Quarter				Total Estimated Cost (Design Only) ($000)
	A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete	
FY 2006 Budget Request (*Preliminary and Final Design Only*)	1Q 2006	3Q 2007	N/A	N/A	32,070
FY 2007 Budget Request *(Preliminary and Final Design Only)*	1Q 2006	4Q 2008	N/A	N/A	29,291

2. Financial Schedule

(dollars in thousands)

Fiscal Year	Appropriations	Obligations	Costs
2006	7,791	7,791	7,791
2007	6,030	6,030	6,030
2008	15,470	15,470	15,470

3. Project Description, Justification and Scope

This construction project data sheet summarizes the Nuclear Energy requirements for architect-engineering services for Preliminary and Final Design for two subprojects, they are the Gas Test Loop 06-01 and the Remote Treatment Project 06-02. The design effort will be sufficient to assure project feasibility, define the scope, provide detailed estimates of construction costs based on the approved design and working drawings and specifications, and provide construction schedules including procurements.

Conceptual design studies are prepared for each project using operations and maintenance funds prior to receiving design funding under a PED line item. These conceptual design studies define the scope of the project and produce a rough cost estimate and schedule. All future year estimates in this request are rough cost estimates, as neither project has a final preliminary or performance baseline.

The use of project engineering and design funds will: 1) enable a project to proceed immediately upon completion of the conceptual design into Title I and Title II designs because only the design funds are requested; 2) provide a range for the construction cost and schedule; 3) permit acceleration of new facility projects, providing savings in construction costs based on current rates of inflation; and 4) permit more mature cost, schedule, and technical baselines for projects when the construction funds are requested from the Congress.

Following completion of preliminary design activities, Nuclear Energy personnel will determine preliminary project baselines and provide detailed funding and schedule estimates for physical construction and procurements. At completion of the preliminary design, the Department's Office of Engineering and Construction Management will provide external independent reviews of the project requirements, scope, schedule, cost and budget. Based upon the results of this assessment, and a review of the continuing programmatic requirement for the project, the acquisition executive will either approve the project performance baseline and authorize proceeding, defer the project or cancel the project.

The project performance baseline will be the basis for the request to Congress for authorization and appropriations for physical construction and procurement. The request will identify the project baseline and provide the acquisition executive approval to proceed with final design. For certain projects, in order to meet project schedules, construction and/or procurement activities may be required in the same year as the final design, Project Baseline, and Acquisition Executive approval is completed. For those projects, a report will be provided by the Office of Engineering and Construction Management to Congress with the results of preliminary design, project baseline, external independent reviews, and acquisition executive approval. Long-lead project and/or construction start will not proceed until 30 days after the report has been submitted to Congress. Each project that proceeds to physical construction will be separated into an individual construction line item, the total estimated cost of which

will identify the costs of the engineering and design activities funded through the project engineering and design account.

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary Design Costs	8,882	12,763
Final Design Costs	13,071	14,281
Preliminary Design Management Costs	783	693
Final Design Management Costs	993	736
Project Management (Preliminary Design) Costs	1,354	1,030
Project Management (Final Design) Costs	1,754	1,331
Total Design Costs	26,837	30,834
Design Contingency (Title I & Title II)	2,454	1,236
Total Design Costs	29,291	32,070

5. Method of Performance

Please refer to the individual subprojects for contract strategies.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2005	FY 2006	FY 2007	Out years	Total
Facility Design Cost						
Preliminary Design	0	0	6,891	210	2,406	9,507
Final Design	0	0		4,427	9,595	14,023
Project & Design Management...	0	0	900	1,393	3,468	5,761
Total PED	0	0	7,791	6,030	15,470	29,291
Other Project Costs						
Conceptual Design Cost	1,317	7,004	0	0	0	8,321
NEPA Documentation Costs	100	1,000	0	0	0	1,100
Other Project-Related Costs	1,198	240	1,980	4,336	12,000	19,754
Total Other Project Costs	2,615	8,244	1,980	4,336	12,000	29,175
Total PED and Other Project Costs	2,615	8,244	9,771	10,366	27,470	58,466

FY 2006 Proposed Design Subprojects

Subproject 06-01, Gas Test Loop in the Advanced Test Reactor, Idaho National Laboratory, Idaho

Fiscal Quarter				Total Estimated Cost Design Only) ($000)	Full Total Estimated Cost Projection ($000)
A-E Work Initiated	A-E Work Completed	Physical Construction Start	Physical Construction Complete		
4Q 2007	4Q 2008	3Q 2008	3Q 2010	9,470	45,000 – 65,000

Fiscal Year	Appropriations	Obligations	Costs
2006	0[a]	0	0
2007	770	770	770
2008	8,700	8,700	8,700

The Gas Test Loop in the Advanced Test Reactor (ATR) will provide for the design and construction of a gas test loop to support the irradiation testing requirements of the Generation IV Nuclear Energy Systems Initiative (Gen IV) and Advanced Fuel Cycle Initiative (AFCI) programs. This project is managed by the Idaho National Laboratory (INL) for the Office of Nuclear Energy.

The Department of Energy has initiated programs to help revitalize nuclear power generation growth in the United States, in support of the "National Energy Policy" (NEP). Two important programs to help implement the NEP are the Gen IV and AFCI. The goals of these two programs are designed to stimulate research and development related to advanced reactor concepts and fuel cycles over the next 30 years.

A portion of the Gen IV and AFCI programs' focus is directed toward technologies that can reduce the commercial spent fuel burden on both a geologic repository and the environment. In particular, one primary goal is the reduction and elimination of long-lived transuranic elements contained in commercial spent nuclear fuel. The neutron spectrum characteristic of fast reactors provides the most efficient way to transmute these highly toxic materials.

Transmutation and fission of these long-lived transuranic actinides into shorter-lived fission products has revived interest in fast spectrum irradiation testing of new transmuter fuels and materials. In order to assess the fuel performance of these candidate reactor fuels, such as the minor actinide fuel concentrates, these fuels must be irradiated under actual or prototypical fast reactor flux intensities and energy spectral characteristics. There are no operating fast reactors or fast flux test facilities in the United States. The unpredictable availability of fast test facilities outside the United States increases the risk to programs such as AFCI. Gas Test loop also offers the advantage of a relatively short construction time compared to a new test reactor, providing a highly desirable, near term option. The Gas Test Loop will use existing capacity in the DOE's Advanced Test Reactor and will greatly benefit from the capabilities and facilities at the INL site.

[a] Funds appropriated in the amount of $4,770,000 have been redirected to the Remote Treatment Project, Subproject 06-02.

A decision was made to delay the the Gas Test Loop project because technical risks discovered in the conceptual design stage need to be resolved before full system design begins. These risks involve the qualification of the booster fuel that will dramatically increase the fast neutron flux and the design of the gas delivery system. By eliminating these two risk factors prior to the start of system design, the project has a higher probability of success. Therefore, construction will not begin in FY 2006 or FY 2007. Additional PED funds are projected in FY 2008 to complete preliminary and final design.

Compliance with Project Management Order

- Critical Decision – 0: Mission Need completed June 28, 2004
- Critical Decision – 1A: Siting and Technology Development, Completed September 2005
- Critical Decision – 1: Conceptual Design/Preliminary Baseline September 2007
- Critical Decision – 2: Planned for March 2008
- Critical Decision – 3: Planned for September 2008
- External Independent Review: Planned for 3rd quarter 2007

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary Design Costs (Design Drawings and Specifications)(4.3% of TEC)	1,912	963
Final Design Costs (Design Drawings and Specifications)(5.3% of TEC)	2,344	1,181
Preliminary Design Management[a] Costs (0.9% of TEC)	383	193
Final Design Management Costs (1.1% of TEC)	469	236
Project Management[b] (Preliminary Design) Costs (1.9% of TEC)	854	430
Project Management (Final Design) Costs (2.4% of TEC)	1,054	531
Total Design Costs (15.8% of TEC)	7,016	3,534
Design Contingency (Title I & Title II) (5.5% of TEC)	2,454	1,236
Total Design Costs (21.3% of TEC)	9,470	4,770

5. Method of Performance

Design engineering will be performed utilizing INL engineering resources where feasible. If required, additional services will be obtained through competitive bid, cost-reimbursable subcontracts.

[a] Design Management consists of oversight and control of design activities, not the actual design costs.
[b] Project management includes activities for the project manager, design reviews, project document control, project manager supervision, cost estimating and conduct of operations.

6. Schedule of Project Funding[a]

	(dollars in thousands)					
	Prior Years	FY 2005	FY 2006	FY 2007	Outyears	Total
Facility Design Cost						
Preliminary Design	0	0	0	210	2,406	2,616
Final Design	0	0	0	267	2,950	3,217
Project & Design Management	0	0	0	293	3,344	3,637
Total PED	0	0	0	770	8,700	9,470
Other Project Costs						
Conceptual Design Cost	207	6,214	0	0	0	6,421
NEPA Documentation Costs	0	0	0	0	0	0
Other Project-Related Costs	338	0	1,980	4,336	12,000	18,654
Total Other Project Costs	545	6,214	1,980	4,336	12,000	25,075
Total PED and Other Project Costs	545	6,214	1,980	5,106	20,700	34,545

Subproject 06-02, Remote Treatment Project, Idaho National Laboratory, Idaho

Preliminary Design Fiscal Quarter				Total Estimated Cost (Prelim. Design Only) ($000)	Full Total Estimated Cost Projection ($000)
A-E and Support Work Initiated	A-E and Support Work Completed	Physical Construction Start	Physical Construction Complete		
2Q 2006	2Q 2007	2Q 2008	3Q 2010	7,791	90,700

Fiscal Year	Appropriations	Obligations	Costs
2006	7,791	7,791	7,791

[a] This schedule reflects planned cash flow, not funding (appropriations), costs and other project costs supporting the Title I and Title II and FY 2005 Congressional earmark operating funds of up to $2,000,000 appropriated to Naval Reactors.

Final Design Fiscal Quarter				Total Estimated Cost (Final Design Only) ($000)	Full Total Estimated Cost Projection Range ($000)
A-E and Support Work Initiated	A-E and Support Work Completed	Physical Construction Start	Physical Construction Complete		
2Q 2007	1Q 2008	2Q 2008	3Q 2010	12,030	90,700

Fiscal Year	Appropriations	Obligations	Costs
2007	5,260	5,260	5,260
2008	6,770	6,770	6,770

The Remote Treatment Project (RTP) is required to provide the infrastructure necessary to address waste management legacies arising from past nuclear research activities at the Idaho Site, as agreed between the Department and the State of Idaho. Meeting the Departments legacy waste management commitments and priorities requires the use of a facility in which the remote handling and treatment of highly radioactive materials may be conducted.

The RTP facility is currently conceived as an annex to the Hot Fuel Examination Facility, consisting of a 28,000 ft^2, four-level facility built around a 56 ft long by 22 ft wide x 31 ft high air atmosphere hot cell. The hot cell would employ fourteen radiation-shielded work station windows with a set of sealed remote manipulators at each window, two floor penetrations and a roof hatch. To provide adequate safety from expected radiation levels, walls, roof, and sections of the air cell floor would be constructed of four foot thick high density concrete. The air cell would be designed to accommodate remote installation and repair of all process equipment. The RTP would also provide for design, fabrication, and installation of all required hot cell waste processing equipment as well as completion of all necessary activities to bring the facility to operational status.

Because the RTP facility is an annex to existing hot cell facilities at the INL, it would minimize capital expenditures by sharing existing infrastructure and capability. It would also integrate existing support capabilities, such as analytic chemistry laboratories, into its operation.

Over the years various DOE-sponsored programs undertaken at INL have produced radioactive wastes and other materials that are classified as remote-handled. These materials include Spent Nuclear Fuel (SNF), transuranic (TRU) waste, waste requiring geological disposal, mixed waste, and radioactively-contaminated reactor components. They were packaged and are presently stored at the Radioactive Scrap and Waste Facility (RSWF) at INL (349 cubic meters). There are other program remote handled (RH) legacy wastes (482 cubic meters) that may need processing in the RTP at the INL's Radioactive Waste Management Complex (RWMC), these waste streams also fall under the 2018 Site Treatment Plan and Settlement Agreement milestones. All or portions of that entire waste stream could be processed through the RTP under a work-for-others agreement wherein the appropriate capital and operating costs would be charged for any services provided. The current design and scope of the RTP are for the worst-case RH waste (highest radioactivity) currently stored at the RSWF. No RTP design changes would be required to deal with any other program RH waste mentioned if it were decided and

agreed by the program parties to include those wastes in the current RTP characterization, treatment and repackaging campaign.

The RTP would be designed to characterize, segregate, treat, repackage, and ship these RH wastes, as required by the RSWF RCRA permit, the INL Site Treatment Plan Consent Order, and the 1995 DOE/State of Idaho Settlement Agreement on TRU waste and spent fuel management. Characterization and treatment of mixed waste is required to ensure compliance with Resource Conservation and Recovery Act (RCRA) storage permits, the Federal Facility Compliance Act and RCRA Land Disposal Restriction (LDR) requirements. Characterization, treatment and repackaging are also required for licensed transportation of this waste. Following appropriate characterization, processing, and treatment, the wastes would be shipped out of Idaho to a designated DOE permanent disposal site.

Although a preliminary baseline was established by CD-1 in December 2004 for the Remote Treatment Project, the new INL contractor has indicated their intention to independently validate the conclusions and recommendations of the previous contractor relative to the RTP. The results of that review could result in a revised preliminary baseline for the project. The time constraints imposed by the Site Treatment Plan and Settlement Agreement will require an expeditious determination on the validity of the preliminary design. Until the new contractor validates the critical decision to proceed with preliminary design, a decision has been made to only request PED funds in FY 2007. The need for additional PED funds beyond FY 2007 will be determined once the current preliminary design decision is validated. Total design costs will not exceed the FY 2006 estimate.

Compliance with Project Management Order

- Critical Decision – 0: Completed December 2000
- Critical Decision – 1: Conceptual Design/Preliminary Baseline - Completed December 2004
- Critical Decision – 2: Planned January 2007
- Critical Decision – 3: Planned October 2007
- External Independent Review: Planned 4th Qtr 2006

4. Details of Cost Estimate

(dollars in thousands)

	Current Estimate	Previous Estimate
Design Phase		
Preliminary Design Costs (Design Drawings and Specifications)	6,970	11,800
Final Design Costs (Design Drawings and Specifications)	10,727	13,100
Preliminary Design Management Costs (0.6% of TEC)	400	500
Final Design Management Costs (0.6% of TEC)	524	500
Project Management (Preliminary Design) Costs (0.7% of TEC)	500	600
Project Management (Final Design) Costs (0.9% of TEC)	700	800
Total Design Costs	19,821	27,300

(These Costs are based on compound escalation of 20.6% and 85% confidence level contingency of 23.9%) Escalation was compounded, commencing in FY2002 (when the original cost estimate was performed) from "Escalation Rate Assumptions, January 2004", obtained from the OECM web site.) The compounded escalation was applied over the duration of the design activity.

5. Method of Performance

Facility engineering and design will be performed under a negotiated A-E contract with guidance, review and monitoring by INL personnel. Process equipment engineering and design will be performed by INL personnel. All permit and safety assessment activities will be performed by INL personnel. Project management will be performed by INL personnel.

6. Schedule of Project Funding

(dollars in thousands)

	Prior Years	FY 2005	FY 2006	FY 2007	Out years	Total
Facility Design Cost						
Preliminary Design	0	0	6,891	0	0	6,891
Final Design	0	0	0	4,160	6,646	10,806
Project & Design Management	0	0	900	1,100	124	2,124
Total PED	0	0	7,791	5,260	6,770	19,821
Other Project Costs						
Conceptual Design Cost	1,110	790	0	0	0	1,900
NEPA Documentation Costs	100	1,000	0	0	0	1,100
Other Project-Related Costs	860	240	0	0	0	1,100
Total Other Project Costs	2,070	2,030	0	0	0	4,100
Total PED and Other Project Costs	2,070	2,030	7,791	5,260	6,770	23,921

Program Direction

Funding Profile by Category

(dollars in thousands/whole FTEs)

	FY 2005	FY 2006	FY 2007
Idaho Operations Office			
Salaries and Benefits	0	0	24,035
Travel	0	0	1,000
Support Services	0	0	925
Other Related Expenses	0	0	5,401
Total, Idaho Operations Office	0[a]	0[b]	31,361[e]
Full Time Equivalents	7[c,d]	0[e]	197[f]
Oak Ridge Operations Office			
Salaries and Benefits	1,729	1,799	1,870
Travel	42	43	44
Support Services	47	49	50
Other Related Expenses	139	141	123
Total, Oak Ridge Operations Office	1,957	2,032	2,087
Full Time Equivalents	5[g]	14	14
Headquarters			
Salaries and Benefits	19,318	20,604	23,201
Travel	1,000	1,141	1,360
Support Services	2,101	1,800	6,181
Other Related Expenses	1,842	4,129	3,418
Total, Headquarters	24,261	27,674	34,160
Full Time Equivalents	124[g]	151	161

[a] Excludes $33,587,000 for program direction expenses at the Idaho Operations Office appropriated under Other Defense Activities, and a $271,000 0.8% rescission in Other Defense Activities.

[b] Excludes $30,792,000 for program direction expenses at the Idaho Operations Office appropriated under Other Defense Activities.

[c] Excludes 203 Full Time Equivalents appropriated under Other Defense Activities.

[d] This number represents actual FTE usage for resources transferred to Idaho Operations Office from Chicago Operations Office prior to the FY 2005 appropriation.

[e] Excludes 197 Full Time Equivalents appropriated under Other Defense Activities.

[f] Beginning in FY 2007, funding for program direction expenses and Full Time Equivalents for the Idaho Operations Office is requested in the Energy Supply and Conservation appropriation.

[g] This number represents actual FTE usage.

(dollars in thousands/whole FTEs)

	FY 2005	FY 2006	FY 2007
Total Program Direction			
Salaries and Benefits	21,047	22,403	49,106
Travel	1,042	1,184	2,404
Support Services	2,148	1,849	7,156
Other Related Expenses	1,981	4,270	8,942
Total, Program Direction	26,218[a]	29,706[b]	67,608[c]
Total, Full Time Equivalents	136[d,e]	165[f]	372[c]

Mission

Program Direction provides the Federal staffing resources and associated costs required to provide overall direction and execution of the Office of Nuclear Energy, Science and Technology (NE). NE promotes secure, competitive, and environmentally responsible nuclear technologies to serve the present and future energy needs of the country. NE carries out this mission in several ways. As the central organization with the Federal Government's core expertise in nuclear technology, NE directs the Nation's investment in nuclear science and technology by sponsoring research at the national laboratories, U.S. universities, and private industry. Through its support of innovative, higher risk science and by helping to preserve the national research and development infrastructure, NE works to advance the responsible use of nuclear technology. NE also manages the safe operation and maintenance of critical nuclear infrastructure and provides nuclear technology goods and services to industry and government.

In addition to our appropriated funds, NE also manages over $230 million dollars annually in work for others and reimbursable funding. This includes over $110 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. In addition, NE manages the High Flux Isotope Reactor for the Office of Science.

NE is one of the most programmatically diverse organizations in the Department of Energy (DOE) and is faced with critical human capital challenges in pursuing its mission. Extensive downsizing several years ago resulted in numerous skill imbalances and particularly affected NE's retention of technical and scientific specialists. Wherever possible, employees were redeployed from lower priority programs to

[a] Excludes $33,587,000 for program direction expenses at the Idaho Operations Office appropriated under Other Defense Activities.
[b] Excludes $30,792,000 for program direction expenses at the Idaho Operations Office appropriated under Other Defense Activities.
[c] Beginning in FY 2007, funding for program direction expenses and Full Time Equivalents for the Idaho Operations Office is requested in the Energy Supply and Conservation appropriation.
[d] Excludes 203 Full Time Equivalents appropriated under Other Defense Activities.
[e] This number represents actual FTE usage.
[f] Excludes 197 Full Time Equivalents appropriated under Other Defense Activities.

higher priority programs to meet mission needs. At this point, with expanding programs, limited resources, and skill gaps, NE faces a variety of staffing challenges as it works to meet the requirements set for it by the President and the Secretary of Energy.

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 and help lead the Nation in achieving its nuclear technology goals for the twenty-first century.

NE is the Lead Program Secretarial Officer (LPSO) of the Idaho site. NE Headquarters and the Idaho Operations Office reorganized in January 2005 to more effectively support the new nuclear energy missions and prepare for the oversight and management of the new contracts for the operation of the Idaho site. This new structure will carry out all programmatic, project, and landlord responsibilities assigned to NE now and in the future, both as LPSO and Contracting Officer for DOE's operations in Idaho, and as the responsible PSO for programs, projects, facilities, and operations at other DOE sites. In FY 2005 and FY 2006, the program direction account for the Idaho Operations Office was funded from the Other Defense Activities appropriation. Beginning in FY 2007, funding for Idaho Operations Office is requested under Energy Supply and Conservation appropriation.

The NE Workforce Plan was updated in June 2005 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 48.0 years, just slightly higher than the 46.3 year average age of the Federal workforce overall. Currently 14 percent of the workforce is eligible to retire and an additional 28 percent will be eligible by the end of FY 2008. 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. As reflected in the NE Workforce Plan, skills gaps currently exist in supervisory, engineering and scientific, and program and project management positions that need to be addressed in the near term.

As stated in the Departmental Strategic Plan, DOE's Strategic and General Goals will be accomplished not only through the efforts of the major program offices in the Department but with additional effort from offices which support the programs in carrying out the mission. The Office of Nuclear Energy, Science and Technology performs critical functions which directly support the mission of the Department. These functions include: (1) develop new nuclear generation technologies - that foster the diversity of the domestic energy supply through public-private partnerships that are aimed in the near-term (2015) at the deployment of advanced, proliferation-resistant light water reactor and fuel cycle technologies and in the longer-term (2025) at the development and deployment of next-generation advanced reactors and fuel cycles; and (2) maintain, enhance, and safeguard the Nation's nuclear infrastructure capability - to meet the Nation's energy, environmental, medical research, space exploration, and national security needs.

Detailed Justification

(dollars in thousands)

	FY 2005	FY 2006	FY 2007
Salaries and Benefits	**21,047**	**22,403**	**49,106**

NE Headquarters has retrained and redeployed staff to reduce dependence on contractors; and continuously redirected and realigned staff to accomplish program goals efficiently and effectively. NE believes that it is essential 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 continuing. Currently 14 percent of the workforce is eligible to retire and an additional 28 percent will be eligible by the end of FY 2008; therefore, it is essential that program direction resources are available to compete for needed skills. In FY 2005 and FY 2006, the Idaho Operations Office was funded under the Other Defense Activities appropriation. Beginning in FY 2007, funding for the Idaho Operations Office personnel (197) is requested in the Energy Supply and Conservation appropriation. In addition to the Headquarters and Idaho Operation staff, NE also supports one employee who serves on the staff of the U.S. mission to the Organization for Economic Cooperation and Development; and field employees in the Oak Ridge Operations Office (14).

The FY 2007 budget also requests funds for an additional 10 FTEs, including lead project managers to support the acceleration of the Advanced Fuel Cycle Initiative (AFCI) program. This acceleration is part of the Global Nuclear Energy Partnership (GNEP). Beginning in FY 2007, the AFCI program will be refocused and accelerated toward near-term demonstration at engineering scale of the most promising technologies developed to date. In FY 2007, under the GNEP, the Department will initiate work towards conducting an engineering scale demonstration of the UREX+ separations process (operational 2011) and developing an advanced fuel cycle facility capable of laboratory development of advanced separations and fuel manufacturing technologies (operational 2016). Over the coming year, NE will collaborate with international and private parties to refine the GNEP concept and gauge interest in a demonstration of the sodium cooled reactor technology, which would serve as the fast Advanced Burner Reactor component of GNEP (operational 2014). This staff will include three project groups with the expertise needed for National Environmental Policy Act determination, nuclear facility design, project management, safety, licensing, environmental protection, and project integration. The Department does not currently have the numbers of highly qualified project management personnel required to accomplish the goals set forth with the acceleration of the AFCI program.

Travel	**1,042**	**1,184**	**2,404**

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 increase in travel reflects inclusion of the Idaho Operations Office in the Energy Supply and Conservation appropriation and funds travel required for the additional 10 FTEs in support of the accelerated Advanced Fuel Cycle Initiative.

Support Services	**2,148**	**1,849**	**7,156**

Support Services includes funding for technical and management support services provided to NE

(dollars in thousands)

FY 2005	FY 2006	FY 2007

Headquarters and Operations Office employees. The increase in support services reflects inclusion of the Idaho Operations Office in the Energy Supply and Conservation appropriation. In addition, the FY 2007 budget also requests funds for support service contractors to support the acceleration of the Advanced Fuel Cycle Initiative program. This will allow the Department to hire the best available industry experts in construction project management to assist federal staff in managing the large complex nuclear projects. In addition to rapidly acquiring this expertise, this approach provides unlimited flexibility in team composition as the needs of the projects evolve. The size of the support service staff will increase and decrease as the project progresses with no residual cost to the government at projects' end.

Other Related Expenses	**1,981**	**4,270**	**8,942**

The major expenditure in the Other Related Expenses category in FY 2007 is $3,093,000 million earmarked 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 project management career development program. The Other Related Expense category also includes support for the Nuclear Energy Research Advisory Committee**.** Also included in other expenses are costs associated with the one employee who serves on the staff of the Organization for Economic Cooperation and Development such as housing, training, office communications, supplies, miscellaneous expenses and International Cooperative Administrative Support Services (ICASS). The increase in other expenses reflects inclusion of the Idaho Operations Office in the Energy Supply and Conservation appropriation, and increases in the Working Capital Fund and training required for an additional 10 FTEs to support the accelerated Advanced Fuel Cycle Initiative.

Total, Program Direction.....	**26,218**	**29,706**	**67,608**[a]

[a] Beginning in FY 2007, funding for program direction expenses and Full Time Equivalents for the Idaho Operations Office is requested in the Energy Supply and Conservation appropriation.

Explanation of Funding Changes

	FY 2007 vs. FY 2006 ($000)
Salaries and Benefits	
▪ An increase of $26,703,000 reflects a 2.5 percent escalation in accordance with established guidelines and funds for promotions and within-grade salary increases ($726,000); the transfer of the Idaho Operations Office program direction funds from Other Defense Activities to the Energy Supply and Conservation appropriation ($24,035,000) and salaries and benefits for the additional 10 FTEs required to implement the acceleration of the Advanced Fuel Cycle Initiative ($1,942,470)	+26,703
Travel	
▪ An increase of $1,220,000 is attributable to increases in travel requirements at Headquarters and Oak Ridge ($20,000); the transfer of the Idaho Operations Office program direction funds from Other Defense Activities to the Energy Supply and Conservation appropriation ($1,000,000); and the travel to support the additional 10 FTEs required for the acceleration of the Advanced Fuel Cycle Initiative ($200,000)	+1,220
Support Services	
▪ An increase of $5,307,000 is provided for additional technical and management support services required for NE Headquarters and Operations offices ($236,000); the transfer of the Idaho Operations Office program direction funds from Other Defense Activities to the Energy Supply and Conservation appropriation ($925,000); and the support service contractors required to implement the acceleration of the Advanced Fuel Cycle Initiative ($4,146,000)	+5,307
Other Related Expenses	
▪ An increase of $4,672,000 reflects the transfer of the Idaho Operations Office program direction funds from Other Defense Activities to the Energy Supply and Conservation appropriation ($5,401,000); and the Working Capital Fund costs and training associated with the 10 FTEs required for the acceleration of the Advanced Fuel Cycle Initiative ($712,000); offset by a decrease due to the completion of an National Academy of Sciences study in FY 2006 and reprioritization of funding to other program direction activities (-$1,441,000)	+4,672
Total Funding Change, Program Direction.....	**+37,902**

Support Services by Category

(dollars in thousands)

	FY 2005	FY 2006	FY 2007	$ Change	% Change
Technical Support					
System Review and Reliability Analyses	25	0	1,036	+1,036	+100%
Economic and Environmental Analyses	310	250	310	+60	+24.0%
Surveys or Reviews of Technical Operations	100	100	4,135	+4,035	+4,035.0%
Total, Technical Support	435	350	5,481	+5,131	+1,466.0%
Management Support					
Automated Data Processing	1,086	1,250	1,275	+25	+2.0%
Reports and Analyses Management and General Administrative Services	627	249	400	+151	+60.6%
Total, Management Support	1,713	1,499	1,675	+176	+11.7%
Total, Support Services	2,148	1,849	7,156	+5,307	+287.0%

Other Related Expenses by Category

(dollars in thousands)

	FY 2005	FY 2006	FY 2007	$ Change	% Change
Other Related Expenses					
Working Capital Fund	953	2,232	3,093	+861	+38.6%
Advisory and Assistance Services	0	1,200	200	-1,000	-83.3%
Operations and Maintenance of Equipment	425	430	1,053	+623	+144.9%
Printing and Reproduction	40	41	166	+125	+304.9%
Training	285	86	445	+359	+417.4%
Rent and Utilities	0	0	925	+925	+100.0%
Communications	28	28	2,127	+2,099	+7,496.4%
Supplies and Materials	121	122	187	+65	+53.3%
Other Services	129	131	746	+615	+469.5%
Total, Other Related Expenses	1,981	4,270	8,942	+4,672	+109.4%