U.S. DEPARTMENT OF ENERGY

2010 Performance Plan

OFFICE OF NUCLEAR ENERGY

Office Of Nuclear Energy

Fiscal Year 2010 Nuclear Energy Performance Plan

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Foreword

"… to create more of these clean energy jobs, we need more production, more efficiency, more incentives. And that means building a new generation of safe, clean nuclear power plants in this country."

— President Obama, State of the Union address, January 27, 2010

This 2010 Performance Plan captures the Office of Nuclear Energy's (NE) performance in critical program areas for Fiscal Year (FY) 2009 and describes how progress will be assessed in FY 2010. In addition, it provides our stakeholders with an overview of NE's programs, funding profile, and designated role within the U.S. Department of Energy's (DOE) Strategic Plan. This document will be updated annually to reflect NE's continued progress toward meeting its long-term performance goals and objectives. It is our hope that this summary of the Office and its performance framework will help you understand the importance of our work and the contributions we are making toward safely advancing nuclear energy in the United States and abroad.

Nuclear energy is an important source of energy in the United States, supplying approximately 20 percent of the Nation's electricity and over 70 percent of our clean, non-carbon-emitting electricity. More than 100 nuclear power plants currently operate within the United States, providing reliable and affordable baseload electricity without air pollution or emissions of greenhouse gases. A plentiful, reliable supply of energy is the cornerstone of our Nation's sustained economic growth and prosperity.

NE contributes to Federal efforts to develop new nuclear energy generation technologies to meet energy and climate change goals and advanced, proliferation-resistant technologies that maximize energy from nuclear fuel. An important NE priority is to support expanded use of nuclear energy in the United States through programs such as Nuclear Power 2010 (NP 2010), as well as through implementation of incentives enacted in the Energy Policy Act of 2005 (EPAct) that encourage building new nuclear plants in the United States. NE is actively engaged in several international research and development (R&D) activities, including the development of advanced reactor designs through the Generation IV International Forum (GIF). Through its Fuel Cycle Research and Development program, NE also seeks to ensure the long-term sustainability of nuclear power as a viable energy resource by developing technical options to the Nation's current fuel cycle management strategy.

NE works with the private sector, overseas partners, and other agencies to assure that the benefits of nuclear technology continue to contribute to the Nation's security and quality of life. In addition, NE's Federal Advisory Committee, the Nuclear Energy Advisory Committee (NEAC), advises NE to ensure that NE's long-range plans, priorities, and strategies are consistent with both the policy and technical aspects of civilian nuclear energy. By focusing on the development and deployment of advanced nuclear technologies, NE supports DOE's strategic goal to develop new generation capacity while making improvements in environmental quality.

Nuclear Energy Overview

Mission

The Office of Nuclear Energy promotes nuclear power as a resource capable of meeting the Nation's energy, environmental, and national security needs by resolving technical, cost, safety, security, and regulatory barriers through research, development, and demonstration.

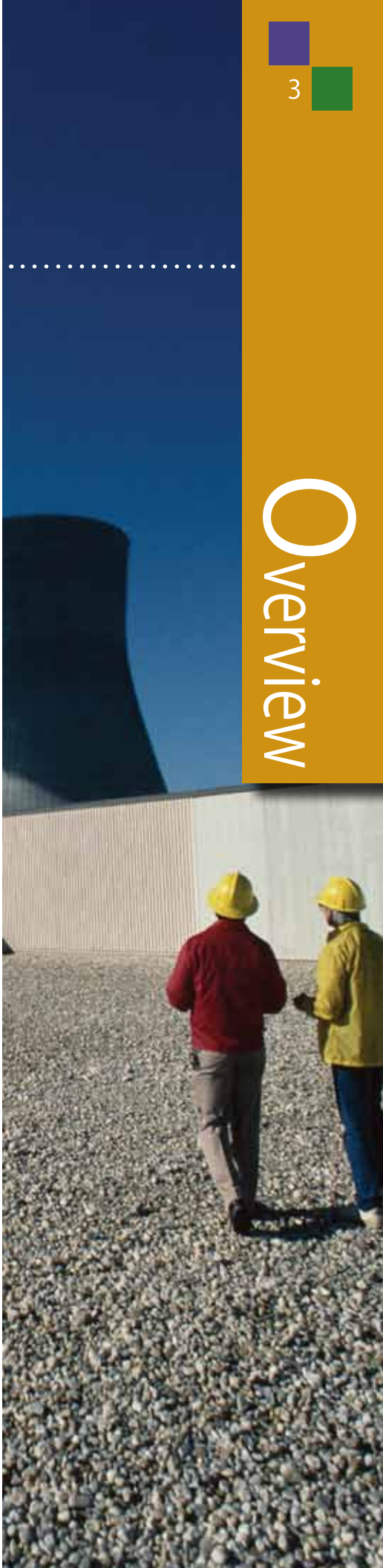
Vision

Increasing demand for clean, efficient, and economical energy generation technologies shapes NE's vision for today, tomorrow, and the future. NE envisions nuclear energy as a widely accepted, safe, clean, secure, and economically stable energy resource that helps meet our Nation's energy security goals, while contributing to global climate change abatement.

Today . . . NE is laying the groundwork for a nuclear renaissance in the United States. New nuclear power plants will soon be licensed and under construction. Renewed investments in the national nuclear infrastructure, including advanced modeling and simulation and research into aging phenomena of materials, equipment, and structures, will support innovations in nuclear energy applications, including next-generation nuclear power and fuel cycle technologies. Expanding partnerships and outreach with industry, academia, and the global community will ensure that nuclear energy contributes to the cleaner, safer, and more energy-secure world of tomorrow.

Tomorrow . . . NE supports and promotes the continued revitalization and expansion of the U.S. nuclear industry. The first new nuclear plants are beginning operation, construction activities are underway on additional new nuclear plants, and existing nuclear plants have the technical basis to support extending their operating licenses beyond 60 years. These new and existing plants are producing economic and safe carbon-free energy. A robust national nuclear R&D infrastructure has been re-established, enabling the demonstration of next–generation nuclear power and associated cogeneration technologies, as well as advanced fuel cycle technologies. Strong educational programs and partnerships with local communities and regional governments continue to contribute to an informed public and skilled nuclear workforce. The future of deep space exploration is more assured due to the new, sustainable domestic production of radioisotopes for space power systems.

Future . . . NE continues to push the frontiers of advanced nuclear energy R&D. The national nuclear infrastructure is fully restored, with advanced engineering techniques and fully mature modeling and simulation technologies aiding in the development of new materials and fuels capable of enhancing nuclear plant operation, supporting increases in the efficiency of energy generation, enabling the design of advanced reactor technologies "beyond next generation," and developing new applications for nuclear power. The nuclear fuel cycle is fully optimized with technically and economically viable fuel cycle management options for industry consideration, including the use of fast reactor technologies for resource conservation and waste management. The space power systems program meets national objectives for deep space exploration. The United States has regained its role as the global leader in nuclear energy technologies.



Organization

Under the Assistant Secretary for NE, the organization includes Deputy Assistant Secretaries (DAS) who oversee NE functional areas. NE's new Assistant Secretary has created a framework for reorganizing NE DAS offices to better align the organization with its goals. The NE reporting structure for each program element in relation to its DAS office under the reorganization is illustrated in Figure 1 and summarized hereafter.

Nuclear Reactor Technologies

The Office of Nuclear Reactor Technologies leads programs that work toward the Objectives to extend plant lifetimes, to extend new nuclear reactor builds, and to reduce the carbon footprint in transportation and industrial sectors. This office advances deployment of light-water and gas-cooled nuclear reactors and nuclear power applications; manages collaborative R&D activities with universities; investigates advanced reactor concepts; and manages NE's modeling and simulation efforts through the new Modeling and Simulation Hub. Program elements that report to the DAS for Nuclear Reactor Technologies include Nuclear Power 2010 (NP 2010), Generation IV Nuclear Energy Systems Initiative (Gen IV), and the Modeling and Simulation Energy Innovation Hub.

International Nuclear Energy Policy and Cooperation

The Office of International Nuclear Energy Policy and Cooperation is responsible, in conjunction with other Federal agencies, for formulation of U.S. international nuclear energy policy and oversight of technical and business activities related to the export of U.S. nuclear goods and services (i.e., bilateral and multilateral cooperative efforts).

Business and Technical Support

The Office of Business and Technical Support provides support to NE operations, strategic planning, budget and administrative management, human resources, information technology, program performance measurement and evaluation, and intergovernmental activities. This office also supports the National Aeronautics and Space Administration (NASA) and national security needs for radioisotope power systems (RPS), and is responsible for the Department's uranium management policy.

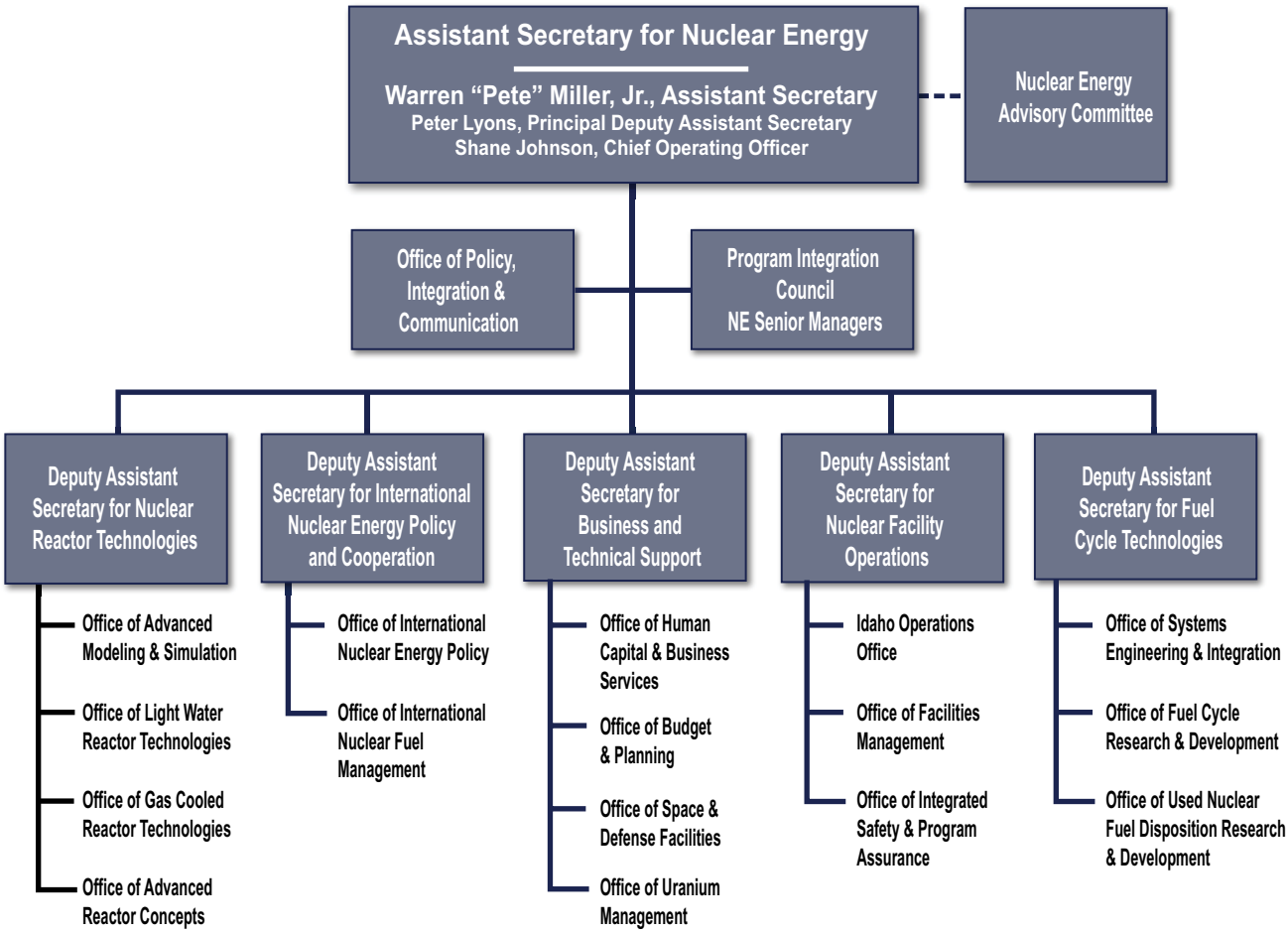
Nuclear Facility Operations

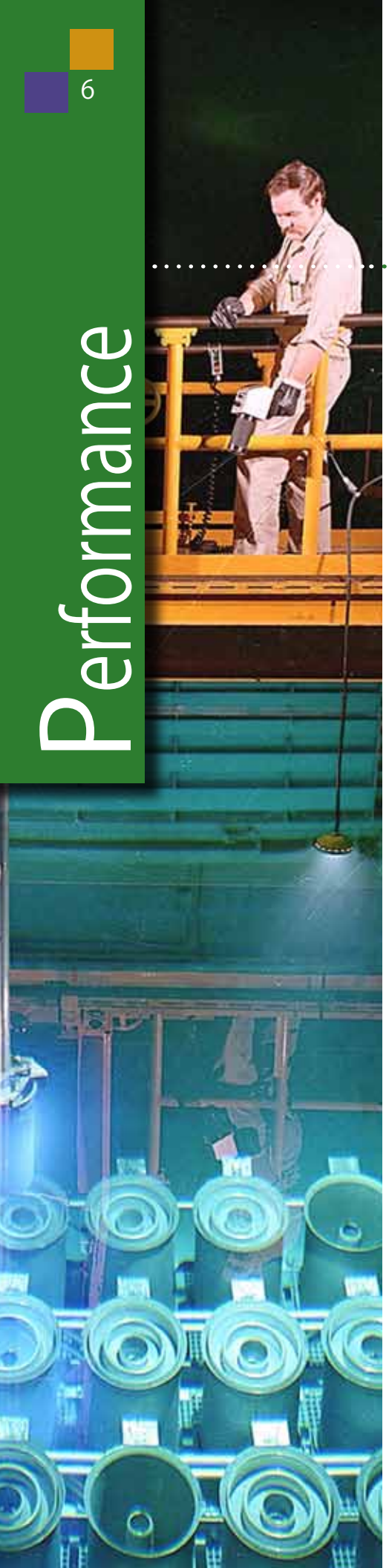
The Office of Nuclear Facility Operations supports R&D activities by providing and maintaining safe and secure research, development, and demonstration facilities at the Idaho National Laboratory (INL). The Office serves as the operational interface in support of NE's Lead Program Secretarial Officer responsibilities at the Idaho National Laboratory (INL). Program elements that report to the DAS for Nuclear Facility Operations include Idaho Facilities Management (IFM), Idaho Sitewide Safeguards and Security, and the Idaho Operations Office (ID). ID provides procurement, contract, cooperative agreement, grant, and safety and security support for NE program activities. Working together as an integrated organization, NE Headquarters and ID staff are supporting the creation of INL as a world-class nuclear energy and national security R&D laboratory.

Fuel Cycle Technologies

The Office of Fuel Cycle Technologies provides technical leadership and expertise in advanced fuel cycle R&D focused on options for a sustainable fuel cycle.. It is also responsible for developing technical and policy options to the Nation's current fuel cycle management strategy. The program elements directly related to Fuel Cycle Management include the Fuel Cycle R&D program.

Figure 1. Office of Nuclear Energy Organizational Chart





Nuclear Energy Strategy and Performance

I. NE's Strategic Fit within the Department

A new Strategic Plan reflecting the priorities of the Administration is currently under development by the Secretary of Energy. In the meantime, the Secretary has identified five priorities to guide Departmental activities:

- Science Discovery and Innovation
- Clean Secure Energy
- Economic Prosperity
- Climate Change
- National Security and Legacy

Since NE's most direct and obvious benefit is providing clean and secure power to our Nation's electricity grid, NE falls under the second priority, Clean Secure Energy. However, work conducted within NE contributes to all five of the Secretary's priorities. The Department has also created goals with targets that complement the Secretary's five priorities. Nuclear power will help the Department meet its clean energy and greenhouse gas reduction goal:

Reduce CO_2 emissions by 80% by 2050.

In addition to NE's work on nuclear power for the electricity grid, it's important to recognize NE efforts in other areas. These areas include future and innovative applications of nuclear power; management of used fuel and nuclear wastes; stewardship of nuclear infrastructure; and international issues and cooperation surrounding nonproliferation issues. All areas of work within NE are described in the following sections.

II. NE Strategy

The United States is among the countries with the highest per capita use of electricity and total CO_2 emissions. In 2007, approximately 40% of our CO_2 emissions resulted from electricity generation, and about 33% came from the transportation sector. Industrial uses of fossil fuels contributed about 16% of our total CO_2 emissions. Comparing these figures to the Department's goal to reduce CO_2 emissions by 80% by 2050, it is evident that immense changes must occur in these sectors. With nuclear power producing 70% of our CO_2-free electricity today, clearly nuclear power must be a significant component in realizing the Department's goal.

Analyses such as those in the **August 2009 Electric Power Research Institute's (EPRI) Prism/MERGE** study have evaluated the current portfolio of electricity generation and developed highly ambitious goals for both reduction of carbon emissions and for new construction of large amounts of CO_2-free generation. Even with ambitious forecasts for clean coal and renewable energy sources, the EPRI study still requires that approximately 30% of our electricity be derived from nuclear power as soon as 2030 in order to meet the EPRI study's energy goals of reduced CO_2 emissions from the electricity sector. Given that nuclear power currently generates approximately 20% of our electricity, this implies a significant increase in the number of nuclear plants by 2030.

Nuclear power has a substantial role to play in satisfying the future demand for clean energy. However, the current state of nuclear power in the United States complicates the challenge of expanding nuclear power. No new reactors have been built in the last 30 years. Most nuclear power reactor vendors are located outside the United States. To a good approximation, U.S. manufacturing capabilities and technologies have not been exercised domestically for three decades, leading to varying degrees of atrophy. The Nation's human infrastructure supporting nuclear technologies has declined substantially over the last few decades, many experimental facilities have closed, many university research reactors have ceased operation, and the number of nuclear engineering programs has decreased.

In addition to infrastructure atrophy, nuclear power must overcome a number of obstacles associated with risk. Waste management and proliferation are serious risks. Capital cost is another, and arguably more immediate, obstacle to the expansion of nuclear power. The capital cost of a large new plant is high, and it is quite often prohibitive for utilities to invest in nuclear energy, especially when interest rates are high. It is important to minimize investment risk by employing government loan guarantees and improving regulatory processes.

NE seeks to fill the appropriate federal government role in nuclear power by supporting policy changes and conducting work that addresses the barriers listed above.

From these observations regarding our Nation's projected demand for clean energy and the obstacles that nuclear power currently faces, several strategic goals for nuclear power are evident:

Objective 1 — Develop technologies and other solutions that can improve the reliability, sustain the safety, and extend the life of current reactors. Actions to extend the lifetime, improve the performance, and sustain the health of the current fleet of nuclear power plants are vital. We depend on nuclear power today for most of our carbon-free electricity. We must maintain that contribution and develop options to enhance its capability.

The current fleet of 104 nuclear power plants has reliably and economically contributed almost 20 percent of electricity generated in the United States over the past two decades. However, by 2030 most existing nuclear power plants will be reaching the end of their 60-year operating licenses. Replacement of this large 100 GWe generating capacity with other conventional fossil plants will lead to larger CO_2 emissions. Extending lifetime beyond 60 years is a low-risk option to continue generating power at a fraction of the cost of building new plants.

Programs working toward this goal for existing plants have a common objective, which is to provide a comprehensive technical basis for licensing and managing the long-term, safe, and economical operation of the current fleet of nuclear power plants. Major innovations are needed in the following areas:

- Research and Development (R&D): High-performance fuels and long-life materials.
- Analysis: Advanced modeling and simulation tools.
- Licensing Support: Science-based and risk informed regulatory process.

Generation IV (Light Water Reactor Sustainability licensing support, Energy Innovation Hub for Modeling and Simulation, and R&D on long-life materials) and **Fuel Cycle R&D** (R&D on high performance fuels) will contribute to achievement of this Objective.

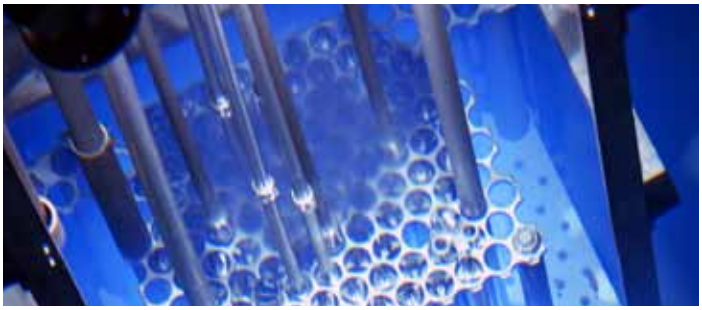
Objective 2 — Develop improvements in the affordability of new reactors to enable nuclear energy to help meet the Administration's energy security and climate change goals. Given the projected steep rise in electricity demand, significant builds of new plants will be required just to maintain the current 20% nuclear contribution. The economics of nuclear power will have to continue to improve to enable new builds. In addition, if large parts of our transportation sector transition to electric power and away from fossil fuels to avoid carbon emissions, the importance of new carbon-free electricity generation will intensify. Innovative new reactor concepts must be studied to enable much more capable systems in future decades.

The previous 30-year hiatus in new nuclear plant orders in the United States presents a number of immediate hurdles for the construction of new Generation III plant designs. In particular, investor confidence is low due in part to uncertainties in the new regulatory framework, which has not been fully exercised, and concerns regarding the trend toward increased reliance on foreign manufacturing sources, especially for larger plant components. This investment challenge is exacerbated by the capital-intensive nature of nuclear power plants, a rapid increase in the price of construction commodities over the past few years, and the poor economic situation in the United States today. These factors combine to create a huge financial hurdle for the construction of new nuclear plants for even the largest U.S. utilities, and virtually preclude the nuclear energy option for smaller utilities.

To effectively address key barriers to the construction of new nuclear power capacity, NE has established the following goals:

- Enable construction and operation of the first Generation III+ plants by reducing financial risk for the first few customers.
- Facilitate accelerated licensing of small modular reactor (SMR) designs that offer lower capital cost and increased opportunities for domestic manufacturing jobs.

NE supports the diverse energy programs of the United States.



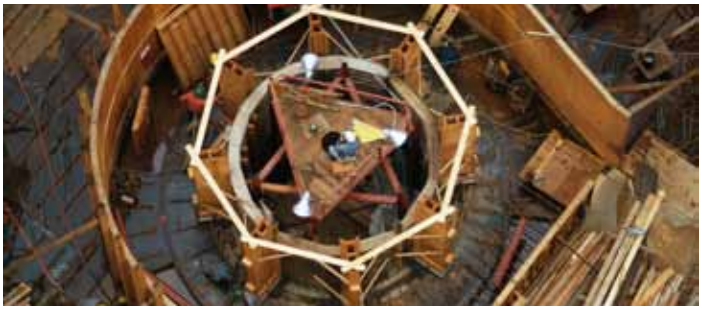
- Facilitate the development and demonstration of advanced manufacturing technologies applicable to new nuclear plant builds.
- Develop next-generation advanced plant concepts and technologies that offer a high potential for significant performance improvements in nuclear plant designs, including substantial reduction in capital and operating costs, reduced water utilization, greatly extended plant lifetime, and greater fuel cycle sustainability.

NE's Nuclear Power 2010 program has facilitated several new plant designs through Nuclear Regulatory Commission (NRC) certification, and the program will complete these efforts in FY 2010. However, the financial hurdles described above remain. The first objective (reduce business risk to initial customers) is accomplished through financial assistance mechanisms enabled by the 2005 Energy Policy Act, such as loan guarantees, and does not require any R&D support. The remaining three goals have additional licensing and R&D requirements. While the **Generation IV** and **Fuel Cycle R&D** programs will perform R&D to remove technical barriers, the best method for accomplishing the three remaining goals is being analyzed.

The full capacity of the 104 commercial nuclear power plants in operation today is used to generate baseload electricity. Nuclear power has the potential to displace greenhouse gas-emitting fuels in the transportation and industrial sectors, but new plant designs will be needed to effectively meet these demands. Specifically, many industrial process heat applications require that heat be delivered at temperatures substantially above the 300-350° C outlet temperature of existing Light Water Reactors. Achieving higher output temperatures will require switching to a new coolant technology such as gas, liquid metal, or molten salt, which in turn will require the development and qualification of fuels, materials, and instrumentation, especially at the higher end of the temperature range. Advanced modeling and simulation tools will be vital to accurately characterize and predict the performance of the new coolants, fuels, materials, and components in these high-temperature reactor plants.

The Next Generation Nuclear Plant (NGNP) project is moving forward in FY 2010. EPAct directed the demonstration of an NGNP, and NE is committed to completing the project as specified in the Act. NGNP will facilitate the extension of nuclear energy into the broader industrial and transportation sectors, reducing fuel use and pollution and improving on the inherent safety of existing commercial light water reactor technology.

The **Generation IV** program will perform the bulk of the work for this goal (reactor designs, materials, modeling and simulation, and the NGNP project, among other initiatives). The **Fuel Cycle R&D** program will also contribute to R&D on fuels.



Objective 3 — Develop sustainable nuclear fuel cycles. For the large expansion of nuclear power discussed in Objectives 1 and 2 to be realized, nuclear power must minimize operational risks. Domestic nuclear plants have demonstrated superb safety records over many decades, and that record must be maintained. In addition, the long-term management of the used fuel must be addressed for nuclear power to continue or expand. Thus, another Objective is to achieve a sustainable fuel cycle, where sustainability is viewed from the perspectives of public acceptance, economics, safety, and environmental considerations.

The key challenge is to develop a suite of options that will enable future decision makers to make informed choices about how best to manage the used fuel from reactors. The Administration has established the Blue Ribbon Commission on America's Nuclear Future to inform this waste-management decision-making process. DOE will conduct R&D in this area to investigate technical challenges involved with three potential strategies for used fuel management:

- Once-Through – Develop fuels for use in reactors that would increase the efficient use of uranium resources and reduce the amount of used fuel requiring direct disposal for each megawatt-hour of electricity produced.
- Modified Open Cycle – Investigate fuel forms and reactors that would increase fuel resource utilization and reduce the quantity of long-lived radiotoxic elements in the used fuel to be disposed, with limited separations steps using technologies that substantially lower proliferation risk.
- Full Recycling – Develop techniques that will enable the long-lived actinide elements to be repeatedly recycled rather than disposed. The ultimate goal is to develop a cost-effective and low proliferation risk approach that would dramatically decrease the long-term danger posed by the waste, reducing uncertainties associated with its disposal.

A major science-based, goal-oriented R&D program supporting long-term management of high level wastes (HLW) is a high priority to develop options for storing, reprocessing, recycling, and possibly transmuting the constituents of used fuel and disposing of remaining HLW safely, economically, and in a proliferation-resistant manner.

NE has developed the following goals for Objective 3:

- In the near term, define and analyze the various fuel cycle technologies to develop options that increase the sustainability of nuclear energy.
- In the mid-term, select the preferred fuel cycle option(s) for further development.
- In the long term, be prepared to demonstrate the selected fuel cycle options at an engineering scale.

The technologies required to fully close the fuel cycle are not mature enough for deployment, and the cost associated with the implementation is highly uncertain. Thus a focused R&D effort for cost reduction for all aspects of the fuel cycle is prudent. The **Fuel Cycle R&D** program will lead work on this goal.

The Office of Nuclear Energy's budget must build on important work to deploy new nuclear plants by the next decade.

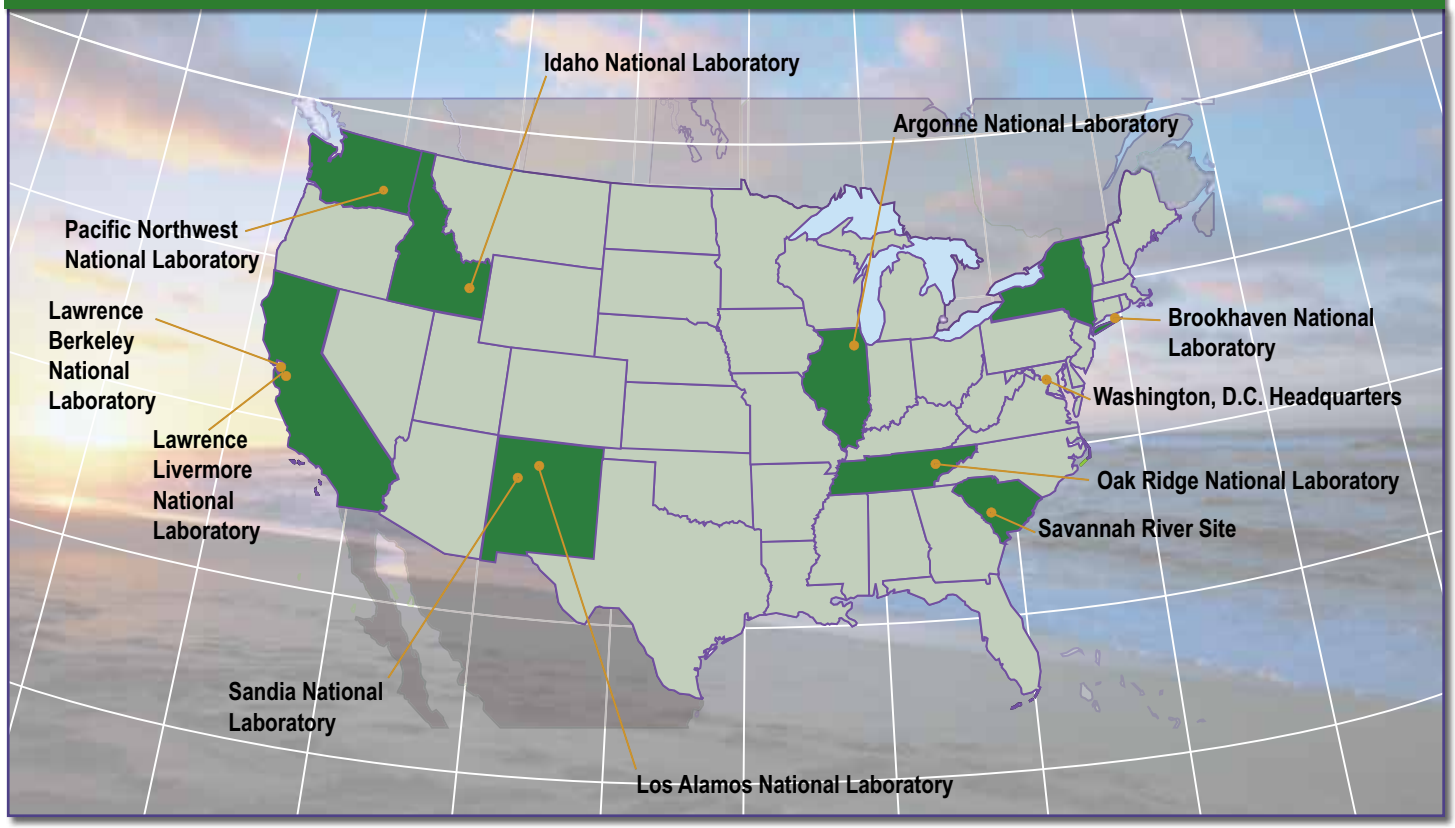
Objective 4 — Understand and minimize the risks of nuclear proliferation and terrorism.

Another risk presented by nuclear power involves the proliferation of nuclear technologies and materials to Nations that wish to develop nuclear weapons. Expansion of nuclear power around the world clearly requires careful attention to nonproliferation.

President Obama stated that while we *"must harness the power of nuclear energy on behalf of our efforts to combat climate change and to advance opportunity for all people… [nuclear terrorism] is the most immediate and extreme threat to global security."* (Prague, April 5, 2009). The final goal for NE is to enable nuclear energy expansion by developing and demonstrating options that limit proliferation and terrorism risks associated with nuclear power while also achieving economic, public health and safety, and environmental goals. This requires NE advocacy for, and execution of, an integrated program to develop technologies, frameworks, and policy options for the future nuclear enterprise, cutting across all aspects of the fuel cycle.

Limiting proliferation and terrorism threats requires protecting materials, facilities, sensitive technologies, and expertise. The anticipated expansion in nuclear energy utilization means that while nonproliferation and terrorism challenges are evolving (e.g., new technologies and fuel cycle strategies, more and different types of materials in more locations), there are important opportunities for impacting these challenges through integrated development of nuclear fuel cycle options. Integrated development will be pursued in the context of broader nonproliferation and counterterrorism initiatives, all the while strengthening effective coordination with other government agencies and industry.

Figure 2. Primary Nuclear Energy R&D Sites within DOE



NE leads the development of new nuclear energy generation technologies to meet energy and climate change goals.

Crosscutting Support — Stewardship of the Infrastructure Supporting Nuclear Technologies

The level of support for stewardship of the Nation's nuclear technology infrastructure (both people and facilities) has varied dramatically over the past four decades, even reaching zero in the 1990s. This has reduced experimental capabilities, the availability of trained craftsmen, and innovation within the communities associated with nuclear engineering and related specialties. In order to support the reference case in nuclear energy as well as the myriad requirements for trained individuals, these fields require sustained funding support and enthusiastic leadership to keep and retain the brightest and most capable students, faculty, and researchers. This requires support for university-based training reactors, academic research, fellowships, and scholarships.

Support must extend beyond the university community to include community colleges and trade schools. Construction and operation of new plants requires many technically trained personnel. Retirement of existing plant workers is further increasing demand for such individuals.

Nuclear infrastructure at the national laboratories is also a concern. In many cases, the required facilities are out of date and need upgrades or replacements. Many programs in the Department require utilization of these facilities, which have applications that extend far beyond nuclear energy. In addition, NE has a site stewardship responsibility for the Idaho National Laboratory, which must remain a first-rate applied science and engineering laboratory operating with the highest standards of safety and security.

Under the current budget structure, the following programs work to support Infrastructure Stewardship: **Idaho Facilities Management, Radiological Facilities Management**, and the **Nuclear Energy University Program**.

Figure 3. FY 2009 – FY 2010 Nuclear Energy Funding Summary ($ in thousands)

Office of Nuclear Energy Activities	FY 2009 Appropriation	FY 2010
Nuclear Energy		
Integrated University Program	5,000	5,000
Nuclear Power 2010 (NP 2010)	177,500	105,000
Generation IV (Gen IV)	180,000	220,137
Nuclear Hydrogen Initiative (NHI)	7,500	0
Fuel Cycle R&D*	145,000	136,000
Radiological Facilities Management	66,146	72,000
Idaho Facilities Management	140,000	173,000
Idaho Sitewide Safeguards and Security**	78,811	83,358
Program Direction	73,000	73,000
Transfer from State Department	3,300	–
Congressionally Directed Projects	2,854	2,500
Use of Prior Year Balance	(5,000)	–
Total Nuclear Energy	875,111	869,995

* Formerly Advanced Fuel Cycle Initiative
** Funded in the Other Defense Activities appropriation

Key Events for 2010

November 2009

- NE issues first call for proposals for Advanced Test Reactor (ATR) National Scientific User Facility (NSUF) experiments.

December 2009

- NE completes irradiation of the first two NSUF university experiments and removes them from the Advanced Test Reactor.

January 2010

- NASA issues a draft Announcement of Opportunity offering the Advanced Stirling Radioisotope Generator (ASRG), being developed by NE, as the power source for an upcoming mission. If selected, this would be the first flight of this new power system.
- NE issues Request for Proposals (RFP) for university R&D projects and Request for Application (RFA) for scholarships and fellowships.

March 2010

- French-Hosted Nuclear Energy Conference in Paris, France.
- NE announces Next Generation Nuclear Plant Conceptual Design awards.

April 2010

- President Obama hosts international nuclear security summit.

May 2010

- Nuclear Nonproliferation Treaty Review Conference in New York.
- NE completes Final Safety Analysis Report Addendum in support of Presidential Launch Approval Process for the Mars Science Laboratory mission, to be launched in 2011.

June 2010

- Idaho National Laboratory hosts the ATR NSUF User Week Workshop.
- NE announces the team of laboratories, industries, and universities that will lead the Modeling and Simulation Energy Innovation Hub.

July 2010

- NE hosts Small Modular Reactors Workshop.

August 2010

- NE holds the Annual University Program Workshop.

September 2010

- NE initiates Nuclear Energy Advisory Council's review of NGNP.
- General Conference of the International Atomic Energy Agency in Vienna, Austria.

October 2010

- The Nuclear Regulatory Commission issues an advanced Safety Evaluation Report (SER) for Southern Company's Vogtle site Combined Construction and Operating License (COL).
- The NRC Advisory Committee on Reactor Safeguards concludes review of the advanced SER for the General Electric-Hitachi Economic Simplified Boiling Water Reactor design certification.
- NE issues Request for Pre-Applications (RPA) for university R&D projects and RFA for scholarships and fellowships.

December 2010

- The NRC issues a final SER for the Westinghouse Electric Company AP1000 reactor design certification.
- NE issues RFP for university R&D projects.

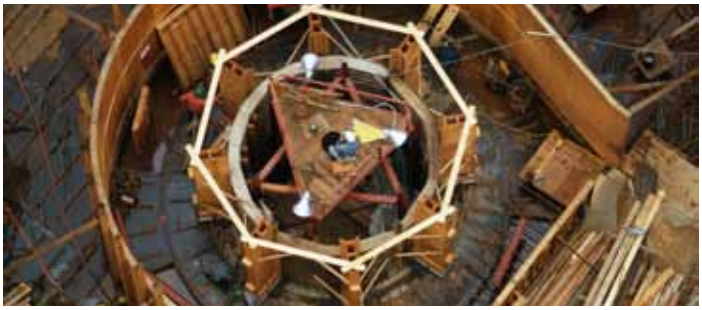
Existing nuclear power plants are among the most economic sources of electricity on the grid today.

Figure 4. Performance Measures

Performance Measures			
Objectives and Programs	FY 2009 Measure	FY 2010 Measure	Notes
1: Current Reactors	N/A	Develop the scientific basis to extend nuclear power plant operating life beyond the current 60 year limit and ensure the long term reliability, productivity, safety, and security of existing and new light water reactors by conducting research and development activities in partnership with national laboratories, industry, universities, and international partners.	Work supporting Existing Plants will take place under NE's Generation IV program in FY 2010.
2: New Reactors NP 2010, (Gen IV, Nuclear Hydrogen Initiative)	Enable industry to make a decision to build a new nuclear power plant by 2010 by supporting New Nuclear Plant Licensing Demonstration Projects within the planned scope, schedule, and budget of the program, and by administering the Department's standby support program. — TARGET MET — Determine a path forward for the design and construction of a next generation nuclear power plant by 2011 by partnering with private industry on the development of NGNP, performing environmental assessment activities, and continuing with the research, analysis, design, and licensing activities needed to identify the preferred and alternative technologies for the reactor system, including examination of fuel and graphite materials. — TARGET MET — Select a hydrogen production technology by 2011 that will be demonstrated in a pilot scale experiment by conducting thermochemical and high-temperature steam electrolysis integrated laboratory-scale experiments. — TARGET MET —	Enable industry to make a decision to build a new nuclear power plant by 2010 by continuing to support the completion of construction and operating license and design certification efforts. Determine a path forward for the design and construction of a next generation nuclear power plant by 2011 by partnering with private industry on the development of NGNP, performing environmental assessment activities, and continuing with research, analysis, design, and licensing activities to establish the basis for determining whether the project should continue to Phase 2.	The NP2010 program will end in 2010, as planned. Other activities are currently being formulated to work toward the New Plants Objective. These activities will be represented by a performance measure. The Nuclear Hydrogen Initiative ended in FY 2009. Objective 3 will continue to be represented by the NGNP Performance measure.

Figure 4. Performance Measures (continued)

Performance Measures			
Objectives and Programs	FY 2009 Measure	FY 2010 Measure	Notes
3: Nuclear Fuel Cycle (Fuel Cycle R&D)	Support the development of advanced technologies to close the fuel cycle by performing specific used fuel separations, transmutation fuels, and fast reactor research and development activities in support of the Advanced Fuel Cycle Initiative. — TARGET MET —	Demonstrate progress toward the long-term mission to develop options to the current commercial fuel cycle management strategy by establishing long-term strategic plans for the program, identifying gaps in knowledge and uncertainties to resolve, and beginning the path to achieve the program's grand challenge goals.	N/A
4: Proliferation Issues	N/A	N/A	N/A
All: Infrastructure (Idaho Facilities Management, Radiological Facilities Management)	To ensure unique nuclear facilities are available to support critical Departmental missions, achieve cumulative variance of less than 10 percent from cost and schedule baselines at Idaho National Laboratory for Idaho Facilities Management program facilities and activities (which include facilities used by the Radiological Facilities Management program), consistent with safe operations. — TARGET MET — To ensure unique nuclear facilities are available to support critical Departmental missions, maintain a facility operability index of 0.9 for key Idaho Facilities Management and Radiological Facilities Management program facilities. — TARGET MET —	Execute general plant and construction projects within approved cost profiles and schedules, as measured by the total percentages of projects with cost performance indexes and schedule performance indexes between 0.9 and 1.15 (using earned value measurement systems for GPPs and other program-defined maintenance and upgrade projects). To ensure unique nuclear facilities are available to support critical Departmental missions, maintain a facility operability index of 0.9 for key Radiological Facilities Management program facilities. (IFM removed from this measure). Enable nuclear research and development activities by providing operational facilities and capabilities, as measured by availability percentages.	The methodology for the Infrastructure performance measures has changed for FY 2010. The same activities are tracked, and the new methodology is designed to make the measure more meaningful.



Future use of nuclear energy is vital to meet U.S. needs for carbon-free, dependable, and economical electric power.

Program Assessment

The Administration is now planning to fundamentally change how program performance is measured. The data currently used in Office of Management and Budget's (OMB) Program Assessment Rating Tool (PART) will be employed differently, with a focus on giving clear explanations of performance trends rather than rating programs on past performance only.

In developing the new performance management system, the Administration is concentrating on five key principles. They include:

1) Senior leader ownership of the performance management process. It is critical that senior agency leaders "own" the overall performance management process and their agency goals and measurements. Secretaries and Deputies will be charged with the setting of agency goals, will be held responsible for performance against those goals and their related measurements, and will be expected to be actively engaged in all aspects of the performance management process.

2) Cascading goals and measurements. A clear line must link agency strategic goals and measurements to program-level targets. Linkages are critical to the functioning of a successful performance management system.

3) Outcome-oriented cross-agency goals and measurements. Outcome-oriented goals and measures connect government agencies to their missions. Similarly, achieving broad government outcomes often requires contributions from multiple actors across different agencies and others inside and outside of government. Goals and measurements must support coordination across these organizational boundaries.

4) Review and accountability. Measurement has no value if it is not used by decision makers. Clear communication of progress against targets and frequent reviews of performance against plans are essential. These reviews must be done on a regular basis, preferably at least quarterly. Only this kind of review process will result in performance management becoming ingrained into the culture of government.

5) Transparent process. Achieving important government goals requires the active engagement of the public, Congress, and the overall government workforce. Transparency plays a critical role in this engagement, promoting understanding of what the government is doing, stimulating involvement of broader groups, communicating results, and creating accountability for agency managers.

NE welcomes these changes in performance measurement and looks forward to contributing to a fully meaningful and useful government-wide performance management structure and system.

Nuclear Energy Activities that Address DOE Leadership Challenges

The Department carries out multiple complex and highly diverse missions. Although the Department is continually striving to improve the efficiency and effectiveness of its programs and operations, some specific areas merit a higher level of focus and attention. These areas often require long-term strategies for ensuring stable operations and represent the most daunting Leadership Challenges the Department faces in accomplishing its mission.

The Reports Consolidation Act of 2000 requires that the Inspector General (IG) annually prepare a report summarizing what he considers the most serious management and performance challenges facing the Department. These challenges are included in the Other Accompanying Information section of that report. Similarly, in FY 2003 the Government Accountability Office (GAO) identified six major management challenges and program risks to be addressed by the Department.

The Department, after considering all critical activities within the agency and those areas identified by the IG and GAO, has identified nine Leadership Challenges that represent the most important strategic management issues facing the Department now and in the coming years. It is the Department's goal to develop strategies to address these areas that will also help mitigate related IG and GAO management challenges.

The Department's strategic approach to these challenges is captured in the Department's Annual Financial Report. NE is actively contributing to the Department's overall efforts in six of the nine leadership challenges through a variety of activities, as described on the following pages.

Contract and Project Administration

Challenge — Congress has directed that the Department take corrective action to be removed from the GAO High Risk List for inadequate contract and project oversight and management. DOE has been on this GAO list since its inception in 1990.

NE Activities[1] — In 2005, NE became the Lead Program Secretarial Office for the Idaho National Laboratory. NE and ID work together to ensure that INL's contractor, Battelle Energy Alliance, manages and operates the laboratory in compliance with contract requirements. NE and ID provide formal written guidance, review detailed work plans and monthly status reports, and conduct frequent face-to-face reviews at the staff and senior management levels.

A 2006 review by the Department's IG recommended improvements in management controls for performance fees within the INL contract. NE and ID have worked to improve the use of outcome-oriented metrics to more appropriately assess and reward contractor performance. Specific performance milestones are captured in the Performance Evaluation Management Plan (PEMP). The PEMP, reviewed annually, ties the contractor's achievements to its performance fee.

In the area of project administration, NE initiated the application of project management principles contained in DOE Order 413.3A, *Program and Project Management for the Acquisition of Capital Assets*, to programs in FY 2005. Through this effort, NE applied an earned value management system (EVMS) to selected major programs to track cost, technical, and schedule performance against the program's baseline and assure greater control of the program and its resources. Additionally, as required by DOE Order 413.3A, NE ensures that all of its capital asset projects develop and track their baselines using earned value, when appropriate. When projects are mature

[1] Activities within this challenge area also relate to the IG's Acquisition Process Management Challenge area.

enough to track earned value (at critical decision [CD]-2), NE tracks this internally through the same reporting mechanism used for tracking the earned value for programs. When a project attains CD-0, project performance reviews are held quarterly with the NE acquisition executive to ensure that project performance is assessed regularly.

Within the area of Federal Project Director (FPD) certification, NE leads the Department in its support of the Project Management Career Development Program (PMCDP). NE has hosted numerous continuing education opportunities for its certified FPDs to assist them in maintaining certification. In January 2009, NE commenced its PMCDP Level 1 boot camp, bringing all of the required level-one PMCDP courses to participating NE staff who are not yet certified to help them attain certification. NE held its first boot camp in FY 2006, training over 50 staff members whose jobs required fundamental knowledge of program and project management principles.

Security

Challenge — The need for improved homeland defense, highlighted by the threats of terrorism and weapons of mass destruction, created new and complex security issues that must be surmounted to ensure the protection of our critical energy resources, infrastructure, and personnel.

NE Activities — On September 30, 2006, the 2003 Design Basis Threat (DBT) was fully implemented at INL. The DBT is an approach for designing safeguards systems to prevent the theft of special nuclear material. NE was in the process of implementing the 2005 DBT at INL when the Department's Graded Security Protection (GSP) policy was issued in August 2008, superseding the 2005 DBT. INL will submit an implementation plan for the GSP in 2010. In addition, NE has accomplished various activities to bolster security and protect vital assets at INL. In May 2005, the de-inventory of Category I material at one INL facility was completed, leaving only two co-located Category I facilities within the INL Materials and Fuels Complex.[2]

In October 2007, the INL Radioactive Scrap and Waste Facility also became a Category I facility with a two-year waiver. NE continues to partner with the Idaho Operations Office and the Office of Health, Safety, and Security to test, develop and deploy new security technologies at INL.

Nuclear Waste Disposal

Challenge — The Department's FY 2010 budget request announced the Administration's intended termination of the Yucca Mountain repository project and included funding to explore alternatives for nuclear waste disposal. The termination of the Yucca Mountain project has left the Nation without a repository in which to store used nuclear fuel and high-level radioactive waste.

NE Activities — In addition to the Secretary's action of convening a Blue Ribbon Commission of experts to evaluate alternative approaches to meet the Federal government's responsibility, NE's Fuel Cycle R&D program is also tackling this challenge. The program conducts research and development focused on nuclear fuel recycling and waste management to meet U.S. needs. The program is working to discover the best ways to recycle and reuse waste materials to the maximum extent possible, to reduce the environmental burden and uncertainty associated with long-term nuclear waste management, and to minimize the risk of waste that needs to be handled or stored prior to disposal to include eliminating long-term storage of liquid wastes.

Cyber Security

Challenge — Cyber attacks are increasing in complexity and frequency, and are becoming more aggressive. DOE's INL is attacked over a million times each month in a wide variety of ways. Although DOE has defense-in-depth mechanisms based on industry and government best practices, some of the very sophisticated attacks have been able to penetrate DOE networks and computers. Cyber attacks continue to evolve to avoid detection by these defenses. The DOE comprehensive

[2] "Category I" refers to the storage of strategic special nuclear material with the risk and potential for direct use in a clandestine nuclear weapon or for use in the production of nuclear material for use in a nuclear weapon. Category I material requires an especially high level of security.

The Office of Nuclear Energy's budget supports important work to deploy new nuclear plants by the next decade.

cyber security program must continually employ the best available management practices and technical defenses to provide adequate protection of its systems and data in the face of the increasing threat.

NE Activities — NE, in collaboration with the DOE Idaho Operations Office and the Battelle Energy Alliance, is working to enhance INL's cyber security framework. In FY 2006, a cyber security project was established to implement unclassified cyber security requirements as defined in the National Institute of Standards and Technology (NIST) 800-53, DOE Orders and Manuals, and the Under Secretary of Energy's (USE) Program Cyber Security Plan (PCSP). Contracted services and experts have been added to INL staff to develop and implement cyber security improvements. As part of the systematic and disciplined approach to solving cyber security issues, cyber security improvement plans are independently reviewed by industry experts and/or a Site Assistance Visit team. Independent industry experts also perform operational readiness reviews and System Testing and Evaluations of the effectiveness of new policies, standards, processes, and technology.

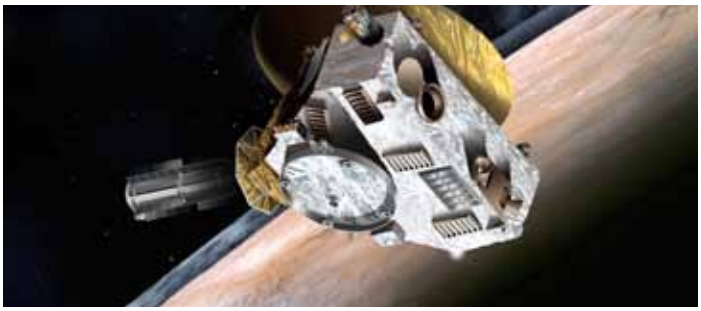
INL and ID unclassified information system networks have been reconfigured based on NIST standards and received Designated Approval Authority to commence operations in January 2008. The first phase of a three-step, risk-based plan to implement additional cyber security improvements, as defined in the PCSP, was initiated in FY 2007. The first-phase improvements were completed in FY 2008; additional activities will extend into FY 2009 and beyond.

Additional cyber security projects have been established to implement classified cyber security requirements. In September 2008, NE completed a project to convert classified computers to diskless workstations. This achievement, among others, helped NE resolve cyber security issues identified in an Office of Health, Safety and Security inspection of classified computing systems. NE will continue to implement cyber security requirements, as defined in DOE Orders, Manuals, and the USE PCSP.

Human Capital Management

Challenge — The Department requires a highly technical and specialized workforce to accomplish its scientific and technological missions. Maintaining a capable workforce is an ongoing challenge. The challenges in creating and implementing innovative human capital management strategies to maintain a workforce with the right people and skills is compounded by increased competition for individuals with the knowledge, skills, and competencies that the Department needs, and retirements that threaten to rob the organization of critical skills. The average employee age is over 49 years, and a significant number (30 percent) will be eligible to retire in the next three years. In 2007, retirements exceeded historical trends and attrition reached 7.6 percent. The attrition rate for the first half of 2008 climbed higher, to 8.3 percent. A continuation of this trend can deprive the organization of the skills needed to perform its mission. To maintain its workforce, DOE will need to hire more than 5,000 new employees in the next four years.

NE Activities — NE is one of the most programmatically diverse organizations in DOE. NE faces a variety of critical human capital challenges in pursuing its mission and meeting current requirements. The NE Human Capital Plan describes how NE is developing and maintaining a talent pool of well-qualified candidates with skills to meet current and projected needs through: (1) recruiting, redeploying, and promoting qualified personnel from inside and outside NE; (2) implementing leadership development programs; and (3) working to demonstrate a strong commitment to reducing the under-representation of women and minorities.



NE supplies Radioisotope Power Systems to power NASA deep space missions.

NE faces challenges in today's job market. To meet the challenge, NE is pursuing a wide variety of recruiting and outreach initiatives. Among these are participation in hiring fairs and the implementation of an NE Cooperative Education program. NE also participates in the Presidential Management Fellowship Program, Department of Energy Career Intern Program, Student Career Intern Program, Student Career Employment Program, Student Temporary Employment Program, and Minority Educational Institution Student Partnership Program. When advertising recruitment notices, NE often uses professional publications targeting minority groups. With regard to attracting qualified candidates, NE offers a variety of recruitment incentives such as recruitment bonuses, relocation expenses, advance-in-hires, and student loan repayment.

NE employees are encouraged to participate in a variety of career development programs, including the Senior Executive Service Candidate Development Program, Executive Potential Program, Executive Leadership Program, Aspiring Leader Program, and New Leader Program. These programs help develop the leaders of tomorrow, and help reduce the underrepresentation of women and minorities in management positions.

Safety and Health

Challenge — Ensuring the safety and health of the public and the Department's workers is one of our top priorities in accomplishing our challenging scientific and National security missions. Due to the inherently critical nature of these issues, continuous vigilance and improvement is needed.

> ***NE Activities*** — NE continues implementation of DOE Order 226.1, *Implementation of Department of Energy Oversight Policy*. This effort includes development of an integrated oversight plan and schedule, as well as an Oversight Proficiency Assurance Program to assure that the personnel with oversight responsibilities possess appropriate knowledge, skills, and abilities for safety oversight and provide a clear process for the delegation of critical safety authorities. NE continues to augment the safety staff and address gaps identified in staff safety coverage. NE implements its oversight activities and delegation of safety authorities per approved standard operating procedures. NE is conducting line management assessments and safety oversight of INL with the participation of the Idaho Operations Office.

Authorizing Legislation

NE is guided by authorizing legislation including the Atomic Energy Act, Energy Reorganization Act, Department of Energy Act, and the Energy Policy Act of 2005. The following are brief descriptions of the legislation.

The Atomic Energy Act of 1954

This Act is the fundamental U.S. law on both the civilian and the military uses of nuclear materials. On the civilian side, it provides for both the development and the regulation of the uses of nuclear materials and facilities in the United States, declaring the policy that "the development, use, and control of atomic energy shall be directed so as to promote world peace, improve the general welfare, increase the standard of living, and strengthen free competition in private enterprise." The Act requires licensing for civilian uses of nuclear materials and facilities. For more detailed information, please refer to: **http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0980/ml022200075-vol1.pdf**.

Energy Reorganization Act of 1974

Under the Atomic Energy Act, a single agency, the Atomic Energy Commission, had responsibility for the development and production of nuclear weapons and for both the development and the safety regulation of the civilian uses of nuclear materials. The 1974 Act split these functions into The Energy Research and Development Administration, NRC, and Energy Resources Council. For more detailed information, please refer to: **http://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0980/rev1/vol-1-sec-2-to-5.pdf**.

The Department of Energy Organization Act of 1977

This Act brought the Federal Energy Administration, the Energy Research and Development Administration, and the Federal Power Commission into a single agency. On October 1, 1977, DOE assumed the responsibilities of the aforementioned agencies, and parts and programs of several other agencies, under one organization governing the responsibility for the development and production of nuclear weapons, promotion of nuclear power, and other energy-related work. For more detailed information, please refer to: **http://uscode.house.gov/download/pls/42C84.txt.**

The Energy Policy Act of 2005

This Act encourages the deployment of nuclear power through loan guarantees and protection tax credits for advanced nuclear power facilities. It offers a new form of Federal risk insurance for the first six builders of new nuclear power plants. These incentives, coupled with the authorization of the Next Generation Nuclear Plant and R&D appropriations, move America closer to a vital national goal of energy independence with the aid of new nuclear power. For more detailed information, please refer to: **http://www.ne.doe.gov/energypolicyact2005/neEPACT2a.html**.

Validation and Verification

NE conducts various internal and external reviews and audits to validate and verify program performance. Periodic program reviews evaluate progress against established plans. NE holds monthly, quarterly, semi-annual, and annual reviews, consistent with program management plans and project baselines, to ensure technical progress, cost, and schedule adherence, and responsiveness to program requirements.

Internally, NE provides continual management and oversight of its R&D and vital infrastructure programs. Examples of NE's R&D programs include NP 2010, Gen IV, and Fuel Cycle R&D. NE infrastructure programs, such as the Radiological Facilities Management program and the IFM Program, are managed using similar oversight techniques.

NE has engaged its stakeholders in a number of recent evaluation activities to help define the appropriate scope of NE's program activities in supporting nuclear energy's role in meeting the Nation's energy security and environmental goals. In July 2008, the Battelle Corporation released its report, *Nuclear Energy for the Future: Executive Recommendations for R&D Capabilities*, which identifies the capabilities and facilities required to support the achievement of the nuclear energy industry's goals. This report reflects input from the domestic nuclear energy industry and the academic community. In August 2008, the Directors of the Department's National Laboratories released *A Sustainable Energy Future: The Essential Role of Nuclear Energy*, which describes how nuclear energy should contribute to our Nation's energy portfolio.

NE has also released several draft reports including *Facilities for the Future of Nuclear Energy Research: A Twenty-Year Outlook and Required Assets for a Nuclear Energy Applied R&D Program*. These reports focus on the capabilities required to carry out robust nuclear energy research, development, and demonstration programs that are able to support the recommendations of the reports described above.

NE's programmatic activities are also subject to periodic external reviews by Congress, GAO, the Department's IG, NRC, the U.S. Environmental Protection Agency, state environmental and health agencies, and the Department's Office of Engineering and Construction Management. In addition, NE solicits the advice and counsel of external agencies such as Nuclear Energy Advisory Committee and National Academy of the Sciences. The following are some examples of external validation and verification activities.

Nuclear Energy Advisory Committee

The Department obtains advice on the direction of its programs from NEAC. An independent formal Federal advisory committee, NEAC provides expert advice on long-range plans, priorities, and strategies for the nuclear technology R&D and research infrastructure activities of NE.

In November 2008, NEAC published *Nuclear Energy: Policies and Technology for the 21st Century*, which calls attention to the role of nuclear power and its impact on energy security, the environment, and non-proliferation. The report recognizes the integral role that the Department of Energy has played and will continue to play in securing safe nuclear power for our Nation, including a very important and fundamental role in advancing the technology. The report also emphasizes that a global approach is vital to ensure a sustained U.S. nuclear program at home and international leadership abroad. Finally, it recognizes the importance of strengthening multilateral institutions such as the International Atomic Energy Agency (IAEA), which recently completed its 20/20 Commission Report that identified a strategy for the strengthening of the non-proliferation agenda and nuclear energy development in an era of international nuclear expansion.

NEAC has several active subcommittees examining various aspects of nuclear technology R&D. Additional reports issued by these subcommittees that address the future of nuclear energy include: "Long-Term Nuclear Technology Research and Development Plan," "Nuclear Science and Technology Infrastructure Roadmap,""A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010," "A Technology Roadmap for Generation IV Nuclear Energy Systems," "Report of the Subcommittee on Nuclear Laboratory Requirements," and "An Evaluation of the Proliferation Resistant Characteristics of Light Water Reactor Fuel with the Potential for Recycle in the United States."

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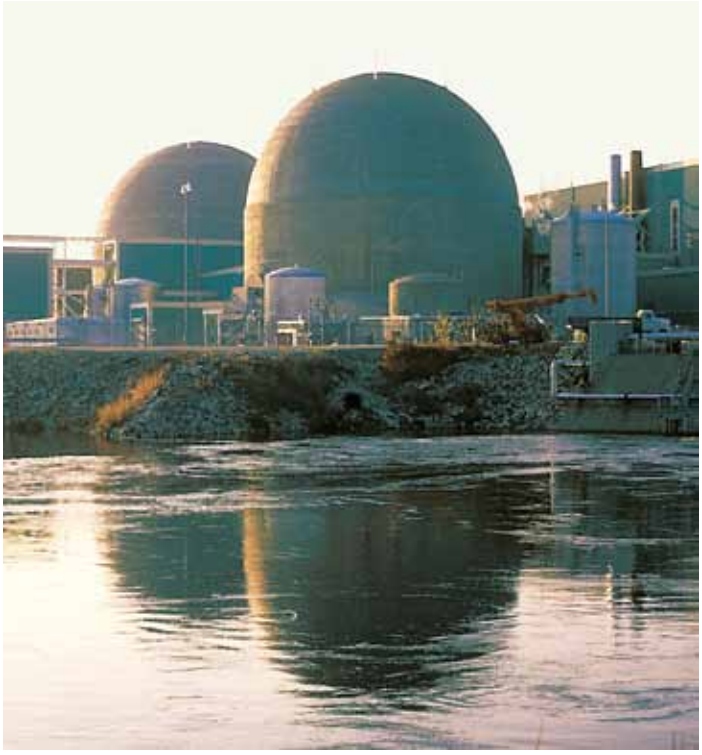

National Academy of Sciences

In April 2008, the National Academy of Sciences published its final report on NE R&D and Infrastructure program goals and plans. The evaluation resulted in a detailed set of policy and research recommendations and associated priorities for an integrated agenda of research activities supporting the long-term commercial energy option to provide diversity in energy supply. NE is continuing to review the report findings and is working to develop a viable strategy for implementing the committee's recommendations.

Government Accountability Office

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

In April 2008, GAO completed a comprehensive audit of NE's Global Nuclear Energy Partnership (GNEP) activities. The report recommended that additional R&D on advanced fuel cycle technologies should proceed prior to either an engineering or commercial scale demonstration of a used fuel recycling facility. The program will revise its schedule to ensure proper alignment of development and deployment activities, and to work with industry to the extent possible.

Future use of nuclear energy is vital to meet U.S. needs for carbon-free, dependable, and economical electric power.

List of Acronyms

Acronym	Definition
AFCI	Advanced Fuel Cycle Initiative
ASRG	Advanced Stirling Radioisotope Generator
ATR	Advanced Test Reactor
CD	Critical Decision
COL	Construction and Operating License
DAS	Deputy Assistant Secretary
DBT	Design Basis Threat (referring to security)
DOE	U.S. Department of Energy
EPAct	Energy Policy Act of 2005
EPRI	Electric Power Research Institute
EVMS	Earned Value Management System
FPD	Federal Project Director
FY	Fiscal Year
GAO	Government Accountability Office
Gen IV	Generation IV Nuclear Energy Systems Initiative
GIF	Generation IV International Forum
GNEP	Global Nuclear Energy Partnership
GSP	Graded Security Protection
GWe	Gigawatts (electric)
HLW	High Level Waste
IAEA	International Atomic Energy Agency
ID	Idaho Operations Office
IFM	Idaho Facilities Management
IG	Office of the Inspector General, U.S. Department of Energy
INL	Idaho National Laboratory

Acronym	Definition
NASA	National Aeronautics and Space Administration
NE	Office of Nuclear Energy
NEAC	Nuclear Energy Advisory Committee
NGNP	Next Generation Nuclear Plant
NHI	Nuclear Hydrogen Initiative
NIST	National Institute of Standards and Technology
NP 2010	Nuclear Power 2010
NRC	Nuclear Regulatory Commission
NSUF	National Scientific User Facility
OMB	Office of Management and Budget
PART	Program Assessment Rating Tool
PCSP	Program Cyber Security Plan
PEMP	Performance Evaluation Management Plan
PMCDP	Project Management Career Development Program
R&D	Research and Development
RFA	Request for Application
RFP	Request for Proposals
RPA	Request for Pre-Application
RPS	Radioisotope Power Systems
SER	Safety Evaluation Report

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