Department of Energy Laboratory Plans

FY 2007-FY 2011

March 1, 2006

Background

The Department of Energy's (DOE) laboratories were created as a means to an end; victory in World War II and national security in the face of the new atomic age. Since that time, they have consistently responded to national priorities; first for national defense, but also in the space race and more recently in the search for new sources of energy, new energy-efficient materials, and new methods for countering terrorism domestically and abroad.

The Department manages 16 Federal Funded Research Development Centers (FFRDCs) that have been justifiably referred to as among the "crown jewels" of the U.S. scientific enterprise. These FFRDCs are commonly referred to as national laboratories and have been a major national success story, contributing scientific advances in nuclear energy, nuclear medicine, advanced computation, genomics, materials science, chemistry, physics, and other areas that have resulted in numerous Nobel Prizes and thousands of industrial patents since DOE's inception in 1977. No other organization in the world builds, operates and manages such a diverse array of technical talent and large-scale scientific instruments.

Managing the national laboratories and ensuring that they achieve critical DOE and national objectives is a complex undertaking. Effective laboratory management is essential for DOE to achieve its critical missions in national security, environmental restoration, energy security, and scientific discovery.

The Department's Federal Program Managers determine which scientific and technological programs the national laboratories should be pursuing and closely evaluate their progress toward mission accomplishment. Decisions associated with activities at the National Laboratories reflect the following key management principles that DOE follows:

- Federal Direction of Program Goals: Program goals for the national laboratories are established by DOE Federal program managers. In recent years steps have been taken to ensure that Federal oversight is clearly articulated and managed.

- Competition for Resources: DOE's national laboratory complex is run as a competitive system, with each laboratory vying for scarce Federal resources. Competition leads to the cancellation of poorly performing programs and the start of major new initiatives.

- Federal Oversight of Laboratory Performance: Peer review, annual laboratory appraisals, and other mechanisms are utilized by DOE Federal program managers to monitor laboratory progress being made toward DOE and national goals. Each national laboratory agrees to clear performance goals that are codified in a contract that is evaluated on an annual basis by Federal program managers.

Laboratory Plan Development

The House Committee on Appropriations report for the FY 2006 Energy and Water Development Appropriations Bill (HR-109-86) directed the Department to produce five-year budget plans for major individual programs and an integrated five-year budget plan for the Department. In addition to preparing the five-year plans, the Department was challenged to develop business plans for each of the national laboratories that describe the mission(s), activities and future vision for each lab:

> *"Essential to producing five-year budget plans for the major programs and for the entire Department is the need to define the missions and activities, and therefore the future budget requirements, of the various national laboratories. The five-year plans prepared by the major program offices and the comprehensive five year plan for the Department should reflect the business plans for each of the Department's laboratories."*

The attached laboratory plans are designed as a supplement to the DOE five-year plan. The DOE's laboratory plans are presented in two distinct sections: 1) The Office of Science's 10 laboratory portfolio, and 2) The 5 remaining major Program Office controlled laboratories (e.g., NNSA, EM).

Given the corporate structure of the Office of Science's 10 laboratories, their plans use a more detailed format than the remaining 5 laboratory plans which are designed specifically to address the requested data outlined in the House Committee on Appropriations report. The Office of Science plans include sections addressing common challenges faced by all of Science's laboratories such as the condition of key laboratory facilities, human resource diversity, and project risk.

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OFFICE OF SCIENCE LABORATORY BUSINESS PLANS

Introduction

The House Committee on Appropriations report for the FY 2006 Energy and Water Development Appropriations Bill (HR-109-86) directed the Department of Energy to produce five-year budget plans for major individual programs and an integrated five-year budget plan for the Department. In preparing these Five-Year Plans, the DOE was challenged to develop and draw from business plans for each of the national laboratories:

> *"Essential to producing five-year budget plans for the major programs and for the entire Department is the need to define the missions and activities, and therefore the future budget requirements, of the various national laboratories. The five-year plans prepared by the major program offices and the comprehensive five year plan for the Department should reflect the business plans for each of the Department's laboratories. These business plans, to be submitted concurrent with the fiscal year 2007 budget submission, shall include a clear statement of the primary mission of each laboratory as such mission relates to each lab's lead program office(s), a clear statement of secondary missions to support other DOE program offices and other Federal agencies, and a five-year plan identifying the research, facilities, and resource requirements necessary to fulfill these primary and secondary missions. The laboratory business plans shall also include a longer-range vision statement to define where these laboratories are headed beyond the five-year budget horizon."*

Accordingly, the Office of Science initiated a year-long effort to develop Business Plans for the Office of Science national laboratories. The results of that effort are summarized in this document.

Laboratory Management and Oversight

It is the Department's challenge and responsibility to manage its laboratories to ensure focus on the Department's missions and to maintain sufficient competition to keep the laboratories scientifically "sharp," while avoiding costly duplication of effort and restraining operating costs. This document reflects part of the Department's effort to do just that.

In the summer of 2004, the Director of the Office of Science held a series of institutional reviews of each of the SC laboratories to understand the long-term scientific future, individually and collectively, of its ten national laboratories. The reviews focused on determining the distinguishing capabilities and the major challenges, both scientific and institutional, facing each laboratory. They also emphasized the Director's expectation that each laboratory be world-class in its primary business lines, and work synergistically with other laboratories in its secondary business lines. The results of these meetings are summarized in the laboratory business plans contained in this document.

Overall, this process delivered several advantages to the Department that we hope convey, in part, to the readers of these plans. First, we believe that the highly descriptive mission perspectives provide meaningful insights that aren't often found with glossy, one-line mission statements. It was our goal to bring to the fore a perspective on the distinct value-added provided by each laboratory. A combination of the Mission and Overview section, the Focus and Vision section, and the Business Line matrices all contribute to our composite perspective on what each lab brings to the table now and what they would like to bring in the future. Second, the planning process was an engaging opportunity to work across the stovepipes within DOE and to share views about our visions for where each laboratory could be headed without regard to resource constraints. We hope this corporate perspective and "one-stop-shop" resource will prove valuable to the Congress and other stakeholders.

The tables below illustrate how the Office of Science laboratories contribute to the Department of Energy's major programmatic missions organized around major strategic emphases for the DOE.

The Administration determines the details of its appropriations request one year at a time. Each year, the Administration works to develop the detailed estimates for the budget year for individual programs. Then, right before the Budget is printed, OMB's computer generates amounts for the outyears (FY 2008-2011) by account that hit overall targets for defense, homeland security, and non-security spending, so that the Administration can calculate the deficit path. These mechanistic, computer-generated account data for the outyears do not represent the President's proposed levels for these individual agencies, accounts, or programs. The FY 2008 and subsequent year's requests will be made in the future. As a result, the outyear numbers represent placeholders, pending decisions in future years.

DOE Strategic Themes DOE Goals SC Strategic Programs	Multifunction Laboratories ANL	 BNL	 LBNL	 ORNL	 PNNL
Energy Security					
Energy Diversity	- Nuclear Fuel Cycle & Reactor Design	- Nuclear reactor licensing and regulation - Collect, evaluate, and disseminate nuclear physics data (Nuclear Data Center)	- Characterize and engineer chemical synthesis processes; - Carbon sequestration science & technology	- Materials, fuels, and instrumentation for nuclear power	- Bio-based products and fuels - Solid Oxide Fuel Cells - Hydrogen storage and safety
Environmental Impacts		- Significant capabilities in aerosol research	- Characterize and engineer chemical synthesis processes - Measure and model global environmental change		
Energy Infrastructure			- Electricity transmission technologies	- Electric transmission and grid control technologies	- Power grid technology
Energy Use	- Transportation Science		- Efficient commercial building system designs; - Electricity transmission technologies	- Energy-efficient industrial and buildings technologies - High-efficiency, low-emission transportation technologies	
National Nuclear Security					
Nuclear Deterrent	- Infrastructure Assurance				
Weapons of Mass Destruction Control	- Nuclear Risk Mitigation - Bioagent Detection			- Safeguarding materials - Detecting illicit production of nuclear materials - Radiological dispersal devices (for DHS)	- Radiation detection - Radioanalytical chemistry & radiochemical processing - Visual analytics - Critical infrastructure simulation & cyber security
Science					
Scientific Discovery					
Basic Energy Sciences	- Biological and Inorganic Materials Synthesis & Characterization - Hard X-ray Nanoscale Research	- Novel X-ray and Ultraviolet/Infrared techniques - Strongly correlated systems in materials research - Fuel cell nanoparticle synthesis and reactivity	- VUV, soft and intermediate x-ray probes for science and technology - Chemical dynamics, photoionization, and other atomic, molecular, and optical phenomena - Ultrafast photon sources - Advanced catalytic, electronic, superconducting, structural, and optical materials - Dynamic electron beam microcharacterization facilities	- Pulsed (SNS) and steady-state (HFIR) neutron beams for research and industrial development. - Next generation instrumentation - Understanding of the mechanisms that determine materials properties - Synthesis, characterization, and processing of alloys, ceramics, carbon-based/ electronic materials - Instruments for characterizing nanoscale materials	
Biological & Environmental Research	- Imaging - Structural Biology/Genomics: biomolecular structure determination - Bioinformatics	- Radiotracer development - PET/fMRI for translational neuroimaging focused on addiction - Significant capabilities in aerosol research - Structural biology: protein crystallography	- Microbial organisms and communities; - Genome sequencing; - Biogeochemical changes and remediation; - Molecular, cellular, and tissue models of disease; - New probes and imaging systems for diagnosis; - Low-dose radiation effects and DNA damage response - Structural biology at ALS	- Physical and computational methods for bioscience - Genomics and proteomics of microbes and plants - Field ecological, environmental, and subsurface research - Mouse genetics	- Environmental microbiology - Applied proteomics - Climate physics - Chemical physics & analytics - Computational Chemistry - High performance computing
Fusion Energy Sciences			- Heavy ion drivers for high energy density physics and inertial fusion	- Fusion materials - Plasma theory, simulation, and modeling - Advanced torus and stellarator concepts - Fusion technologies (RF and fueling systems) - Participation in national and international tokamak experiments	
Advanced Scientific Computing Research	- Advanced Architecture Research - Applied Modeling & Simulation - Computational Mathematics		- Scientific computing and connectivity - Mathematical tools and algorithms for science	- Provide unique, world-class scientific computing resources (NCCS) - Methods and tools for advanced architecture supercomputers - Early research in new technologies and architectures - Advanced science and engineering models	
High Energy Physics	- Superconducting RF Design - Synchrotron Radiation Sources - High energy physics experiments, accelerator R&D and theory	- Detector expertise in the calorimeter and muon systems (U.S. ATLAS detector for LHC) - Low noise electronics and innovative detectors for particles and photons	- Dark energy studies; - Particle physics (matter-antimatter symmetry, neutrinos)		
Nuclear Physics	- Nuclear structure and astrophysics with stable beams (ATLAS) - Laser trapping of individual atoms - Accelerator R&D for low velocity beams	- Relativistic heavy ion collisions - Proton spin studies with beams of polarized protons - Quantum Chromodynamics (QCD) theory - Accelerator design and R&D in advanced beam cooling techniques - National Archive for Nuclear Physics Data (NNDC) - High Performance Computing Effort in Lattice Quantum Chromodynamics (LQCD) - Advanced detector instrumentation and electronics	- Nuclear structure and astrophysics - Development of next-generation gamma ray instrumentation - Development of next-generation neutrino experiments - Accelerator R&D in electron cyclotron resonant ion sources - Development of heavy-ion experiments at the LHC'	- Nuclear structure and astrophysics with radioactive beams (HRIBF) - Neutron physics - Accelerator R&D in high power targets	
Foundations of Science	APS; Structural Biology Center; IPNS; ATLAS; High-Voltage Electron Microscopy Center; Cloud and Radiation Testbed; Engine Research Facility for diesels; Advanced Powertrain Test Facility for hybrid vehicles; Electrochemical Analysis and Diagnostics Laboratory; Center for Nanoscale Materials.	RHIC; NSLS; ATF; Center for Imaging and Neuroscience (CIN); Free Air Carbon Dioxide Enrichment (FACE) facility; Center for Functional Nanomaterials.	Advanced Light Source; NERSC; ESNet; Joint Genome Institute; 88-Inch Cyclotron; National Center for Electron Microscopy; Molecular Foundry.	SNS; Center for Nanophase Materials; HFIR; HRIBF; National Center for Computational Sciences (NCCS); Center for Comparative and Functional Genomics; High Temperature Materials Laboratory; Surface Modification and Characterization Research Center; Research Equipment Program; Oak Ridge National Environmental Research Park; Buildings Technology Center; Center for Structural Molecular Biology; National Transportation Research Center;	EMSL; life sciences laboratories; Process Science and Engineering Complex; Applied Process Engineering Laboratory.
Environmental Legacy					
Environmental Cleanup	- Transportation Science				- Biogeochemistry & subsurface science - Chemical process engineering - Atmospheric sciences & climate modeling - Marine sciences
Managing the Legacy					

DOE Strategic Themes / DOE Goals / SC Strategic Programs	Program Directed (single mission) Laboratories				
	Ames	FNAL	PPPL	SLAC	TJNAF
Energy Security					
Energy Diversity					
Environmental Impacts					
Energy Infrastructure					
Energy Use					
National Nuclear Security					
Nuclear Deterrent					
Weapons of Mass Destruction Control					
Science					
Scientific Discovery					
Basic Energy Sciences	- Novel optical materials - Materials preparation, synthesis and processing - Magnetic materials and correlated electron systems - Complex intermetallic compounds Catalytic materials - Electrochemically modulated liquid chromatography - Solid-state Nuclear Magnetic Resonance (NMR) for heterogeneous polymers			- Ultrafast X-ray science - Complex/correlated & magnetic materials science. - Molecular, environmental & interface science - Strong integration with outstanding research university (Stanford)	
Biological & Environmental Research				- Structural biology: multifunctional structural biology capability	
Fusion Energy Sciences			- Experimental research in all facets of physics of magnetized plasmas - Constructed and operated the only D-T experiment in the U.S. - Leaders in developing diagnostics, radio frequency and current drive heating systems - World leading spherical torus experiment - Unique world leading diagnostic tools - Unique compact stellarator experiment - Plasma theory, simulation and modeling - Basic plasma science and applications		
Advanced Scientific Computing Research					
High Energy Physics		- Subatomic Collider based Physics at Tevatron - Particle Astrophysics - World leading capabilities for neutrino research - Accelerator R&D - US Lattice Quantum ChromoDynamics (LQCD) collaboration		- CP violation in B mesons - precision Particle Physics at the electron energy frontier - non Accelerator tests of the Standard Cosmological Model through investigations of Dark Matter and Dark energy - Strong integration with outstanding research university (Stanford)	
Nuclear Physics					- Continuous beams of polarized high-energy electrons for studies of the quark structure of matter - Accelerator R&D in superconducting radiofrequency technology - High Performance Computing Effort in Lattice Quantum Chromodynamics (LQCD) - Advanced detector instrumentation - ERL-based Free Electron Laser
Foundations of Science	MPC, MRSH, Scalable Computing Lab	Tevatron; CDF; DZero; MiniBooNE; NuMI/MINOS.	NSTX; ITER participation; NCSX.	SLAC; B Factory; BaBar; PEP-II storage ring; SPEAR; LCLS.	CEBAF; CLAS; ARC; IFEL.
Environmental Legacy					
Environmental Cleanup	- Electrochemically modulated liquid chromatography - Solid-state Nuclear Magnetic Resonance (NMR) for heterogeneous polymers				
Managing the Legacy					

DOE Business Plan for the Office of Science's Ames Laboratory

Mission and Overview

The Ames Laboratory (Ames) was formally established in 1947 and became part of the Manhattan Project after developing the most efficient process to produce high-purity uranium metal in large quantities for atomic energy. Today Ames' mission focus of materials science, engineering, analytical instrumentation and chemical sciences provides expertise to the Department of Energy laboratory system in the areas of energy, environmental improvement. Ames operates the Materials Preparation Center (MPC) which provides capabilities in preparation, purification, fabrication and characterization of materials in support of R&D programs throughout the world. Ames also collaborates with the DOE's applied energy technology and nonproliferation programs and supports the National Institutes of Justice, National Institutes of Health, Department of Defense, FBI, and corporate entities. Since 1984 Ames Laboratory has received 15 R&D 100 awards from R&D Magazine, which selects the 100 most significant technical products and innovations each year. Over 2900 Masters and Ph.D. degrees in science and engineering have been awarded to Ames students since 1947.

Laboratory Focus and Vision

Five areas of core competency underpin activities at Ames Laboratory:

1. Materials design, synthesis and processing
2. Analytical instrumentation/device design/fabrication
3. Condensed matter theory (including photonic band gap and other novel materials)
4. Materials characterization, x-ray and neutron scattering, solid-state Nuclear Magnetic Resonance (NMR), spectroscopy/microscopy
5. Separation science.

The Office of Science believes that these five competencies will enable Ames to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the areas of:

- Fundamental materials research with emphasis in optical magnetic, intermetallic, and catalytic materials; and studies of the structure and properties of high temperature materials.
- Analytical techniques and instrument development.

Lab-at-a-Glance

Location: Ames, IA

Type: Single-program laboratory

Contract Operator: Iowa State University (ISU) of Science and Technology

Responsible Field Office: Ames Site Office

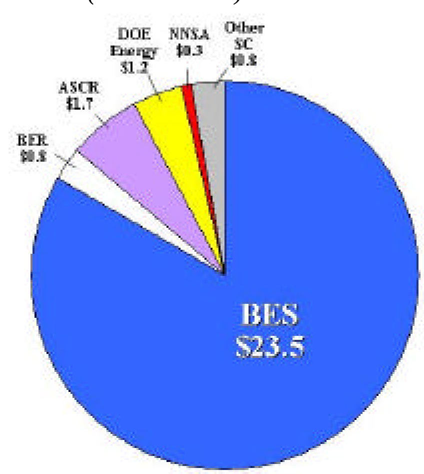
Website: http://www.Ameslab.gov/

Physical Assets:
- 12 buildings
- 10 acres (lease–long term, no cost)

Human Capital:
- 320 Full-time equivalent employees;
- 185 ISU grad/undergrad students
- 140 Facility users, visiting scientists, and associates

FY 2005 Total DOE Funding: $28.2M

FY 2005 DOE Funding by Source
PALS data (BA in Millions):



FY 2005 Non-DOE Funding: $3M

Business Lines

The following capabilities, aligned by business lines, distinguish Ames and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of Ames and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, identify research facilities that convey particular, strategic strengths and capabilities to the Lab. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Primary Business Line			
Fundamental Materials Research	• **Novel optical materials;** • **Materials preparation, synthesis and processing;** • **Magnetic materials and correlated electron systems;** • **Complex intermetallic compounds;** • **Catalytic materials;** • *Materials Preparation Center;* • *Materials Referral System and Hotline;* • *Scalable Computing Lab.*	Leader in photonic band gap materials and super lenses; Recognized world leader in rare earth and intermetallic compounds; Materials Preparation Center (MPC); Pioneering work on Environmentally-benign refrigeration and magnetic molecules; Leader in quasi-crystals; properties of complex materials; Pioneering work on novel structures; high-specificity reaction, controlled drug release.	Advance Basic Sciences for Energy Independence Synthesis and characterization of the next generation of materials for energy efficiency/storage, communications, and environmental stewardship.
Secondary Business Line			
Analytical Techniques and Instrument Development	• **Mass spectrometer techniques and instrument design;** • **Single-cell analyses;** • **Single-molecule analyses;** • **Electrochemically modulated liquid chromatography;** • **Surface-enhanced Raman scattering;** • **Solid-state Nuclear Magnetic Resonance (NMR) for heterogeneous polymers.**	Record of internationally recognized excellence: inductively-coupled plasma – mass spectrometer (ICP-MS) in every analytical lab in world; biomolecule analysis; Pioneering work in fundamentals of cellular physiology; disease diagnosis, treatment; Studying reactivity at single molecule level; Largest concentration of internationally acclaimed researchers focusing on greater precision in nanostructure analyses.	Provide the Resource Foundations that Enable Great Science Development of techniques for characterization of novel materials and rapid, sensitive detection of chemicals and biomaterials for applications ranging from bioremediation to national security.

Major Activities

Following is a set of major activities that Ames Lab would like to pursue to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. The Office of Science is examining all of these potential activities and they are at different stages of development. Some are currently underway and some are mere concepts at this time. For those that are still in the conceptual phase, Ames has indicated significant interest and is viewed to have current supporting research and mission focus to pursue such activities. Budgets, the Office of Science's strong commitment to a fair and competitive funding process and technical advice from its major scientific advisory committees will ultimately contribute to decisions about which activities can be pursued and at which sites. The companion documents, the DOE's Five Year Plans, provide greater insights into these activities in terms of various five-year budget scenarios.

The major activities are:

1. Bioinspired Materials
2. Materials Discovery, Synthesis and Processing
3. Distributed Electrostatic Levitation User Facility

1. Bioinspired Materials

- **Summary:** Synthesis and characterization of novel materials that mimic living systems.

  Expectations: Materials will be designed and synthesized that possess the ability to: switch among several states in response to the environment (pH, temperature); self-assemble and build complex structures hierarchically; and serve as directed templates for such synthetic processes as biomineralization/biometallization.

- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk*. This research area is quite new so there is a high degree of uncertainty.
  - Market/Competition: *Moderate risk*. It is too early to determine the market/competition risk, however, certainly development of self-assembling materials is widespread in the research community.
  - Management/Financial: *Moderate risk*. This will be a new direction for the Materials Chemistry Program. The Program is currently in a transitional period where some of the current research efforts must be phased out, as new bioinspired efforts are commenced.

Ames Laboratory management has decided to direct significant efforts and resources to the synthesis and characterization of novel materials that mimic living systems. These materials possess the ability to switch among several states in response to the environment and to self-assemble into complex structures. Ames believes that the rational design of such self-assembling systems will become a very significant part of materials science. A current project that demonstrates the power of this approach is to process the self-assembled polymers with other self-assembling components, in this case mineralization proteins, for the synthesis of a very interesting class of materials, nanomagnets. Over the next several years, Ames expects to build and strengthen this overall program in support of the DOE mission and in keeping with the future vision for the laboratory. This building process will involve creating teams of bioengineers, theorists, synthetic chemists, biologists and experts in chemical characterization, and will require the combined scientific strengths of the Lab and its contractor and collaborator, Iowa State University.

2. Materials Discovery, Synthesis and Processing (MDSP)

- **Summary:** Comprehensive enhancement of facilities and collaborations in materials discovery, synthesis and processing to maintain U.S. world leadership.
- **Expectations:** Enhancing facilities, staff and external collaborations to train the next generation of materials scientists in MDSP.
- **Benefit Perspective:** Potentially *Substantial/Sustaining* benefits
- **Risk Perspectives:**
  - Technical: *Low risk*. The Ames Laboratory Materials Preparation Center is known worldwide for providing high purity materials for research. In addition, Ames arguably has two of the very best "crystal-growing groups" in the world.
  - Market/Competition: *High risk*. Competition in the area is strong worldwide.
  - Management/Financial: *Low risk*. Ames Laboratory already has the management in place, the scientists on hand, and the university nearby to accomplish the goals of the activity. Also, the desired additional investment from DOE is relatively small.

Late in 2003, the DOE's Basic Energy Sciences program sponsored a national workshop, held in Ames, Iowa, to discuss the declining dominance of the U.S. effort in design, discovery and growth of novel materials for basic research relative to the competition, specifically Europe and Japan. The conclusion was that DOE should act quickly to strengthen the Nation's efforts in this arena "by adding qualitatively new capabilities, and by significantly enhancing Ph.D. and postdoctoral training opportunities. . . ." Ames Laboratory has the physical and intellectual infrastructure to lead in this DOE materials effort. For example, the strong connection between Ames and its contractor, Iowa State University, positions the Lab to enhance Ph.D. and postdoctoral training. A relatively modest increase in funding for this activity will enable the Lab to establish new outreach programs and collaborations with universities, laboratories and industry across the country and to increase staffing and add new research programs in the relevant areas at Ames. Without this and similar activities elsewhere in the laboratory complex, the Nation is unlikely to remain a world leader in materials research, giving way to Germany and Japan which see considerable strategic advantage to strong materials programs and are investing great resources into world-class programs at this time.

3. Distributed Electrostatic Levitation (ESL) User Facility

- **Summary:** Implement a new concept in user facilities for fundamental investigations of intrinsic materials properties and structures at high temperatures.
- **Expectations:** A unique facility for pioneering studies of solids and liquids at high temperatures. The benefits of

this research could be transformational since the efforts will be focused on exploration of materials properties under conditions that are currently inaccessible.

- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk.* The technology has been used by Ames in the past, but access to the NASA ESL has been limited.
  - Market/Competition: *High risk.* Currently, Japan has built an ESL facility and Germany is in the process of building one.
  - Management/Financial: *Moderate risk.* A risk and also a benefit exists from the standpoint that two of these devices will be located at other national laboratories. From a financial standpoint this activity is too large for current Ames funding to be redirected.

This facility enables an important new class of investigations of the high temperature structure and properties of materials by removing the constraints of containment in vessels. Recent advances in electrostatic levitation (ESL) have made this possible, but unfortunately the only two ESL units in the U.S. are not available to the growing list of potential users. This activity involves establishing an ESL User Facility in the Ames Materials Preparation Center, coupled with ESL facilities designed for high-energy x-ray scattering measurements at the Advanced Photon Source and neutron scattering measurements at the Spallation Neutron Source. Together, the proposed facilities will provide a powerful complement of tools for fundamental studies, the discovery of new metastable phases, and advanced materials manufacturing methods. The facility would be unique in the world and would bolster U.S. dominance in the study of high temperature structure and properties of materials. Ames would serve as the operational base for these facilities with partners at major research universities, industry, other national laboratories and private foundations being actively sought to share in the cost.

Financial Outlook

Detailed information regarding the financial outlook for the Ames Laboratory is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors can not be predicted or estimated in advance. The third, programmatic decisions are developed in accordance with the planning targets reflected in the Department of Energy programmatic Five Year Plans, a companion document to these strategic laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

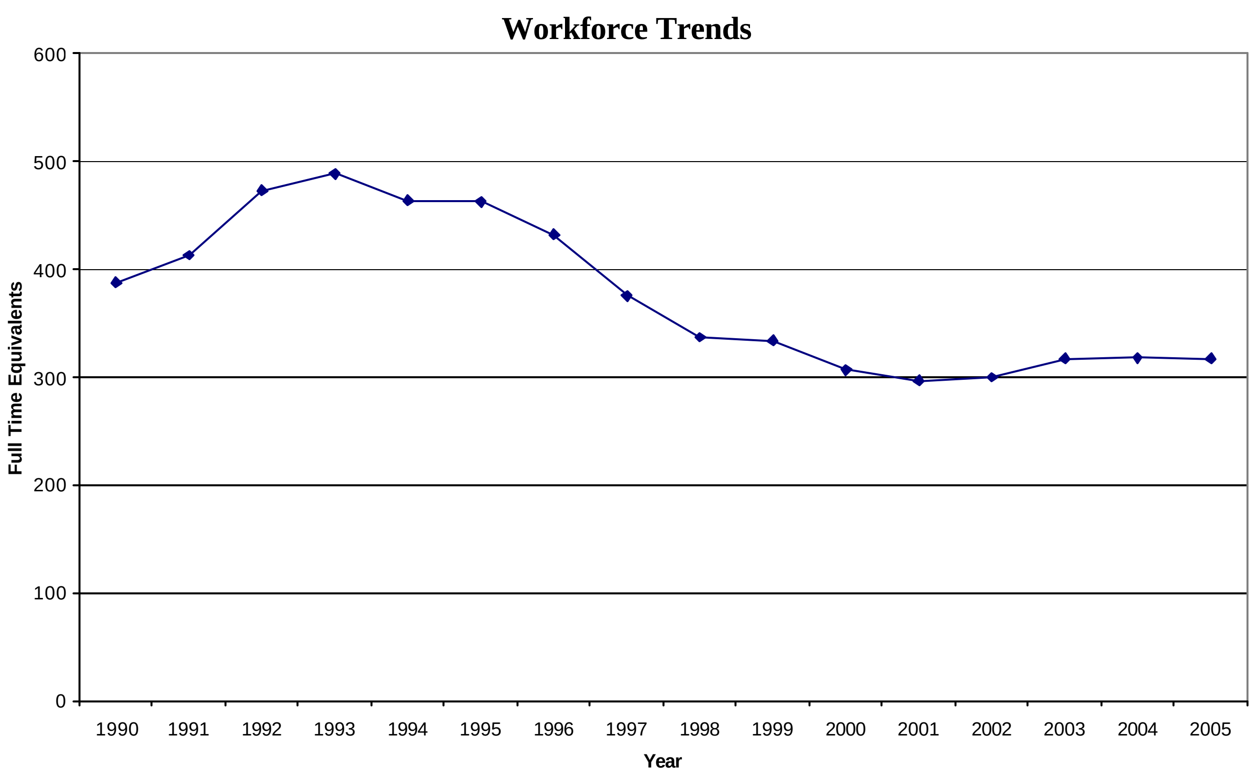
Support for Non-DOE funded work is a vital role our national laboratories, contributing to national security, energy security, environment stewardship, scientific discovery, and more fundamentally, the competitiveness of the U.S. economy. For Ames, this is no exception. The Office of Science is supportive of this work and although it is not addressed in any detail within the accompanying Five Year Plans, the Office of Science believes it is sufficiently important and appropriate to address within this strategic laboratory business plan. A brief perspective and financial outlook is therefore provided.

The current Ames non-DOE funded activities are primarily supported by the National Institute of Justice and the Department of Defense. The primary National Institute of Justice work is for the operation of the Midwest Forensic Resource Center, a center for advanced research and development in forensic science, whose goals are: to advance innovative technology and management practices in crime laboratories; to provide access to university and laboratory resources for use in casework; and to be a focal point for innovative training and education. Major projects for the Department of Defense include preparation and atomization for powder alloys, preparation and characterization of various alloys, and the development of research systems and software tools for virtual engineering. These two federal sponsors are expected to continue to fund projects at current levels. In addition to these sponsors, Ames has non-DOE funded work with various industrial partners, with activities ranging from designing low temperature rare earth-based magnetic regenerator materials to sharing the operational costs of the Midwest Universities Collaborative Access Team (MUCAT) sector at the Advanced Photon Source. Such industrially funded activities are also expected to continue at the current levels.

Uncertainties and Risk Management

External Factors: The critical risk facing Ames is one of stable funding and subsequent impacts on the workforce. An important source of risk mitigation for Ames is the relationship with its contractor, Iowa State University. Many of the scientists, researchers and administrators at the Lab hold joint faculty or managerial positions at the University and the Lab has access to both undergraduate and graduate student talent. The ability of the University to include the Lab in its pursuit of top faculty and the Lab to include the University in its pursuit of new scientists helps attract key personnel. The Lab also shares the following with its Contractor: employee benefits and services; environment, safety and health support; research support; operations support; and administrative support. An additional source of long-term support for Ames is its wide-ranging scientific interactions. Ames effectively partners with researchers at other DOE laboratories and facilities, including the Ames MPC, collaboration in interlaboratory SciDAC projects, collaborations with Sandia, Argonne, Lawrence Berkeley, and Lawrence Livermore National Laboratories. There are also collaborations involving industry, non-DOE labs and other government agencies. Notably, Ames is successful in terms of licensing revenue per funding dollar, and it ranks third among the DOE national laboratories in total licensing despite its small size. No key community relations issues face the Ames Laboratory.

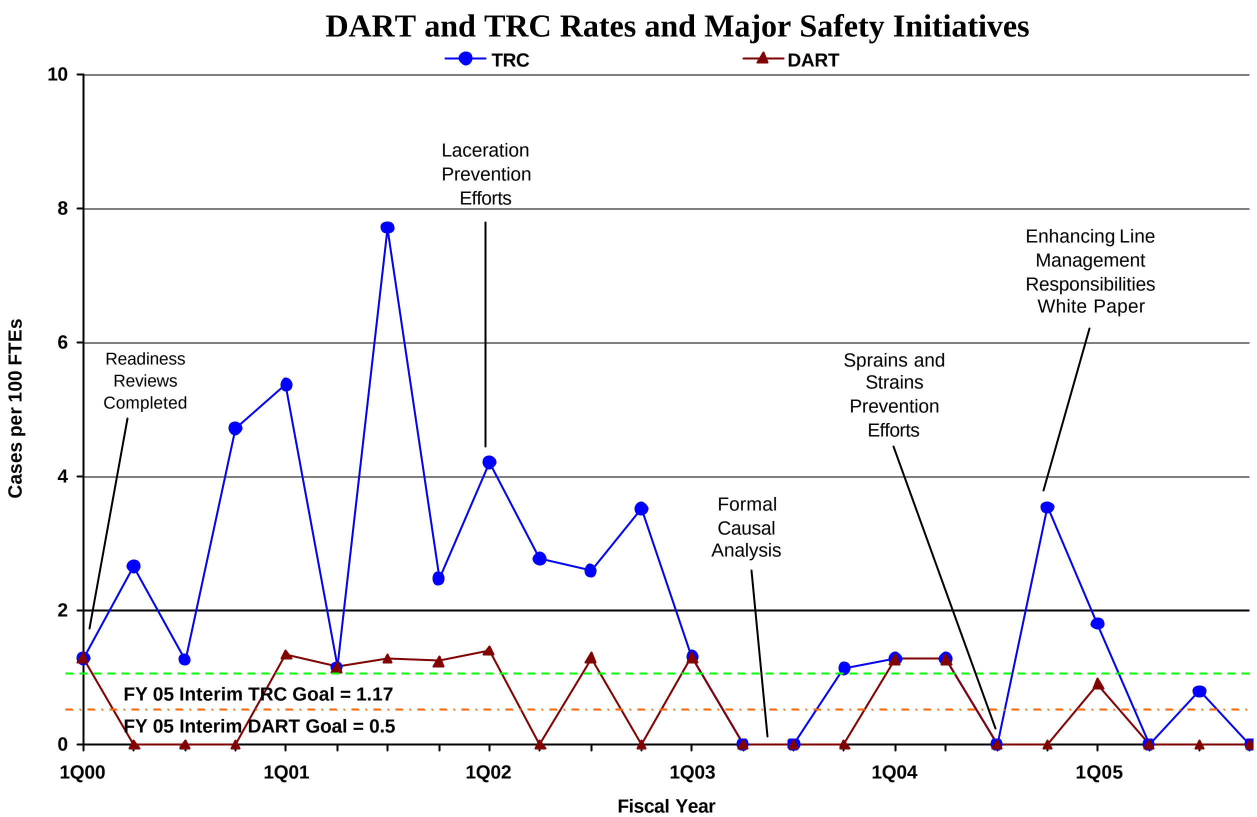
S&T Workforce: The workforce for Ames Laboratory, in recent years, has remained relatively stable from year to year and a major reduction in force or other downsizing over the next five years is not anticipated. Any reductions that will need to be made will likely come from attrition. The projected levels of full time equivalent employees (both direct-funded research FTEs and total FTEs), over the next five years, vary based upon the funding scenarios used to establish this business plan.



Employee Diversity: Because of its location, attracting minorities to Iowa has proven to be very challenging, especially in attracting those with the scientific and technical skills needed at a laboratory such as Ames. In addition, women and minority scientists are in great demand across the country, with competition coming from other laboratories, from universities, and from industry. To improve the minority prospects, the Ames contacts a series of minority and women professional societies and universities when key openings occur.

In the long run, the Ames laboratory firmly believes that engaging youth in science and engineering at an early age and keeping them engaged through their college degree is the best means to provide the next generation of scientists. The laboratory is providing internships through the Student Undergraduate Laboratory Internships that strongly encourages applications from minority and women students. In addition, the laboratory and Iowa State University support Science Bound, a program to engage minority children in science and math in the Des Moines, Iowa, Public Schools. The hope is that these children will go on to pursue careers in science and engineering and become the next generation of scientists for the National Laboratories and Universities, with many choosing Ames as their place of work.

Safety: AMES safety performance has improved over the past ten years and is on-target to meet or surpass current goals. The FY2004 Total Recordable Case (TRC) rate was 1.54 (5 cases) and the Days Away, Restricted or Transferred (DART) rate was 0.62 (2 cases). The estimated FY2005 TRC rate is 0.65 (3 cases) and the DART rate is 0.22 (1 case). The Laboratory's programs of employee training, readiness review, periodic walkthroughs, formal event investigations, and targeted injury prevention efforts have improved safety performance. The continued demonstration of upper management's commitment to safety, in addition to a comprehensive Integrated Safety and Environmental Management System based on sound safety practices and mechanisms, has become the way Ames does business. Ames expects continued improvement in safety performance.



Physical Infrastructure: Ames Laboratory consists of 12 buildings (327,000 square feet (sf)) operating on the campus of the Iowa State University (ISU) in Ames, Iowa. Embedded in the University campus allows the Laboratory to benefit from many utility services provided by ISU, such as steam, chilled water, water treatment, sewage system, landscaping, fire department, electrical and telecommunication systems, and roads without the need for Federal investment to construct, maintain, or recapitalize. The availability of these services allows the Laboratory to focus on maintaining and operating its research and support buildings. The relationship with ISU also enables the Laboratory to use space in University–owned buildings through a space usage agreement without investing in permanent space or long-term leases. Ames's Asset Utilization Index (AUI) is 0.992 (excellent).

Maintenance, recapitalization, and modernization are supported with overhead, operating, and General Plant Project (GPP) funds (projects which cost less than $5M). Ames will attain a maintenance investment level of 1.9% of replacement plant value (excellent) in FY 2006, which will be continued in FY 2007 and the outyears. Ames's deferred maintenance backlog is $1.5M, resulting in an Asset Condition Index (ACI) of 0.97 (good). The few remaining excess facilities will be cleaned and/or removed by the end of FY 2006. The GPP FY 2007 funding request is for $580,000.

DOE Business Plan for the Office of Science's Argonne National Laboratory

Mission and Overview

Argonne National Laboratory (ANL) was founded in 1946 and traces its scientific legacy directly to nuclear physics research teams led by Nobel Laureate Enrico Fermi. ANL was largely responsible for the science behind the emergence of the U.S. nuclear power industry and today has transformed itself into a multipurpose laboratory with a mission focus and deep capabilities in basic and applied materials, chemical science, energy technologies and analysis, high-performance computation, physics, and biosciences. ANL also leads research in other scientific areas of importance to the Department of Energy such as the environmental and national security. ANL has retained strong capabilities in the design, construction and management of major scientific facilities. As a DOE steward of critical national research infrastructure, the laboratory provides access to university, industry and government researchers on a competitive basis. These research facilities include the Advanced Photon Source (APS), which provides x-ray beams for research ranging from materials to structural biology; the Intense Pulsed Neutron Source (IPNS), which has achieved many "firsts" in the field of neutron scattering; the Center for Nanoscale Materials (CNM), which focuses on exploring the nanoscale physics and chemistry of nontraditional electronic materials; and the Argonne Tandem-Linac Accelerator System (ATLAS), a superconducting linear accelerator for heavy atoms. The ANL user community now includes over 3,500 scientists and engineers.

Lab-at-a-Glance

Location: Argonne, IL

Type: Multi-program lab

Contract Operator: University of Chicago

Responsible Site Office: Argonne Site Office (Bob Wunderlich)

Website: **http://www.anl.gov/**

Physical Assets:

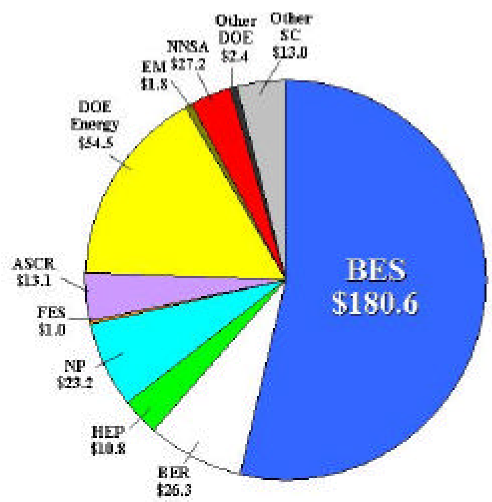
- 4.8M square feet of facilities; 100 buildings
- 1,500 acres

Human Capital:

- 2635 employees
- 600 Students (Undergraduate and Graduate);
- 3500 Facility Users and Visiting Scientists

FY 2005 Total DOE Funding: $353.9M

FY 2005 DOE Funding by Source
PALS data (BA in Millions):



FY 2005 Non-DOE Funding: $138M

Laboratory Focus and Vision

Six core competencies underpin activities at ANL:

1. Materials science, nanoscience, chemistry, and structural biology.
2. Synchrotron radiation science and technology for the study of materials of all kinds.
3. Energy related research, including transportation science and engineering, and nuclear fuel cycle and reactor design.
4. Integration of modeling, fundamental science, engineering and economic expertise for energy and environmental issues.
5. Advanced software tools, massively parallel computer architectures and large-scale computational sciences.
6. Fundamental nuclear physics tied to cosmology and the

origins of the elements.

The Office of Science believes that these six competencies will enable ANL to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the areas of:

- Pursuing the limits of high spatial and temporal resolution for materials research at the nanoscale.
- Capturing the frontiers of low-energy nuclear physics, particularly for the study of rare and unstable isotopes.
- Integrating materials science, computational science and other sciences to create a sustainable and secure energy future.
- Creating the world's leading core accelerator technology development capability.
- Advancing computational science (architectures and applications) to tackle national R&D challenges requiring petascale capabilities.
- Developing nano-bio capabilities to dramatically increase chemical energy conversion.

Business Lines

The following capabilities, aligned by business lines, distinguish ANL and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of ANL and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, identify research facilities that convey particular, strategic strengths and capabilities to the Lab. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Primary Business Lines			
Materials Science	· **Biological & Inorganic Materials Synthesis & Characterization;** · **Hard X-ray Nanoscale Research;** · ***Advanced Photon Source;*** · ***Center for Nanoscale Materials;*** · ***Electron Microscopy center;*** · ***Intense Pulsed Neutron Source.***	International leader; most highly cited papers in materials science; Unrivalled co-location of photon, neutron, electron, and ion based materials analysis facilities; High caliber staff as indicated by 2003 Nobel Prize in Physics.	Understand materials structure for energy, health and national security applications; Lead portions of the nanoscale revolution.
Mathematics & Computer Sciences	· **Advanced Architecture Research** · **Applied Modeling & Simulation** · **Computational Mathematics**	Leader in fundamental architecture for massively parallel computer systems; DOE top 10 scientific achievement for large-scale massively parallel optimization; Partner with ORNL to establish leadership class computing for open scientific research.	Providing computational tools to advance the forefront of science.
Advanced Biosciences	· **Imaging**	Top 3 world-wide in production & characterization of protein structures	Increase bio-defense capabilities, develop new

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
	· **Structural Biology/Genomics: biomolecular structure determination** · **Bioinformatics** · ***Structural Biology Center***	Unique capabilities based on the APS, IPNS, and protein crystallization center	energy sources and environmental technologies, and advance medical sciences.
Fundamental Physics	· **Nuclear structure and astrophysics with stable beams;** · **Laser trapping of individual atoms;** · **High energy physics experiments and theory;** · ***Argonne Tandem-Linac Accelerator System***	World leader; experimental & theoretical nuclear physics Most highly cited nuclear theory paper of past decade Worldwide roles in CDF and ATLAS experiments	Understand fundamental matter and forces and master connections between high energy & nuclear physics, astrophysics & cosmology.
Energy & Environmental S&T	· **Nuclear Fuel Cycle & Reactor Design;** · **Transportation Science;** · **Integration of Economics, Computing, Engineering and Sciences;** · ***Cloud and radiation testbed;*** · ***Engine Research Facility for Diesels;*** · ***Advanced Powertrain Test Facility for Hybrid-vehicles;*** · *Electrochemical Analysis and Diagnostics Laboratory.*	International leadership in fuel cycle & reactor technologies as evidenced by CEA & JNC partnership. World leader; vehicle testing confirmed by Toyota, Hyundai, GM, Ford, others. World's most widely used greenhouse gas and total fuel cycle model (GREET). Shared leadership of Atmospheric Radiation Measurement User Facility with ORNL and PNNL. Internationally recognized expertise in environmental assessment as evidenced by Alaska Pipeline EIS.	Support next generation nuclear reactor design efforts. Advance integrated approaches to energy & environmental challenges. Advance the frontiers of large-scale, systems-level-modeling and simulations as applied to energy and environmental technologies
Secondary Business Lines			
Accelerator Design	· **Accelerator R&D for low velocity beams** · **Superconducting RF Design** · **Synchrotron Radiation Sources**	World's first superconducting ion accelerator. New classes and performance standards for RF cavities World-leading development of synchrotron operations	Maintain DOE lead in accelerator design, construction and operations.
National Security	· **Infrastructure Assurance** · **Nuclear Risk Mitigation** · **Bioagent Detection**	National leader in energy infrastructure risk mitigation National leader in detection and deterrence of radioactive threats National leader in bio-micro-arrays for agent detection	Reduce homeland security threats.

Major Activities

Following is a set of major activities that ANL would like to pursue to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. The Office of Science is examining all of these potential activities and they are at different stages of development. Some are currently underway and some are mere concepts at this time. For those that are still in the conceptual phase, ANL has indicated significant interest and is viewed to have current supporting research and mission focus to pursue such activities. Budgets, the Office of Science's strong commitment to a fair and competitive funding process and technical advice from its major scientific advisory committees will ultimately contribute to decisions about which activities can be pursued and at which sites. The companion documents, the DOE's Five Year Plans, provide greater insights into these activities in terms of various five-year budget scenarios.

The major activities are:

1. Advanced Photon Source (APS) Optimization & Upgrade
2. Integrated Energy, Environment & Economic Research
3. A Next Generation Facility for Nuclear Structure and Astrophysics
4. Petascale Computing

<u>1. APS Optimization & Upgrade</u>

- **Summary:** Create the capability to see nanostructures in real time and in real environments and deliver unprecedented one picosecond time resolution x-ray pulses through major upgrades to the APS accelerator.
- **Expectations:** The unique characteristics of an optimized APS will open up new frontiers of scientific discovery and investigation, and enable exploration of: complex chemical and biological reactions in real time; orders of magnitude capacity improvements for materials studies; and *in-situ* studies of self-assembling nanoscale semiconducting materials.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* because technical issues are addressed within planned contingency,
  - Market/Competition: *Low risk* given the large user community. The upgrade will be necessary to keep the APS among the best of the hard x-ray facilities, and ensure that its performance and scientific output continue to be ground-breaking.
  - Management/Financial: *Low risk* given incremental nature of funding.

The APS has delivered a return on the investment during its past ten years of operation serving approximately 3,000 users per year who conduct leading edge experiments that have made lasting contributions to the U.S. economy and social well-being. Ensuring that the APS remains at the forefront of scientific discovery over the next two decades will draw upon ANL's competencies in synchrotron radiation sources and will build upon the capabilities of the new Center for Nanoscale Materials, which is utilizes the APS's x-ray sources as a primary tool. The APS upgrade will replace and upgrade major components to the accelerator to further increase performance in the hard x-ray region of the spectrum.

ANL's optimization plan enhances DOE's potential to dramatically impact energy source diversity, efficiency, sustainability and security goals. For example in materials research, the APS upgrade addresses the need to observe unique *in-situ* pictures of controlled self-assembly of new nanomaterials under real conditions, and to study the critical failure modes of these and other lightweight materials so necessary to improve transportation energy efficiency. This is created by providing access to one picosecond x-ray pulses as well as high flux pulses in nano-focused spots at high energies. This will create capabilities for imaging and inelastic, high energy and time-resolved x-ray scattering, which will be an order of magnitude greater than any other existing or planned machine in the world. This upgrade will also fill the gap in time resolution between new ~3 GeV storage rings being constructed and FELs offering a unique combination of flux and time resolution for hard x-rays.

2. Integrated Energy, Environment & Economic Research

- **Summary:** Combine ANL's expertise in decision science, computational, fundamental and applied research with social/economic science capabilities to develop a suite of products and tools that advance DOE's mission to provide a more diverse, sustainable and secure energy future for the Nation while mitigating environmental impact.
- **Expectations:** An integrated analytical energy/environment/economic modeling framework to provide the DOE with a new capability designed to: inform policy and investment decisions leading to a more diverse, sustainable and secure energy future; develop new technology options, primarily in the transportation, transmission and nuclear generation sectors; and integrate R&D programs from basic to applied to deployment.
- **Benefit Perspective:** Potentially *Substantial* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* in terms of developing a decision-support framework; *High* in terms of developing specific technologies due to uncertainties in basic research.
  - Market/Competition: *High risk* because many different organizations (public and private) will be competing for market in this area.
  - Management/Financial: *Low risk* because the program will be implemented incrementally.

The DOE currently lacks an integrated approach to the analysis of the impacts that technology options have on energy utilization and production, the economy and the environment. ANL's ability to draw upon the systems and decision modeling expertise, as well as the basic and applied scientific talent contained within the lab and the social/economic sciences capabilities of the University of Chicago (together with its partner universities Northwestern University and the University of Illinois) present an opportunity to provide analytical capabilities that DOE has never before had available.

This investment exploits ANL's capabilities in materials characterization and synthesis, nuclear fuel cycle and reactor design, transportation science and engineering, computational sciences, integration of computing, science, engineering, and large-project delivery. This investment is anticipated to have broad impact and significant returns: a reduction in petroleum use to save $4.5B/year in trade balance, and $6B/year in consumer costs. Diesel engine work at ANL if successful targets 30-40% reduction in average diesel vehicle fuel use; this target also reduces emissions of greenhouse gases by 30-40%.

3. Next Generation Facility in Nuclear Structure and Astrophysics

- **Summary:** A next generation facility in nuclear structure and astrophysics will be a powerful research tool dedicated to producing and exploring new rare isotopes that are not naturally found on earth, will help answer long standing questions of nuclear physics and astrophysics, and is viewed as the top priority of the nuclear physics community.
- **Expectations:** Research conducted at a facility with exotic beam capabilities will have far-reaching results, including: uncovering the origins of heavy elements in the periodic table; determining how galaxies, stars and plants form and evolve; producing isotopes for biomedical applications.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* because technical uncertainties are mitigated by planned contingency.

- Market/Competition: *High risk* due to intense competitive pressures.
- Management/Financial: *High risk* given the scope of the project, but potentially reduced through State of Illinois participation.

ANL will leverage existing capabilities in nuclear physics, including scientific talent and the ATLAS facility, to develop the world's leading exotic beam facility. This activity draws on Argonne's experience with accelerator research & technology, especially Argonne's long history in building and operating ATLAS; and development of specific technologies for rare isotope beam capabilities, fundamental physics, materials, computational sciences; and large project management. Given the complexity of this undertaking, ANL intends to partner with other DOE labs as well as those of the Nation's leading universities and industry, including joint efforts with the University of Chicago and the NSF Physics Frontier Center focusing on nuclear astrophysics.

A facility with exotic beam capabilities will provide the means for the next generation of researchers within nuclear physics and laboratory astrophysics to answer some of the most important and fundamental questions of our time and to train the next generation of nuclear physicists. Fundamental physics research in the U.S. will rise further in pre-eminence and U.S. leadership in low-energy nuclear physics will not be lost to Europe. Important applications in stockpile stewardship and nuclear medicine will be addressed. The proposed Illinois Accelerator Institute will bring together many of these partners and capabilities.

4. Petascale Computing

- **Summary:** ANL will focus on advanced architecture deployment and integration at the petascale to support DOE's missions, including ANL activities in nanoscale materials research, reactor simulation, systems biology, accelerator designs, and the modeling of complex energy and environment systems.
- **Expectations:** Development of petascale computing capabilities for: creation of "designer" nanomaterials for industrial, medical, and other applications; modeling of whole microbial cells for bioengineering and synthetic biology applications in support of energy and environmental research; and fission and fusion reactor modeling that will significantly help reduce design margins and shorten development schedules by streamlining experimental and licensing requirements.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
    - Technical: *Moderate risk* due to commercial risk as well as semiconductor design and software risk. This risk is mitigated by the particular choice of application.
    - Market/Competition: *High risk* because of intense competition of several players for this market.
    - Management/Financial: *High risk* due to close coupling with business plans of computer vendors who may or may not stay in the market.

ANL is a partner with ORNL to develop leadership class computing capabilities to support forefront science, and while supporting broad classes of advanced architectures, aims to focus especially on architectures with substantial promise to reach petascale levels of computing capability within the next five years. This activity builds on ANL's strengths in High Performance Computing (HPC) software, advanced hardware architectures, and application expertise; and enables forefront research, engineering, and facilities**.** The proposed Theory and Computer Science (TCS) building would provide the needed space and facilities support. The TCS building also leverages ANL's plans for co-locating the high energy physics division with the nuclear physics division.

Major technical hurdles involve the development of a computer architecture that achieves high application performance with reasonable cost and power consumption. ANL is working with IBM and other vendors to achieve this goal, in collaboration with researchers at other DOE laboratories and at universities. ANL also must ensure that applications software with appropriate scientific content, efficiency and reliability is available to meet the community's needs. In addition to hiring new staff, ANL will collaborate with other DOE laboratories (especially ORNL and LBNL), the University of Chicago, Northwestern, and the University of Illinois and other universities to build strong software development teams.

Financial Outlook

Detailed information regarding the financial outlook for the Argonne National Laboratory is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors can not be predicted or estimated in advance. The third, programmatic decisions, are developed in accordance with the planning targets reflected in the Department of Energy programmatic Five Year Plans, a companion document to these strategic laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

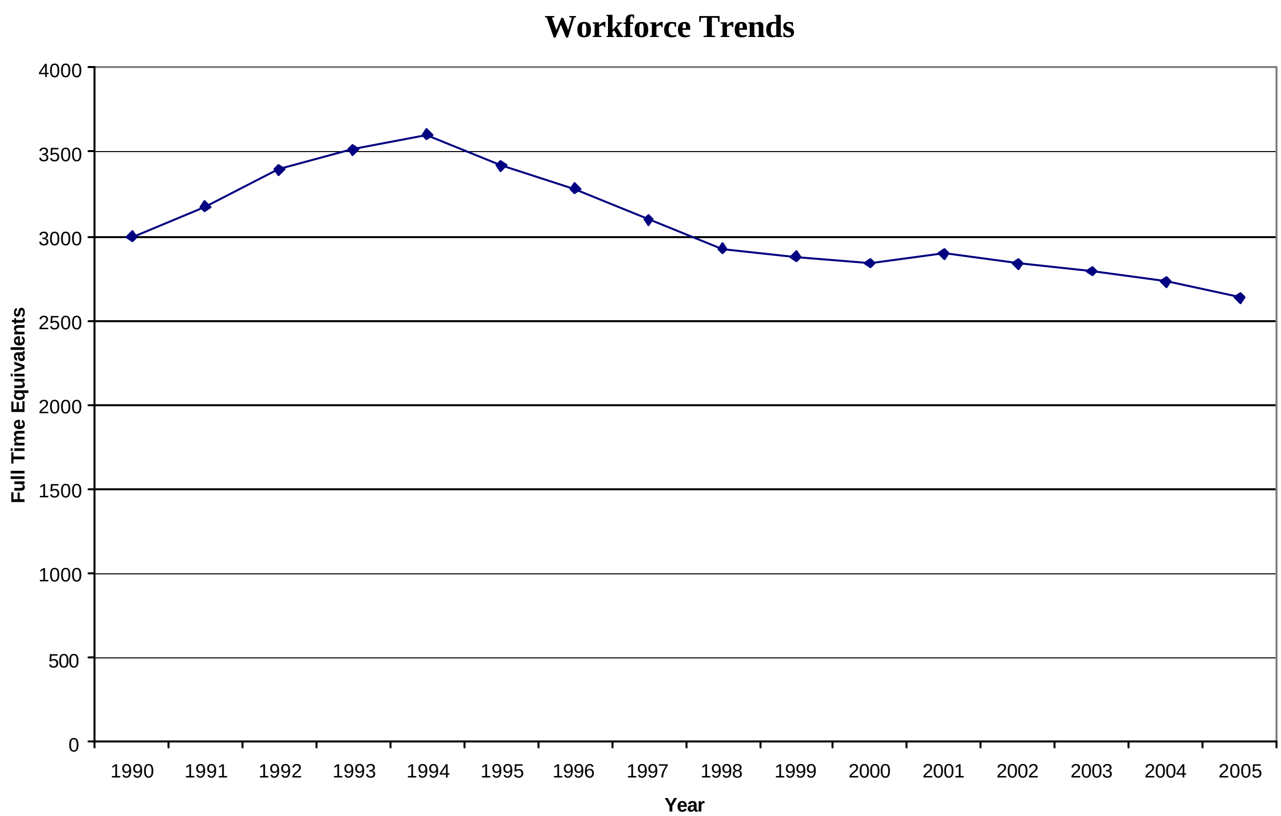
Support for Non-DOE funded work is a vital role our national laboratories, contributing to national security, energy security, environment stewardship, scientific discovery, and more fundamentally, the competitiveness of the U.S. economy. For the Argonne National Laboratory, this is no exception. The Office of Science is supportive of this work and although it is not addressed in any detail within the accompanying Five Year Plans, the Office of Science believes it is sufficiently important and appropriate to address within this strategic laboratory business plan. A brief perspective and financial outlook is therefore provided.

Argonne's non-DOE funded work engages both the Federal and private sectors and represents approximately 25% of the laboratory's total budget. The major ANL non-DOE federally funded activities are primarily supported by the Department of Homeland Security, focused on infrastructure assurance; the National Institutes of Health, emphasizing but not limited to protein characterization; the Department of Defense, covering a broad range of specialized technical (and often classified) assistance, infrastructure assurance, environmental assessments and nuclear related issues; the Department of Agriculture, for hazardous waste assessments; the Department of State, in support of IAEA; and the Nuclear Regulatory Commission, providing a technical basis for regulatory decisions. It is anticipated that each of these areas will continue to grow. Also anticipated is that the Intelligence Community will become a key sponsor over the next five years. Argonne's work for the private sector is varied and is typically a much smaller effort per project and of shorter duration than that for the Federal sector. Typical current work examples include locomotive engine combustion studies for GM Electromotive and DUV lithography support for Intel.

Uncertainties and Risk Management

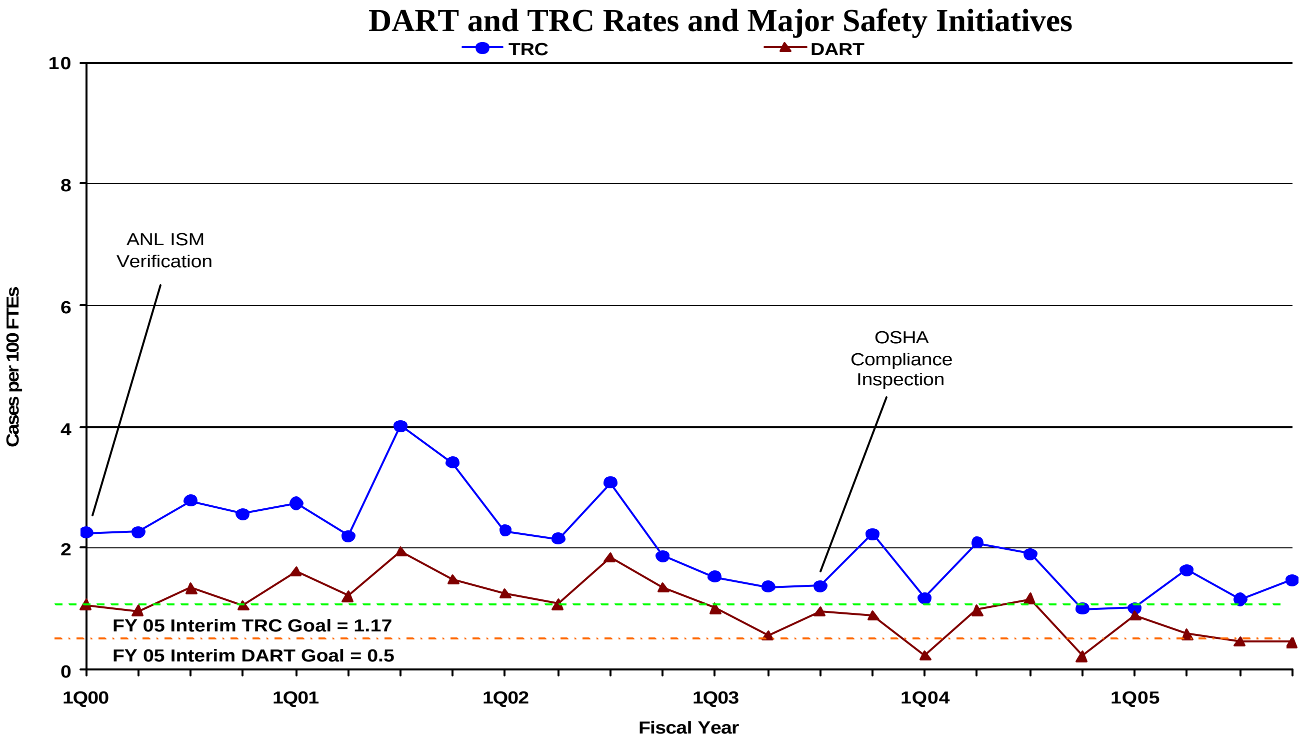
External Factors: Over the next five years, ANL will have a number of concerns driven by external forces. A primary concern is the stability of funding for core scientific programs new facilities, such as petascale computing and the Advanced Photon Source's upgrade. The priority placed by DOE on petascale computing will determine whether or not sustained funding will be provided that is needed to make the program a success. ANL's future is directly coupled with Federal support for a broad science and technology program. In addition, the upcoming competition for ANL's contract brings with it a degree of uncertainty for ANL employees, who have always been a part of the University of Chicago system.

S&T Workforce: ANL's ability to recruit and retain scientific staff and maintain relationships with external partners (universities, other labs, private industry) is vital to its ability to maintain core science and technology programs. The Office of Science has requested that ANL, along with other laboratories, explore and/or expand such incentives as onsite daycare and flexiplace working arrangements to attract the best and brightest to replace its aging workforce and Argonne has accepted these specific recommendations and has undertaken additional activities mentioned in the following discussion of diversity.



Workforce Diversity: As with most DOE labs, ANL must make significant progress in the recruitment and retention of under-represented populations, particularly African American and Hispanic scientific staff. In particular, Argonne is committed to pacing the rapidly increasing representation of women and underrepresented minority science and engineering PhD's graduating from tier 1 universities as evidenced in for example, "A National Analysis of Diversity in Science and Engineering Faculties at Research Universities" by Donna, J. Nelson, January, 2005. ANL, working with the University of Chicago, has organized a regional coalition of national research universities to assist with recruitment and is taking other steps to improve and retain workforce diversity and strength. These include; developing a "rolodex" of potential diverse candidates in all scientific and in particular for senior role model scientific and management fields; identifying and cultivating potential employees early via summer schools and focused workshops; insisting on qualified diverse candidates for each posting; encouraging employee affinity groups; and addressing exit issues critical to retaining a diverse workforce.

Safety: Argonne takes safety very seriously. In 2003 Argonne provided DuPont STOP™ training for its support operations significantly reducing safety incidence in operations. Argonne has implemented rigorous safety walk-throughs for all programmatic areas of the laboratory and is actively removing safety obstacles.



Physical Infrastructure: ANL is located on a 1,500 acre Federal reservation near Chicago, Illinois. Established in the late 1940s, it has 1.4M sf of space in 119 buildings. Fifty six percent of its space, as well as most of its utility systems and roads, are over 40 years old. ANL's AUI is 0.964 (good).

Maintenance, recapitalization, and modernization are supported both with overhead (maintenance and Institutional General Plant Projects [IGPP]), operating, and GPP funds, and with line item funding (projects which cost $5M or more). ANL will attain a maintenance investment level of 2% of replacement plant value (excellent) in FY 2006, which will be continued in FY 2007 and the outyears. ANL's deferred maintenance backlog is $58.5M resulting in an ACI of 0.96 (good). A deferred maintenance reduction initiative was initiated in FY 2006, and will be continued in FY 2007 with funding of $2.6M. The proposed FY 2007 funding for the clean-up and demolition of excess facilities funding is $500,000. The FY 2007 GPP funding request is for $5.6M. The laboratory will begin funding $2M of IGPP in FY 2007 to address roofing needs.

Funding for one new line item project is requested in FY 2007 - Building Electrical Services Upgrade, Phase II. This project will upgrade critical portions of the electrical power distribution system in twelve research buildings and support facilities, including the Canal Water Plant supplying cooling water for site experiments. ANL's future recapitalization and modernization challenges include laboratory space modernization, roads/parking/lighting upgrades, fire safety improvements, and central heating plant upgrades as well as the clean-up and demolition of numerous contaminated facilities.

DOE Business Plan for the Office of Science's Brookhaven National Laboratory

Mission and Overview

Established in 1947, Brookhaven National Laboratory (BNL) originated as a nuclear science facility, conceived by representatives of nine major eastern universities. Today, BNL maintains a primary mission focus in the physical sciences, basic energy sciences, and biomedical sciences, with additional expertise in environmental sciences, energy technologies, and national security. BNL brings specific strengths and competencies to the DOE laboratory system to produce excellent science and advanced technologies with the cooperation and involvement of the scientific and local communities. In support of its Office of Science mission, BNL builds and operates major scientific facilities. These facilities serve not only the basic research of the DOE, but they reflect BNL and DOE stewardship of national research infrastructure that is made available on a competitive basis to a wide range of university, industry and government researchers. The Relativistic Heavy Ion Collider (RHIC)-Alternating Gradient Synchrotron (AGS) complex and the National Synchrotron Light Source (NSLS) are the two facilities that account for most of the approximately 4,000 scientists/year served at BNL. To date, six Nobel Prizes have been awarded for discoveries made at the Laboratory.

Laboratory Focus and Vision

Four core competencies underpin activities at Brookhaven National Laboratory:

1. Conceptualization and design of advanced accelerators, detectors, magnets, and instrumentation
2. Synchrotron radiation science and technology
3. Imaging expertise (including both radiotracer chemistry and imaging instrumentation)
4. Advanced software and facilities for analysis of High Energy Physics and Nuclear Physics data.

The Office of Science believes that these four competencies will enable BNL to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the areas of:

- high-energy heavy ion and spin physics research to understand the essence of nuclear matter
- functional nanomaterials for energy technology applications

Lab-at-a-Glance

Location: Upton, NY

Type: Multi-program lab

Contract Operator: Brookhaven Science Associates (Research Foundation of State University of New York and Battelle Memorial Institute)

Responsible Field Office: Brookhaven Site Office

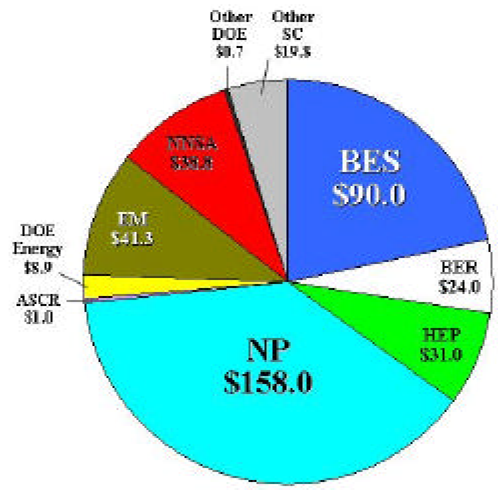
Website: **http://www.bnl.gov/**

Physical Assets:
- 345 buildings
- 5,300 acres

Human Capital:
- 2696 full time employees
- 1550 students (Undergraduate and Graduate)
- 3250 Facility Users and Visiting Scientists

FY 2005 Total DOE Funding: $413.0M

FY 2005 DOE Funding by Source
PALS data (BA in Millions):



FY 2005 Non-DOE Funding: $54.4M

- translational neuro-imaging to understand the origin of addiction that might lead to a cure
- aerosol and airborne pollutant research to understand their critical role in the earth's climate.

Business Lines

The following capabilities, aligned by business lines, distinguish BNL and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of BNL and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, identify research facilities that convey particular, strategic strengths and capabilities to the Lab. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
	Primary Business Lines		
Nuclear Physics	· **Relativistic heavy ion physics;** · **Proton spin studies with beams of polarized protons;** · **Quantum Chromodynamics (QCD) theory;** · **High Performance Computing effort in Lattice QCD;** · **Accelerator design and R&D in advanced beam cooling techniques;** · **Advanced detector instrumentation & electronics;** · ***Relativistic Heavy Ion Collider.***	Most highly cited Laboratory Nuclear Theory group; Lattice Gauge group headed by world-leading theorist; Unique accelerator worldwide for symmetric or asymmetric nucleus-nucleus collisions that will be complemented by the Large Hadron Collider (LHC); Polarized proton capability unique	Search for and characterize quark-gluon plasma. Understand the structure of the nucleon.
Basic Energy Sciences	· **Novel X-ray and Ultraviolet/Infrared techniques;** · **Strongly correlated systems in materials research;** · **Fuel cell nanoparticle synthesis and reactivity;** · ***National Synchrotron Light Source;*** · ***Center for Functional Nanomaterials.***	Nobel Prize in Chemistry for research conducted at NSLS; NSLS-II expected to have 1nm spatial resolution, 0.1meV energy resolution, and world's highest brightness; Since discovery of high Tc superconductors and start of BNL's strongly correlated electron program in 1987, BNL-32 papers with >200 citations, 7>500 citations; Fuel cell electrocatalysis recognized as "world-class" by DOE review team	Advance core disciplines of basic energy sciences. Lead nanoscale science revolution. Master control of energy-relevant complex systems.
Bio-medical Sciences	· **Radiotracer development;** · **PET/fMRI for translational neuroimaging focused on addiction;** · **Structural Biology; protein crystallography;** · ***Center for Imaging and Neuroscience (CIN).***	Leader in impact of addiction on the brain as determined by major external scientific awards to several staff members (National Academy of Sciences, National Institute of Medicine, American Chemical Society National Awards, PECASE, DOE/BER Medical Sciences Distinguished Fellow, etc.)	Master convergence of physical and life sciences for health & medicine.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Secondary Business Lines			
Climate Change Science	· **Significant capabilities in aerosol research;** · ***Free Air Carbon dioxide Enrichment (FACE) Facility.***	Chief scientists for the DOE Atmospheric Science and Atmospheric Radiation Measurement Programs are BNL researchers.	Unravel mysteries of earth's changing climate.
High Energy Physics and Physics Instrumentation	· **Detector expertise in the calorimeter and muon systems (U.S. ATLAS detector for LHC);** · **Low noise electronics and innovative detectors for particles and photons;** · ***Accelerator Test Facility.***	Host Lab for U.S. ATLAS construction project; hosts Tier I Computing Facility and Analysis Support Center; Leading role in defining Deep Underground Science and Engineering Laboratory (DUSEL) and the next-generation long-baseline neutrino oscillation; Innovative contributions to the International Linear Collider (ILC) final focus; Five Nobel Prizes in Physics awarded for discoveries that point to Physics Beyond the Standard Model.	Search for possible Physics Beyond the Standard Model and extend it to an all-inclusive theory.
Nuclear Safety	· **Nuclear reactor licensing and regulation.**	Long-term BNL competency; co-leader in risk assessment, structural analysis and review of license requests as measured by level of Nuclear Regulatory Commission investment	Lead in technology and safety improvements for nuclear.
Nuclear Data Program	· ***National Archive for Nuclear Physics Data.***	Number of data retrievals (~700,000 in FY05) far exceeds that of any other nuclear data center	Understand structure of nucleonic matter.

Major Activities

Following is a set of major activities that BNL would like to pursue to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. The Office of Science is examining all of these potential activities and they are at different stages of development. Some are currently underway and some are mere concepts at this time. For those that are still in the conceptual phase, BNL has indicated significant interest and is viewed to have current supporting research and mission focus to pursue such activities. Budgets, the Office of Science's strong commitment to a fair and competitive funding process and technical advice from its major scientific advisory committees will ultimately contribute to decisions about which activities can be pursued and at which sites. The companion documents, the DOE's Five Year Plans, provide greater insights into these activities in terms of various five-year budget scenarios.

The major activities are:

1. National Synchrotron Light Source – II (NSLS – II)
2. Relativistic Heavy Ion Collider (RHIC) ? QCD Lab
3. Nanoscience research
4. Translational Neuroimaging

1. NSLS-II

- **Summary:** NSLS-II will be the world's most advanced storage-ring-based synchrotron light source, and together with advanced insertion devices, optics, detectors, and a suite of scientific instruments, will accommodate radically new types of experimental capabilities.
- **Expectations:** The unique characteristics of NSLS-II will open up new regimes of scientific discovery and investigation, and enable exploration of: the correlation between nanoscale structure and function; the mechanisms of molecular self-assembly; understanding of structural molecular biology; and the science of emergent behavior, especially for correlated electron systems
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* due to technical specifications of 1nm spatial resolution and 0.1 meV energy resolution.
  - Market/Competition: *Moderate risk.* Although NSLS-II will be best in class, other light sources worldwide are also pursuing aggressive goals in areas of spatial and energy resolution.
  - Management/Financial: *High risk* due to world class team requirement and magnitude of funding required.

In order for the discovery potential of the NSLS to continue beyond the next decade, BNL plans to upgrade its capability by constructing the world's best synchrotron light source, NSLS-II, a 3rd generation storage ring, together with advanced insertion devices, optics, detectors, and a suite of scientific instruments. The NSLS is the first dedicated and the only remaining second generation DOE synchrotron light source. It has been operating since 1982 and serves on average 2300 users/year. However, its capabilities are restricted because the brightness has reached its theoretical limit after many stages of improvement and only a small number of insertion devices are possible. These factors will increasingly limit the scientific productivity and impact of its large user community.

NSLS-II will deliver the world's highest brightness and flux, an increase over those of the current NSLS by more than 10,000 times and 10 times, respectively and unprecedented stability. Its advanced optics will produce spatial resolution of 1 nm and energy resolution of 0.1 meV. The unique characteristics of NSLS-II will open up new regimes of scientific discovery and investigation, and enable exploration of the correlation between nanoscale structure and function, the mechanisms of molecular self-assembly and the science of emergent behavior, especially for correlated electron systems. DOE recently approved CD-0 for NSLS-II.

2. RHIC? QCD Lab

- **Summary:** Evolve the RHIC complex to further the study of quantum chromodynamics (QCD), the theory of strong interactions of quarks and gluons, experimentally and theoretically.
- **Expectations:** RHIC, a 10x luminosity upgrade to RHIC (RHIC II), an electron accelerator ring and associated detector added to RHIC (eRHIC), and the supercomputer QCDOC, together known as the "QCD Lab", will play a major role in determining: the nature of the quark-gluon plasma and the visible universe; the origin of the spin of the proton; and the role of the color glass condensate in the structure and interaction of high energy hadrons
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *High risk* due to challenges associated with electron cooling and the superconducting energy recovery linac.
  - Market/Competition: *Low risk as* the QCD Lab as a package, would offer unique capabilities..
  - Management/Financial: *High risk as* the community must be convinced of its value, the project must be positioned in the Nuclear Physics Long Range Plan, and support must be garnered for a second several hundred million dollar project at BNL.

The discoveries at RHIC have led to compelling questions about quantum chromodyamics (QCD) and vice versa. Compelling questions have in turn prompted the need for evolution of the facility to further the study of QCD experimentally and theoretically. This activity will require experimental equipment upgrades and luminosity (RHIC II), and polarization; construction of an electron ring and an associated new detector for e+A/e+p (electron+heavy ion/electron+protron) eRHIC physics; and high-end computing capability (QCDOC) for next-generation lattice QCD simulations. The expectation is that the combination of an upgraded RHIC, eRHIC, and QCDOC as a "QCD Lab" will play a major role in determining the nature of the quark-gluon plasma and the visible universe, the origin of the spin of the proton, and the role of the color glass condensate (CGC) in the structure and interaction of high energy hadrons.

3. Nanoscience

- **Summary:** The Center for Functional Nanomaterials (CFN) will provide state-of-the-art capabilities for understanding and using the unprecedented functionality of nanomaterials to promote U.S. energy security
- **Expectations:** To develop the scientific foundation and tools for the design and creation of: functional nanomaterials toward: an atomic level view of reactivity in nanocatalysts; bio-inspired assembly of hybrid systems for energy manipulation; tailored nanomaterials for solar energy conversion: and non-noble metal fuel cell catalysts.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk* as CFN scientific themes are tied to core programs, and coordinated facilities are tied to existing expertise.
  - Market/Competition: *Moderate risk* as nanoscience is an emerging field, in which the competition is worldwide. The CFN is the last DOE nanocenter to be built.
  - Management/Financial: *Low risk* as success of the CFN relies on a team approach that integrates research programs and facilities. A DOE approved a reorganization of BNL's BES directorate became effective at the beginning of FY 06, eliminating its stove-piped culture. BNL received DOE's Critical Decision-3 (CD-3) approval for the CFN and the start of construction is imminent.

Nanoscience offers a new approach to address the energy security challenges facing the U.S. through the development of materials exhibiting novel and unprecedented functionality for energy manipulation and utilization. CFN is one of five Nanoscale Science Research Centers (NSRCs) in development at DOE's Office of Science labs, which will be research facilities for the synthesis, processing, and fabrication of nanoscale materials. In addition, the NSRCs will provide specialized equipment and support staff not readily available to the research community and each facility will have a unique focus. Research at CFN will focus on nanoscience for energy security in the areas of nanostructured catalysts**,** electronic nanomaterials**,** and bio/soft nanomaterials and interfaces in order to develop the scientific foundation and tools for the design and creation of functional nanomaterials.

The specific objectives are to understand reactivity in nanocatalysts at the atomic level using the CFN, NSLS, and NSLS-II; synthesize and characterize bio-inspired hybrid systems for energy manipulation; tailor nanomaterials for solar energy conversion, and devise non-noble fuel cell catalysts. At the same time, the future well being of the Laboratory is seen to hinge on the construction and operation of the CFN and even more important, the beginning of construction of NSLS-II.

4. Translational Neuroimaging

- **Summary:** Develop new scientific tools, including radiotracers and multi-dimensional imaging technologies, to image the function of the brain and other organs, relate those images to genetic information, and rapidly translate new discoveries to knowledge that impacts human health**.**
- **Expectations:** A relatively small but significant activity – the combination of expertise in radiotracer

chemistry, imaging physics, and preclinical and clinical neuroscience – will enable the determination of: how the brain develops, changes, and adapts to the environment over a life time; how drug addiction, obesity, and other disorders affect the brain; how genetic variations affect brain structure, biochemistry, and behavior: and how drugs taken during pregnancy affect the brain of the fetus and adult offspring.

- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk.* Imaging is a thriving core competency at BNL. Advances in novel positron emission tomography (PET) applications and PET are stable and possibly growing. DOE's long-term investment in radiochemistry and imaging instrumentation at BNL is beginning to have a real payoff, in light of highly regarded results on addictive behaviors.
  - Market/Competition: *Moderate risk.* Medical imaging is a very active area worldwide; BNL is unique in studying the impact of addiction on the brain. Two notable projects, advances with vigabatrin to treat substance abusers (also known as gamma-vinyl GABA or GVG) and Imaging the Awake Animal are fueling BNL to gain a competitive market edge (decreasing the risk from moderate to low, as they succeed).
  - Management/Financial: *Moderate to High risk.* The imaging programs were structured as the Center for Translational Neuroimaging to facilitate research across departments, but additional administrative infrastructure consolidation is still needed. Establishing a multi-institution collaboration to double the size of the program is a challenge. Since this activity is outside of DOE's core mission areas, other sources of financial support will continue to be a critical factor.

The scope of this activity is to expand the capability of the Center for Translational Neuroimaging (CTN) in its studies of the function and response of the human brain to a variety of factors including addiction, aging, etc., and to relate the findings to genetics at one end and translate them to clinical use at the other end. To accomplish this, BNL will develop collaborations with neighboring research hospitals, forefront PET and fMRI capabilities for animal and human studies and for the development of new tools based on core strengths in the physical sciences.

The combination of expertise in radiotracer chemistry, imaging physics, and preclinical and clinical neuroscience will enable the determination of how the brain develops, changes, and adapts to the environment over a life time; how drug addiction, obesity, and other disorders affect the brain; how genetic variations affect brain structure, biochemistry, and behavior; and how drugs taken during pregnancy affect the brain of the fetus and adult offspring. All of these impact human health, worldwide.

Financial Outlook

Detailed information regarding the financial outlook for the Brookhaven National Laboratory is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors can not be predicted or estimated in advance. The third, programmatic decisions are developed in accordance with the planning targets reflected in the Department of Energy programmatic Five Year Plans, a companion document to these strategic laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

Support for Non-DOE funded work is a vital role our national laboratories, contributing to national security, energy security, environment stewardship, scientific discovery, and more fundamentally, the competitiveness of the U.S. economy. For the Brookhaven National Laboratory, this is no exception. The Office of Science is supportive of this work and although it is not addressed in any detail within the accompanying Five Year Plans, the Office of Science believes it is sufficiently important and appropriate to address within this strategic laboratory business plan. A brief perspective and financial outlook is therefore provided.

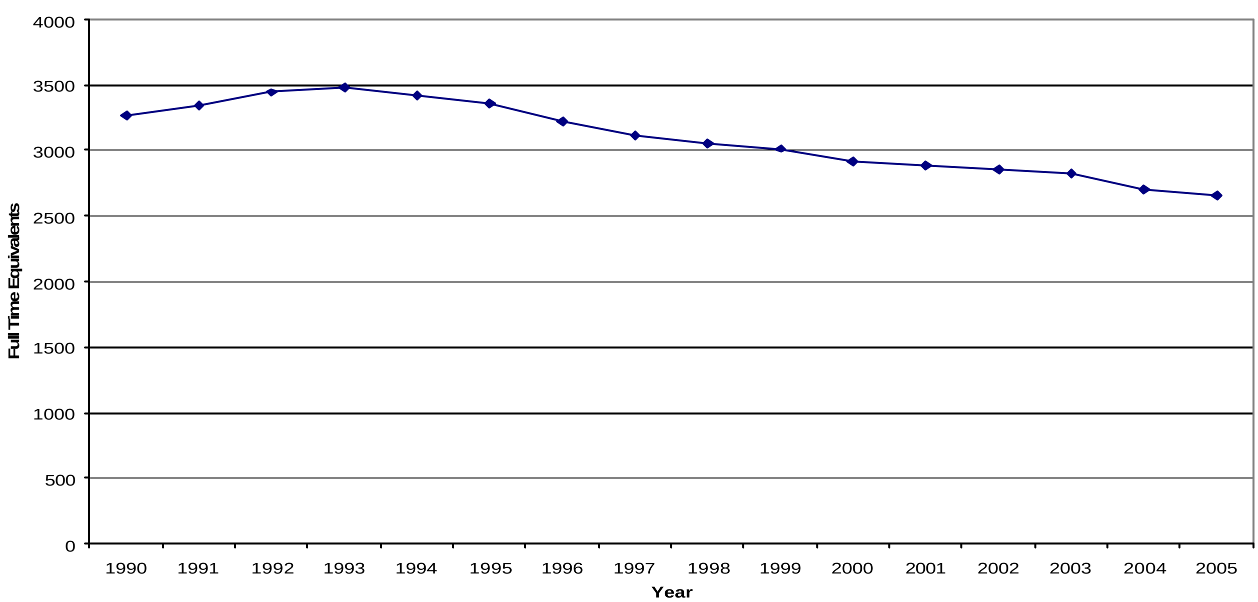
The major BNL non-DOE federally funded activities are primarily supported by the National Institutes of Health (NIH), the National Aeronautics and Space Administration (NASA), the Nuclear Regulatory Commission (NRC), the Department of Homeland Security (DHS), and the Department of Defense (DoD). NIH currently funds aspects of biomedical imaging and molecular, cell, and structural biology at the laboratory; it is difficult to speculate about future NIH funding levels for imaging until a National Academy of Sciences study on the nuclear medicine field is completed. NASA supports research to probe the effects of ionizing radiation on biological specimens and industrial materials at the laboratory; this support is expected to remain constant. NRC funding is likely to grow due to expected increases in nuclear plant licensing. DHS/DoD support for detectors and homeland protection is also expected to grow.

Uncertainties and Risk Management

External Factors: Over the next five years, BNL will have a number of concerns driven by external forces. For example, the power rates beyond 2008, rising fringe benefit costs, and negotiation with the International Brotherhood of Electrical Workers (IBEW) union in 2006 are of particular concern. The BSA prime contract expires in 2008 and that introduces uncertainty for the contractor as well. With the large user population for the scientific facilities, the possible implications of Homeland Security Presidential Directive-12 (HSPD-12) and foreign visits and assignments provide challenges to operations. Relations with the local community and New York political community are very good, but always require attention. Careful management, creative thinking, and the development of risk mitigation strategies will need to occur to handle each one of these significant items.

S&T Workforce: Additionally, BNL has faced challenges with reductions in laboratory staffing. As of June 30, 2005, BNL employed 2696 Full Time Equivalents (FTEs), a reduction of 54 FTEs in the third quarter and a total expected loss of 92 FTEs in FY 05. Additional losses are possible in FY 2006 but no skill mix difficulties are anticipated.

Workforce Trends

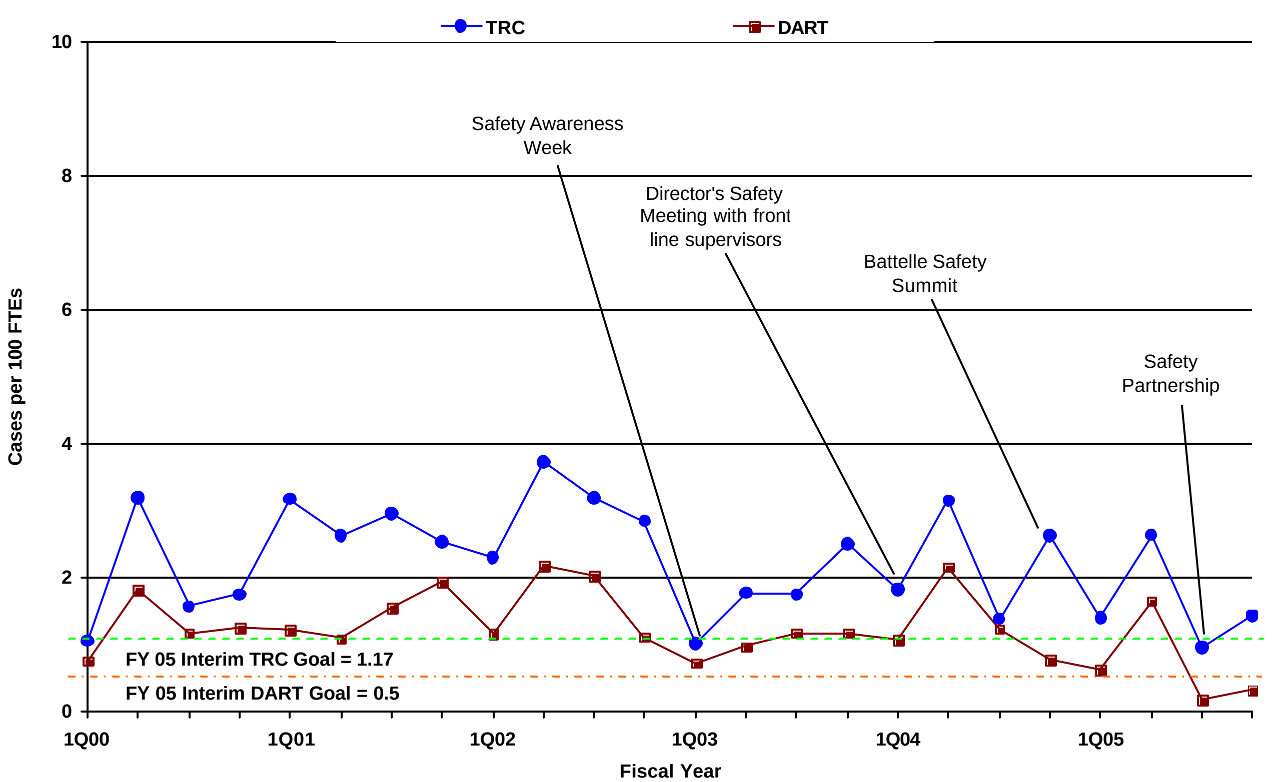


Employee Diversity: BNL's has taken several steps such as: subsidizing the salary of underrepresented scientific/professional staff; building partnerships with Historically Black College and Universities (HBCUs), Minority Serving Institutions (MSIs), and Minority Professional Associations; increasing communication tools and training to support diversity practices; and partnering with corporate affiliates to identify viable diversity candidates to achieve this. Additionally, BNL has invested in on-site daycare and is working with the county and state to take advantage of recruitment and retention programs, subsidies, and housing to attract/retain the best and brightest staff. Specific targets and goals over the next several years include:

- Continue a succession-planning program that is designed to identify women and minorities as successors to key management positions
- Continue the mentoring program for scientific staff and provide training in mentoring to 25% of Lab employment by 2008.
- Establish a standard search procedure for all non-scientific positions by 2007.
- Continue to expose minority faculty from MSIs and HBCUs to BNL through the National Science Foundation (NSF) Faculty and Student Teams (FaST) program which is administered through the Office of Educational Programs. Last summer BNL hosted three FaST collaborations with BNL researchers. The goal is to increase this number by one each year for five years.

Safety: Over the past several years BNL TRC (Total Recordable Case) and DART (Days Away Restricted Time) rates have been above the DOE average. While the lab has experienced significant improvement during FY 2005 (that included ~1.5 million hours without a DART case), BNL has had 18 DART and 37 TRC cases as of 9/30/2005, which fall far above DOE's expectations. BNL's DART and TRC cases and major safety initiatives undertaken since 1998 are shown in the figure below. In order to reach or exceed DOE's targets, BNL has developed an aggressive plan for improvement.

DART and TRC Rates and Major Safety Initiatives



Our strategy for improvement includes enhanced work planning, worker observation programs, case management initiatives, Occupational Health and Safety Assessment Series (OHSAS) 18001 registration, human performance initiatives and safety leadership training and practices. There have been some recent successes. OHSAS registration of three high risk organizations has been achieved, DuPont safety leadership training for senior managers was given, the SC electrical safety audit was laudatory, and improved work planning and control assessment tools were introduced. Ergonomic training was done in June 2003, which contributed to the significant decline in the number of strains and sprains. We should add that a new snow removal policy dramatically reduced the number of weather related injuries this year despite a higher snowfall. During the first half of FY 2005, there were 4 TRC and 2 DART cases resulting in 98 days away and no restricted days, compared to first half FY 2004 with 10 TRC and 9 DART cases with 179 days away, and 190 restricted days due to snow related injuries.

Physical Infrastructure: BNL is located on a 5,322 acre Federal reservation on Long Island, approximately 100 kilometers east of New York City. Established in the late 1940's on the site of the Army's Camp Upton, the laboratory has 3.9M sf of space in 248 buildings. Sixty seven percent of its space, as well as most of its utility systems and roads, are over 40 years old. Twenty three percent of the space is 60 years old or older. BNL's AUI is 0.969 (good).

Maintenance, recapitalization and modernization are supported with overhead, operating, and GPP funds, and with line item funding. BNL will attain a maintenance investment level of 1.9% of replacement plant value (excellent) in FY 2006, which will be continued in FY 2007 and the outyears. BNL's deferred maintenance backlog is $251.6M, resulting in an ACI of 0.83 (fair). A deferred maintenance reduction initiative was initiated in FY 2006 and will be continued in FY 2007 with funding of $5.9M. The FY 2007 GPP funding request is $7M. Funding for one new line item project is requested in FY 2007 - Renovate Science Lab, Phase I. This project will upgrade and rehabilitate existing obsolete and unsuitable laboratory facilities into modern, efficient facilities compatible with world-class scientific research. Construction of the 65,000 sf Research Support Building is continuing. The new building will allow consolidation of Staff Services, Public Affairs, Human Resources, Credit Union, Library, and other support functions in a central quadrangle to provide staff and visiting scientists with convenient and efficient support. After completion of this subproject, 16,400 sf of World War-II era structures will be torn down.

The proposed FY 2007 funding for the clean-up and demolition of excess facilities is $500,000. BNL's legacy cleanup program has transitioned to long term response actions (i.e., maintaining systems to ameliorate past contamination). A new phase involving Decontamination and Decommissioning (D&D) of the laboratory's defueled reactors - the Brookhaven Graphite Research Reactor, High Flux Reactor and the Brookhaven Medical Research Reactor – is beginning.

BNL's future recapitalization and modernization challenges include building replacements and modernization, utility system renovations, and clean-up of excess facilities.

DOE Business Plan for the Office of Science's Fermi National Accelerator Laboratory

Mission and Overview

Fermi National Accelerator Laboratory (FNAL), also known as Fermilab, is the largest U.S. laboratory dedicated to research in particle physics. The University Research Association built Fermilab in 1967 for the Department of Energy and continues to operate the lab today for DOE's Office of Science. Fermilab's mission goal in high energy physics focuses on understanding matter at its deepest level to identify its fundamental building blocks and understand how the laws of nature determine their interactions. Of the 18 fundamental subatomic particles that are known so far, three have been discovered at Fermilab: the bottom quark (1977), the top quark (1995) and the tau neutrino (2000). The original Fermilab Main Ring became the world's highest energy accelerator when it started operation in 1971. The Tevatron, commissioned in 1983, was the first large proton accelerator based on superconducting magnet technology. Since 1985 Tevatron has remained the highest energy proton accelerator in the world, where antiprotons and protons collide with energy of 2 Trillion electron Volts (TeV). Unique capabilities in high energy physics are available to the scientific community that include the Booster and Main Injector pre-accelerators, and the Neutrinos at the Main Injector which operate as part of the Tevatron complex but can be used independently. Fermilab provides leadership and resources for over 2,200 researchers to conduct basic research at the frontier of high energy physics and related disciplines.

Lab-at-a-Glance

Location: Batavia, IL

Type: Program Dedicated Lab

Contract Operator: University Research Associates (Consortium of 90 leading research-oriented universities)

Responsible Site Office: Fermi Site Office

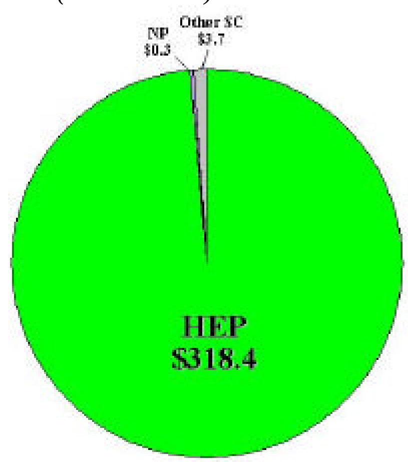
Website: http://www.fnal.gov

Physical Assets:
- 344 buildings
- 6,800 acres

Human Capital:
- 2,085 employees;
- 602 Students (Undergraduate and Graduate);
- 2,258 Facility Users and Visiting Scientists

FY 2005 Total DOE Funding: $322.7M

FY 2005 DOE Funding by Source
PALS data (BA in Millions):



FY 2005 Non-DOE Funding: $0.2M

Laboratory Focus and Vision

Fermilab has a central role in the field of particle physics, both in the U.S. and worldwide. Fermilab's present and future program relies on maintaining world-leading core competencies in:

1. Construction and operation of experimental facilities for particle physics and particle astrophysics
2. Research, design, and development of accelerator technology
3. High-performance scientific computing and networking
4. International scientific collaboration
5. Theoretical particle physics and particle astrophysics

The Office of Science believes that these five competencies will enable Fermilab to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the following areas of particle physics:

- The quantum vacuum, including the Higgs field, supersymmetry, and dark energy;
- The particle zoo, the collection of 57 leptons, quarks and force carriers;
- Unification phenomena, whether all of the forces can be described with a unified theory;
- Origins of space and time, including extra dimensions and quantum gravity.

Business Lines

The following capabilities, aligned by business lines, distinguish Fermilab and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of Fermilab and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, identify research facilities that convey particular, strategic strengths and capabilities to the Lab. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Collider Physics	· **US-Large Hadron Collider (LHC);** · **US-Compact Muon Solenoid (CMS);** · *Tevatron, the Collider Detector at Fermilab (CDF) and Dzero.*	World leader with highest energy and highest luminosity proton-antiproton accelerator	Explore the fundamental interactions of energy, matter, time, and space
Neutrinos	· *Neutrinos at the Main Injector (NuMI) facility;* • *Main Injector Neutrino Oscillation Search (MINOS);* · *MiniBOONE.*	New experiments give Fermilab unique, world leading capabilities for neutrino research	Explore the fundamental interactions of energy, matter, time, and space
Particle Astrophysics	· **Sloan Digital Sky Survey;** · **Cryogenic Dark Matter Search;** · **Dark Energy Survey;** · **Joint Dark Energy Mission (JDEM);** · **Auger South.**	Fermilab plays a leadership role in many of the major experiments	Understand the cosmos
Quarks	· **B-physics at CDF;** · **Dzero;** · **US Lattice Quantum ChromoDynamics (LQCD) collaboration.**	Only source of B_s mesons needed to complete studies of CP violation of b quarks	Explore the fundamental interactions of energy, matter, time, and space
Accelerator R&D	· **LHC quadrupoles;** · **LARP;** · **ILC superconducting RF lead;** · **Photo-injector facility.**	Operation of the world's most powerful and highest peak luminosity proton-antiproton collider facility	Provide the resources that enable great science
Theory	· **Human capital;** · **High performance computing and networking.**	Calculating the consequences of QCD in high-energy collisions	Explore the fundamental interactions of energy, matter, time, and space

Major Activities

Following is a set of major activities that Fermilab would like to pursue to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. The Office of Science is examining all of these potential activities and they are at different stages of development. Some are currently underway and some are mere concepts at this time. For those that are still in the conceptual phase, Fermilab has indicated significant interest and is viewed to have current supporting research and mission focus to pursue such activities. Budgets, the Office of Science's strong commitment to a fair and competitive funding process and technical advice from its major scientific advisory committees will ultimately contribute to decisions about which activities can be pursued and at which sites. The companion documents, the DOE's Five Year Plans, provide greater insights into these activities in terms of various five-year budget scenarios.

The major activities are:

1. International Linear Collider
2. Evolution of Fermilab Neutrino Program, NuMI Upgrades
3. Foundation: the Ongoing Program

1. International Linear Collider

- **Summary:** The Linear Collider would allow physicists to make the world's most precise measurements of nature's most fundamental particles and forces by colliding individual fundamental particles rather than particles with a complex structure such as protons or anti-protons. The physics investigations envisioned at the ILC are both broad and fundamental, and will both require and support a leading-edge program of research for many years.
- **Expectations:** Physicists now know enough to predict that a linear collider, operating initially at energies up to 500 GeV, will be needed to understand how forces are related and the way mass is given to all particles.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate to High risk* – The technical challenges in the project are exemplified by the transverse beam sizes at collision (a few nanometers), by the requirement of providing very high electric field gradients to achieve the large energies, and by the exceptional control of the beams needed during the acceleration process.
  - Market/Competition: *Low/Moderate risk* as there would be only one such international facility but competition to host this facility could be significant.
  - Management/Financial: *High risk* due to large project costs, technical risk, and international project management issues.

The shared goal for the consortium of laboratories around the world working on the International Linear Collider (ILC) is to complete the design of a new electron-positron linear collider with energy in the range of 0.5-1.0 Tera electron volt (TeV). The near term goal for the worldwide ILC effort is to establish all technical components, costs, engineering designs, and management structures to enable a go/no-go decision to start construction. For Fermilab, the additional goals are to prepare for a bid to host the ILC on behalf of the U.S. and to be in a position to take leading roles in developing the detector and the research program. There are many scientific, technical, and economic challenges to this project that must be addressed before a decision to proceed.

To improve its position as a competitor for the ILC, Fermilab must establish world-class expertise in superconducting radio frequency (SCRF) technology. The buildings that would serve as the conventional infrastructure for large SCRF facilities already exists, in the form of large experimental halls that are now not being used in the accelerator-based research program. However, Fermilab will needs to increase power and add cryogenic and radiofrequency infrastructure to these buildings. All of this will need to be done in collaboration with the Global Design Effort (GDE), the organization that coordinates ILC R&D worldwide. The R&D program needed to develop SCRF capability for the ILC would take place over the next few years. This includes a module assembly facility, module fabrication, a test facility, and operations of the test facility. Fermilab plans to develop, in parallel, the SCRF capability needed for a potential high intensity proton accelerator for the neutrino program should the ILC not proceed to construction.

For high energy physics, the energy frontier is the source of new discoveries, confirmations and surprises. The ILC is being designed to maximize scientific potential and minimize costs. If the ILC is built and Fermilab is chosen as the ILC site, it will assure the scientific productivity of the laboratory for many years.

2. Evolution of Fermilab Neutrino Program

- **Summary:** Maintain the leading position in neutrino physics through at least the middle of next decade with the Neutrinos at the Main Injector (NuMI) beam through a combination of efforts to increase beam intensity and add new detectors which are larger and more capable.
- **Expectations:** The neutrino activity would permit a comprehensive neutrino science program over a decade or more that would include the precision measurement of neutrino mass differences and oscillation parameters, plus very possibly the measurement of matter-antimatter asymmetries (CP violation) that could connect the neutrino sector to leptogenesis as a source of the matter-antimatter asymmetry of the universe.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* **-** With a proton beam of 2 megawatts (MW), the level of power is similar to other high-intensity proton machines, such as the Spallation Neutron Source.
  - Market/Competition: *Moderate/High risk* - The Japanese are heavily invested in neutrino physics and will be the primary source of competition in this area. Collaboration will significantly reduce market risk.
  - Management/Financial: *Moderate to High risk* - With a Proton Driver, Fermilab would operate two high-power proton facilities: the driver itself (0.5-2 MW), and a 2-MW Main Injector. This would also entail a world-wide collaboration. The full-scale Proton Driver is also a ~billion-dollar-class project and could not proceed in parallel with an aggressive ILC schedule. This activity could be scaled according to availability of funding to mitigate these risks.

Fermilab has the only accelerator-produced neutrino beam operating in the world today, the Neutrinos at the Main Injector (NuMI) beam. It is also the most powerful neutrino beam that has ever operated, with 0.2 MW of proton beam power directed at the NuMI target. The Main Injector Neutrino Oscillation Search (MINOS) collaboration operates two detectors, one at a distance of 730 km in the Soudan mine - necessary to disentangle the effects of neutrino interactions with matter from the possible effects of CP violation. The sensitivity of an experiment is proportional to (beam power) x (detector mass) x (detector efficiency). Fermilab would like to increase the NuMI beam intensity through a series of steps to a total beam power of 0.6 MW on target by 2010 and to 1 MW or more by 2012 through either improving the present accelerator complex in two stages, or through building a Proton Driver based on SCRF technology if the ILC does not proceed to construction. The first path makes efficient use of the existing infrastructure, and will be chosen if that is seen as the final stage of proton accelerators for High Energy Physics before the ILC. The second path shares R&D with the ILC and provides a suitable platform for further evolution of the proton accelerator complex.

The first step in building better neutrino detectors is NOvA, a proposed detector that would be built in northern Minnesota at a location that can use the NuMI neutrino beam. The NOvA detector is much larger than MINOS and is optimized for clean and efficient identification of electron-neutrino scatters, since the oscillation of muon neutrinos into electron neutrinos has not yet been observed. For the next step, Fermilab is starting a long-term R&D program to develop a liquid argon detector that could be scaled up to the size needed for neutrino experiments. A liquid argon detector could be built adjacent to NOvA to extend the scientific reach of the neutrino program.

Neutrinos permeate the universe and hardly interact with matter. The recent discovery of neutrino mass has important consequences both for particle astrophysics and for unification. The Fermilab activity would maintain U.S. and Fermilab leadership in this important area of research.

3. Foundation: The Ongoing Program

- **Summary:** Enhance long term laboratory success by delivering scientific opportunities that are possible in the current Fermilab program. The laboratory's goal is to achieve the greatest sensitivity possible to discoveries of new physics, and to do so as quickly as possible.
- **Expectations:** Possible discoveries include the Higgs boson or any new physics (beyond the present theory) at the 1 TeV mass scale. These discoveries would also include supersymmetry, either through seeing supersymmetric particles or one of the five Higgs bosons that exist in supersymmetric models; extra dimensions; new dynamics (technicolor, new gauge bosons), and quark or lepton compositeness.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
    - Technical: *Moderate risk* -It is critical to the scientific success of the program and to the future of the laboratory, that Fermilab deliver as much luminosity as possible to the detectors every year.
    - Market/Competition: *High risk* - the LHC, at CERN in Geneva, Switzerland, will overtake Fermilab ~2009.
    - Management/Financial: *Moderate to High risk* - Fermilab's capability in pursuing physics in Run II depends on the funding available to carry it out.

The Tevatron currently provides the only window into supersymmetry, Higgs physics and quark physics with the B_s meson until the LHC turns on. The key to the success of this program is delivering integrated luminosity to the detectors. The laboratory is in the middle of a campaign to build and install luminosity upgrades and reliability improvements. The two large detectors also must operate reliably. This requires support not only from the laboratory but also from the international collaborations, which have to remain strong.

The LHC program is the largest particle physics program for the U.S. in the next 10 years. Fermilab should maintain forefront capability in detectors, accelerators, theory, and computation such that, in any area, scientists can do LHC research at Fermilab as productively as at CERN. In addition, Fermilab must manage the transition from the DZero and CDF collaborations to the CMS and ATLAS collaborations in a way that keeps excellent physics coming from the Tevatron program through 2009. These actions should position Fermilab to contribute to the development of the proposed accelerator and detector upgrades for increasing LHC luminosity in the next decade.

In astroparticle physics, Fermilab must complete the extended operation of the Sloan Digital Sky Survey and with it make possible new discoveries. Fermilab needs to complete the Cryogenic Dark Matter Search program in the Soudan mine and contribute to the design for the Super-CDMS facility. Fermilab would like to build the Dark Energy Survey, both for the science it produces and as a basis for larger projects in the future, including the Joint

Dark Energy Mission. Finally Fermilab needs to complete construction of the Auger South observatory, operate it well, and find out what it tells us about the source of the highest energy cosmic rays.

These efforts seek to maximize the return on investment in Fermilab while providing a role for the laboratory in some of the most important experiments internationally. This is critical to maintaining the high caliber staff and visiting scientists that will be critical to future endeavors.

Financial Outlook

Detailed information regarding the financial outlook for the Fermi National Accelerator Laboratory is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors can not be predicted or estimated in advance. The third, programmatic decisions, are developed in accordance with the planning targets reflected in the Department of Energy programmatic Five Year Plans, a companion document to these strategic laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

Uncertainties and Risk Management

External Factors: The U.S. could be poised to recapture the energy frontier through the development of ILC, with a strong role at the Large Hadron Collider (LHC) in the interim. The U.S. is also poised to have the world-leading neutrino program at accelerators in the near term. However, there are major risks to this future scenario that are scientific, technical, management and financial. Possible delays in starting construction on the ILC, and funding uncertainty can halt the development of the rest of the program. One complication of this is the impact on foreign institutions and funding agencies that have made large investments to the current program. These international partners are needed to build the ILC. Fermilab has had a history of excellent relations with the surrounding communities. However, if the ILC is to be built near Fermilab it will be outside the boundary of the present FNAL site. As a result, a FNAL Community Task Force was formed, including 20 members from local government, business, civic organizations, schools, and neighborhood associations. The committee made recommendations for local community participation in planning and decision-making at Fermilab. This represents a critical first step toward involving the community in having the ILC at Fermilab.

S&T Workforce: Fermilab already has the requisite human resources in all of the core competencies needed to carry out the activities described above with the exception of the experts on SCRF technology. Because of the scale and complexity of the needed R&D program, the laboratory will have to add scientists and engineers to its staff in this area.

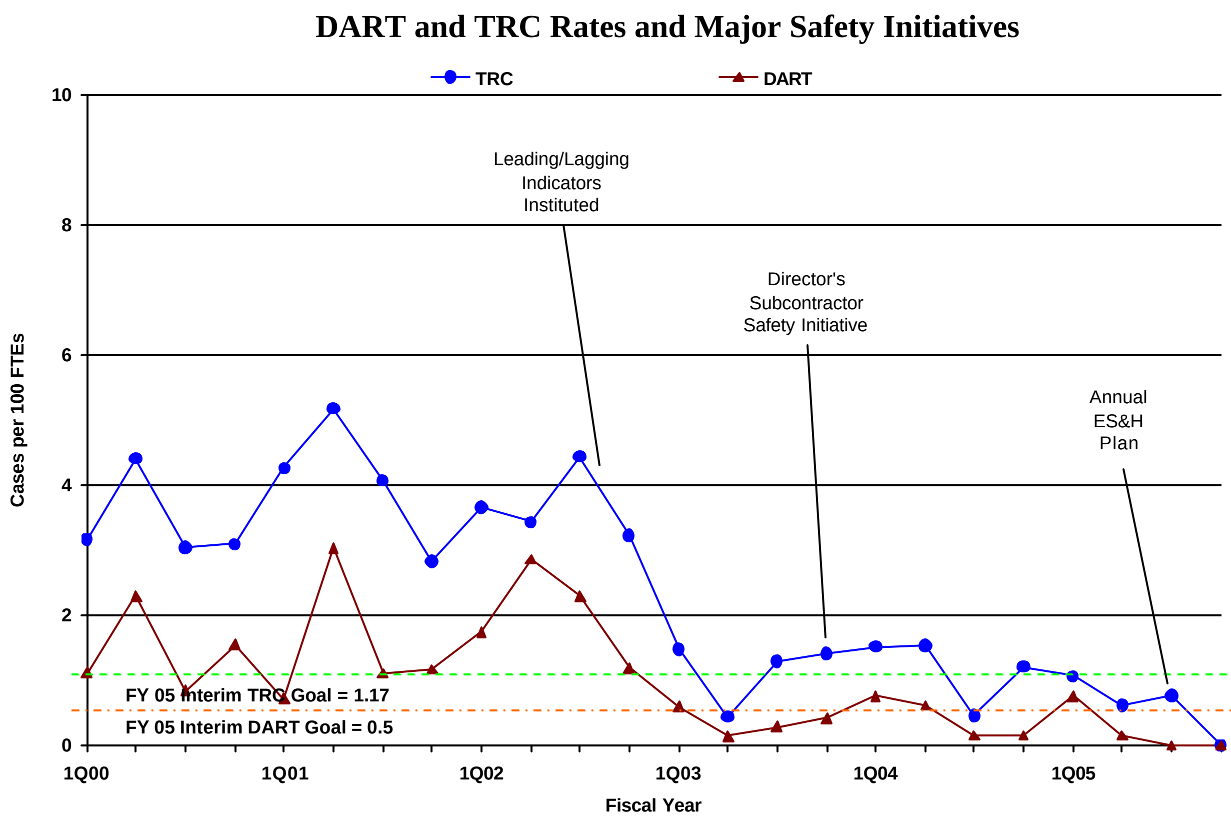
Employee Diversity: The Laboratory works to attract a diverse workforce, although this is more difficult in an era of downsizing the staff size. Fermilab maintains a presence at diversity job fairs and national conferences, such as the National Society of Black Engineers, the Sorority of Hispanic Professional Engineers, the Joint Meeting of Black and Hispanic Physicists, and the Society of Women Engineers. Fermilab also conducts educational programs designed to reach populations underrepresented in science and engineering.

Fermilab has the following goals to improve diversity:

- Recruit underrepresented minorities for Research Associates. This group serves as the feeder for Scientific positions. The Laboratory will partner with University Research Association, Inc. (URA) member institutions for increased recruitment efforts on the undergraduate and graduate levels.
- In FY06, increase the number of Masters trained underrepresented minority professionals in Electrical/Mechanical engineering and computer science. The Laboratory will increase its support of the GEM program. Our recent history with this program is that we realize an acceptable ROI in attracting these interns as professional hires.
- In FY06, move to become a partner in the DOE Office of Science Faculty and Student Teams Program (FaST) which targets colleges and universities serving women and minorities underrepresented in the fields of science and technology.
- In FY06, establish the FNAL Diversity Council for which a proposal has been written. Its mission is to focus on the functional areas detailed in DOE guidelines for a Strategic Plan for Diversity.

Safety: Fermilab has an ambitious and effective program to continuously improve safety in the workplace. As figure 9 shows, the major benchmark accident rates have been reduced by a factor of about eight over the last eight years.

Fermilab recently published an Annual ES&H Plan stating their ES&H Vision & Strategy for improvement in CY05. *"As a result of our deep and unwavering commitment to the safety of all who work here, Fermilab will be recognized internationally and within the ranks of the U.S. national laboratories as 'best in class' in environment, safety & health. We want Fermilab to be 'First in Science & Safety.'"* As the first step in this process, the Laboratory Director wrote to all division and section heads asking them to assess the hazards in their organization and to submit a plan to reduce accidents in 2005. The laboratory management and staff have embraced Integrated Safety Management and have worked hard to bring the accident rates down. It is a greater challenge to integrate contractors into the safety culture we maintain. Fermilab has made progress on this issue by giving it special attention, including a Director's advisory committee on subcontractor safety.



Physical Infrastructure: Fermi is located on a 6,800 acre Federal reservation approximately 45 miles west of Chicago, Illinois. Established in late 1967, it has 2.3M sf of space in 351 buildings. Sixty-three percent of its space as well as most of its utility systems and roads are over 30 years old. Fermi's AUI is 1 (excellent).

Maintenance, recapitalization, and modernization are supported with overhead, operating, and GPP funds and with line item funding. Fermi will attain a maintenance investment level of 2.2% of replacement plant value (excellent) in FY 2006 which will be continued in FY 2007 and the outyears. Fermi's deferred maintenance backlog is $44.6M resulting in an ACI of .925 (adequate). A deferred maintenance reduction initiative was initiated in FY 2006 and will continue in FY 2007 with funding of $1.98M.

The FY 2007 GPP funding request is for $8.2M. Fermi's future recapitalization and modernization challenge is to upgrade its aging utility systems. In addition to capital investments, DOE is considering granting a burdened, public-utility easement to the City of Batavia for its power transmission needs that may allow replacement of a portion of Fermi's high voltage electrical distribution system. Also, the purchase of domestic water from the City of Warrenville will eliminate the need to operate and maintain Fermi's on-site water wells.

DOE Business Plan for the Office of Science's Lawrence Berkeley National Laboratory

Mission and Overview

The Lawrence Berkeley National Laboratory (LBNL) was founded in 1931 and was a driving force behind the launch of serious investigations into particle physics and the nature of matter and energy in our universe. From those early days, LBNL has evolved from the birthplace of nuclear science and medicine into a multidisciplinary research facility that, under the Department of Energy's Office of Science, has the primary mission focus of characterizing and fabricating nanostructured materials; understanding the complexity of biological and earth systems for energy solutions and environmental restoration; physics; computing; cosmology; and science and technology approaches to the understanding and prevention of disease. As a DOE steward of critical national research infrastructure, the laboratory provides access to university, industry and government researchers on a competitive basis. Major facilities include: the Advanced Light Source, which is known as a world center for ultraviolet and soft x-ray synchrotron-based science; the National Center for Electron Microscopy for materials science; the 88-Inch Cyclotron for nuclear science; and the National Energy Research Scientific Computing Center (NERSC), which is a DOE leading provider for high-performance computing capabilities for complex scientific applications. With one-third of its scientific staff jointly affiliated with university campuses, LBNL delivers a highly capable science and engineering workforce for the nation's future. Founder Ernest Lawrence was the laboratory's first Nobel Laureate and following that tradition, overall, ten Nobel Laureates are associated with the Laboratory. In addition, 68 staff are members of the National Academies.

Laboratory Focus and Vision

Seven core competencies underpin activities at Lawrence Berkeley National Laboratory:

1. Advanced energy science and technology
2. Materials synthesis and characterization, and nanotechnology
3. Multidisciplinary biology and environmental science
4. Chemical physics and surface science, and ultrafast science

Lab-at-a-Glance

Location: Berkeley, CA

Type: Multi-program lab

Contract Operator: University of California

Responsible Field Office: Berkeley Site Office

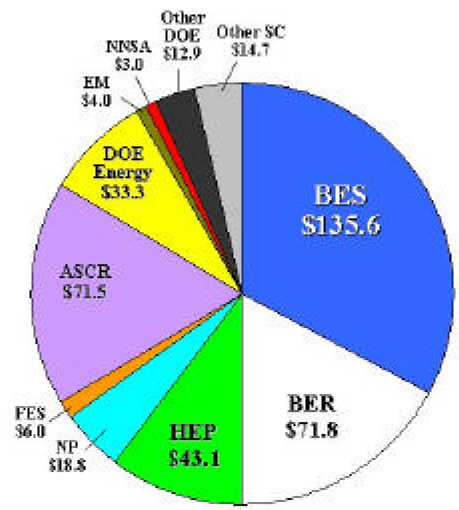
Website: http://www.lbl.gov/

Physical Assets:
- 106 buildings and 53 trailers
- 200 acres

Human Capital:
- 3014 full time employees;
- 1418 Students (Undergraduate and Graduate);
- 3232 Facility Users and Visiting Scientists

FY 2005 Total DOE Funding: $414.9M

FY 2005 DOE Funding by Source
PALS data (BA in Millions):



FY 2005 Non-DOE Funding: $114M

5. Computational science and engineering
6. Advanced detector systems for astrophysics, high energy physics, and nuclear science
7. Photon and particle beams, including those for national user facilities

The Office of Science believes that these seven competencies will enable LBNL to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the areas of:

- Energy science, including carbon-neutral fuels for solar to chemical energy.
- Nanoscience, surface science, and condensed matter physics for energy and scientific applications.
- Genomics and bioscience for understanding the complexity of living systems for energy solutions, understanding health effects of energy and the prevention of disease.
- Particle-, nuclear-, and astrophysics to understand matter and energy in the universe.
- Earth systems research for understanding energy resources and development, global change modeling, and enhanced environmental restoration.
- Mathematics, computer science, and large-scale computational science programs.

Business Lines

The following capabilities, aligned by business lines, distinguish LBNL and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of LBNL and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, identify research facilities that convey particular, strategic strengths and capabilities to the Lab. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Science for a Secure Energy Future	• **Characterize and engineer chemical synthesis processes;** • **Efficient commercial building system designs;** • **Electricity transmission technology;** • **Carbon sequestration science and technologies.**	Recognized leadership in photochemistry, catalysis and physical chemistry (national rankings); National leadership in building systems; National Academy of Sciences (NAS) documents $15 Billion in energy savings from LBNL technologies.	Advance the core disciplines in basic energy sciences; Master the control of energy relevant complex systems
Leading Facilities in VUV, Soft X-ray, and Ultrafast Science	• **VUV, soft and intermediate x-ray probes for science and technology;** • **Chemical dynamics, photoionization, and other atomic, molecular, and optical phenomena;** • **Ultrafast photon sources;** • ***Advanced Light Source.***	Recognized leaders in VUV and soft and intermediate x-ray user facility operation and science productivity (selected to lead design of new Fermi light source at Trieste) ultrafast science experimentation and theory; Leadership in electron bunch and laser interactions; Cover articles in *Nature* and *Applied Spectroscopy.*	Provide the Resource Foundations that Enable Great Science; Advance Basic Sciences for Energy Independence

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Develop Novel Materials and Nanodevices	• **Advanced catalytic, electronic, superconducting, structural, and optical materials;** • **Dynamic electron beam microcharacterization facilities;** • ***National Center for Electron Microscopy*** • ***Molecular Foundry***	Leader in nanoscience, biomimetic materials (Science Citation Index leader); LBNL leads national TEAM effort; Cover articles *Nature Materials, Physics World, Journal of Physical Chemistry, MRS Bulletin, Science, Journal of Physical Chemistry B.*	Lead the nanoscience revolution delivering controlled chemical processes and novel materials
Engineer Living Systems for Energy and Sustain the Global Environment	· **Microbial organisms and communities;** · **Genome sequencing;** · **Biogeochemical changes and remediation;** · ***Joint Genome Institute***	Recognized leaders in microbial studies, most microbial genomes sequenced in the world; Leading structural biology center. First synthetic biology department. Leaders in subsurface modeling; Lead Yucca Mountain vadose zone program; Environmental Research and Life Sciences Distinguished Fellows; BESAC review cites ALS/LBNL as most productive in crystallography; 2 *Science* magazine "Breakthroughs of the Year" for sequencing/analysis;	Tap the power of biology for energy and environmental solutions; Understand the complex physical, chemical and biological properties of contamination for new solutions.
Understand, Detect, and Prevent Energy and Environmental Causes of Disease	· **Molecular, cellular, and tissue models of disease;** · **New probes and imaging systems for diagnosis;** · **Low-dose radiation effects and DNA damage response.** · **Structural biology at ALS**	Leadership in biological models of disease; National leader in new probes and imaging systems, and low-dose radiation effects; Recent cover articles include *Journal of Physical Chemistry B;* 3 Lawrence and 1 National Medal of Science Awards.	Master the convergence of the physical and life sciences to deliver revolutionary technologies for health and medical applications.
Matter and Energy in the Universe	· **Properties of dark energy;** · **Particle physics (matter-antimatter symmetry, neutrinos);** · **Nuclear structure and astrophysics;** · **Accelerator R&D (electron cyclotron resonant ion sources);** · **LHC heavy-ion experiments;** · **Next generation gamma ray instrumentation;** · **Heavy ion drivers for high energy density physics and inertial fusion.** · ***88-Inch Cyclotron***	Recognized leadership in particle astrophysics; advanced detectors; Gammasphere and GRETINA development; and neutrino science; Cover articles in *Nature, Physics World, Physics Today*; 8 Lawrence and 1 National Medal of Science Awards; "Breakthrough of the Year" 1998 and 2004; Selected as science leader for national underground science laboratory.	Develop promising approaches and configurations to confining plasmas for fusion energy applications; Understand the cosmos and identify dark energy and dark matter; Explore nuclear matter from quarks to stars.
Advanced Scientific Computing for	· **Scientific computing capability and connectivity;**	National leader in mathematics and computational science;	Provide discovery-class computational tools for the U.S. scientific community;

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
DOE Research Programs	· **Mathematical tools and algorithms for science.** · ***National Energy Research Scientific Computing Center*** · ***Energy Sciences Network***	Cover articles include *Science, Physics World, Nature*; 2 of the only 3 awarded SIAM/ACM Prizes in Computational Science; S2 Sidney Fernbach and 2 Gordon Bell Prizes.	Deliver network connectivity to the DOE science community through ESnet

Major Activities

Following is a set of major activities that LBNL would like to pursue to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. The Office of Science is examining all of these potential activities and they are at different stages of development. Some are currently underway and some are mere concepts at this time. For those that are still in the conceptual phase, LBNL has indicated significant interest and is viewed to have current supporting research and mission focus to pursue such activities. Budgets, the Office of Science's strong commitment to a fair and competitive funding process and technical advice from its major scientific advisory committees will ultimately contribute to decisions about which activities can be pursued and at which sites. The companion documents, the DOE's Five Year Plans, provide greater insights into these activities in terms of various five-year budget scenarios.

The Major activities are:

1. Advanced Light Source Upgrades
2. National Energy Research Scientific Computing Center (NERSC) Upgrade
3. Solar to Chemical Energy
4. Joint Dark Energy Mission (JDEM)
5. Optical Accelerators for the Energy Frontier
6. Molecular Foundry

<u>1. Advanced Light Source (ALS) Upgrades</u>

- **Summary:** Upgrade the existing Advanced Light Source to accommodate new instruments to explore the traditionally difficult spectral region between optics and electronics for new science and to meet the growing needs of its user community
- **Expectations:** The unique characteristics of the Advanced Light Source will open up new regimes of scientific discovery and investigation, and enable exploration of: electronic structure of wide classes of correlated electronic systems; pathways in chemical reaction dynamics, nanomagnetism and cellular structure; and lensless imaging and dynamical processes in structural biology.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk* for the first phase due to mature technologies employed and moderate for the second which will rely on additional R&D
  - Market/Competition: *Moderate risk* due to investments being made in Europe and Japan
  - Management/Financial: *Low risk* for the first phase, moderate for the second phase due to funding required

The Advanced Light Source (ALS) is a national user facility that generates intense light for scientific and technological research. As one of the world's brightest sources of ultraviolet and soft x-ray beams, and the world's first third-generation synchrotron light source in its energy range, the ALS makes previously impossible studies possible. It has been operating since 1993 and serves over 2000 users/year.

LBNL is currently improving the ALS by replacing the older undulators and beamlines, which will deliver substantially improved capabilities, especially for applications requiring coherence and high spatial and spectral resolution of the output beam. A second stage major upgrade is now being planned to greatly increase the average brightness and flexibility. This upgrade will replace and improve major components of the accelerator to further increase performance in the hard x-ray region of the spectrum, most notably x-ray photon correlation spectroscopy, coherent imaging, and x-ray nanoprobe microscopes. This will enable exciting new science for advanced imaging and spectroscopy. Opening the new scientific frontier will be made possible by advances in accelerator design to increase brightness up to two more orders of magnitude, through the combination of linac injectors and more modern lattice design.

2. National Energy Research Scientific Computing Center (NERSC) Upgrade

- **Summary:** Upgrade NERSC to accommodate a larger number (200-300) of user projects of medium to large scale and continue to provide high-performance computing and resources to support the requirements for scientific discovery.
- **Expectations:** NERSC continues to meet the Office of Science's high-performance production computing needs.
- **Benefit Perspective:** Potentially *Substantial* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk*. The activity will use technology already existing to increase capacity.
  - Market/Competition: *Low risk*. User demand already has and will likely continue to exceed capacity.
  - Management/Financial: *Medium risk*. Increasing power and building lease costs.

NERSC is the flagship multi-purpose scientific computing facility for the Office of Science in the U.S. Department of Energy. It is one of the largest facilities in the world devoted to providing high-performance computational tools and expertise for unclassified basic scientific research and supports large, interdisciplinary teams of researchers to attack fundamental problems in science and engineering that require massive calculations. NERSC continues on a path to address the increased computational needs of the Office of Science to fulfill its user facility mission by doubling the computational capacity at NERSC within projected program funding levels. For NERSC to support a large number (200 – 300) of user projects of medium to large scale, this doubling of computational capacity is required. More than 2000 computational scientists use NERSC for basic scientific research on a wide range of disciplines including: climate modeling, research into new materials, simulations of the early universe, analysis of data from high energy physics experiments, investigations of protein structure, and a host of other scientific endeavors.

3. Solar to Chemical Energy

- **Summary:** Provide high efficiency direct solar energy conversion to fuels approaching 50 percent or more, radically improving the current efficiency of existing biological systems or photovoltaic to chemical conversion.
- **Expectations:** Providing solar-based, carbon neutral energy supplies will require extraordinary science to create new materials for solar energy production and storage. A research program must combines natural and artificial nanoscale components as needed. A successful activity must develop integrated expertise in artificial nanostructures and synthetic biology.
- **Benefit Perspective:** Potentially *Transformational* Benefits

- **Risk Perspectives:**
    - Technical: *Moderate risk* for R&D as cellular components may not crystallize and many metabolic pathways are not known. Potential high risk for commercialization.
    - Market/Competition: *High risk* as some cellular metabolic pathway work is being done by others and some biodiesel work has been done by other DOE labs
    - Management/Financial: *Moderate risk* for R&D as it could be very expensive to engineer a good producer. Possibly high risks for commercialization.

Technology pathways to be understood and pursued would include such novel technologies as biomimetic, bio-inspired, or entirely synthetic catalysts on nanostructured supports for increased durability, higher rates, and high efficiency. Engineered solar light driven proton pumps could be developed for use in synthetic organisms for biomass to fuel conversion. Inorganic and hybrid solar to fuel systems offer the prospects of enhanced efficiency for light absorption, charge separation, and chemical conversion through nanotechnology. A key pathway to this goal is to develop microorganisms to convert sunlight into biodiesel and to convert cellulose into fuels. Microorganisms will be engineered to efficiently harvest sunlight or cellulose and to convert it into biofuels, most likely biodiesel. Biologically derived fuels that are from renewable, carbon-neutral sources will benefit energy security efforts and help minimize environmental impacts.

4. Joint Dark Energy Mission (JDEM)

- **Summary:** Develop and launch a SuperNova/Acceleration Probe (SNAP), a space-based tool to study the dark energy and alternative explanations of the acceleration of the universe's expansion by performing systematic and highly controlled measurements.
- **Expectations:** To provide an understanding of the mechanism driving the acceleration of the universe by observing distant supernovae using a dedicated telescope in earth orbit. The satellite observatory will be capable of measuring up to 2,000 distant supernovae each year of the three-year mission lifetime.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
    - Technical: *Moderate risk* as the detector and associated electronics in development have good prospects for near term success, but meeting the space qualification requirements will be challenging.
    - Market/Competition: *Moderate risk* as delays in the program will put the laboratory's program at risk and limit their ability to compete in the JDEM down-selection process.
    - Management/Financial: *High risk* due to its early phase of forming mission partners and agreements. A range of launch alternatives could ameliorate this risk.

Recent studies of Type Ia supernovae produced significant evidence that, over cosmological distances, the supernovae appear dimmer than would be expected if the universe's rate of expansion were constant or slowing down. This was the first direct experimental evidence for an accelerating universe potentially driven by an unknown dark energy. This space satellite mission would dramatically increase the discovery rate for such supernovae to eliminate possible alternative explanations, give experimental measurements of several other cosmological parameters, and put strong constraints on possible cosmological models.

As one of the possible JDEM designs, the SNAP project and collaboration is led by LBNL and includes scientists from DOE labs, NASA centers, universities, and foreign institutions. Various launch mechanisms are being explored. The largest cost in the scientific payload is the large aperture telescopic mirror, with trade offs possible on its size with mission performance. A possibility of international partnership is being explored.

5. Optical Accelerators for the Energy Frontier

- **Summary:** Exploring centimeter-scale plasma structures that should be able to accelerate high quality beams to GeV and multi-GeV energies.
- **Expectations:** Lead to the development of compact laser wakefield accelerators with multiple stages, which can produce focused, ultrafast, high-energy bunches of electrons to compete with state-of-the-art machines using conventional radio-frequency acceleration. High energy accelerators could be built on size scales that are three orders of magnitude smaller than those built today.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* as the technology may not scale to TeV energies and high luminosity.
  - Market/Competition: *Moderate risk* as there is strong competition from groups in Europe, Japan, and China.
  - Management/Financial: *Moderate risk* as needed funding may not be available.

Today's high energy accelerators are extremely large. Stanford's linear accelerator, for example, is two miles long and can accelerate electrons to 50 GeV (50 billion electron volts). Laser wakefield technology offers the possibility of a compact, high-energy accelerator for probing the subatomic world, for studying new materials and new technologies, and for medical applications.

6. Molecular Foundry

- **Summary:** Operations at the Molecular Foundry will expand in 2006 for the design, synthesis, and characterization of nanoscale materials with the completion of construction this year.
- **Expectations:** With its new model of "user facility," user-researchers will have access to state-of-the-art instrumentation and technical support staff. Users will work with LBNL scientists to develop new methods for nanomaterial synthesis, design and build new instruments and techniques for characterization at the nanoscale.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk* as there are no technical barriers to overcome.
  - Market/Competition: *Low risk* as user demand is expected to exceed capacity.
  - Management/Financial: *Low risk* as eleven Federal agencies support nanoscale R&D.

This is one of five Nanoscale Science Research Centers (NSRCs) in development at DOE's Office of Science labs, which will be research facilities for the synthesis, processing, and fabrication of nanoscale materials. In addition, the NSRCs will provide specialized equipment and support staff not readily available to the research community and each facility will have a unique focus. The focus of the Molecular Foundry is on the multidisciplinary development and understanding of both "soft" (biological and polymer) and "hard" (inorganic and micro-fabricated) nanostructure building blocks and the integration of these building blocks into complex functional assemblies.

The NSRCs will be operated as user facilities and be available to researchers nationwide. The Molecular Foundry's six primary components will be: nanofabrication; inorganic nanostructures; organic polymer/biopolymer synthesis; biological nanostructures; theory of nanostructures; and imaging and manipulation. The facility will accommodate approximately 140 persons, including roughly 40 staff, as well as users and postdoctoral fellows.

Financial Outlook

Detailed information regarding the financial outlook for the Lawrence Berkeley National Laboratory is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors can not be predicted or estimated in advance. The third, programmatic decisions, are developed in accordance with the planning targets reflected in the Department of Energy programmatic Five Year Plans, a companion document to these strategic laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

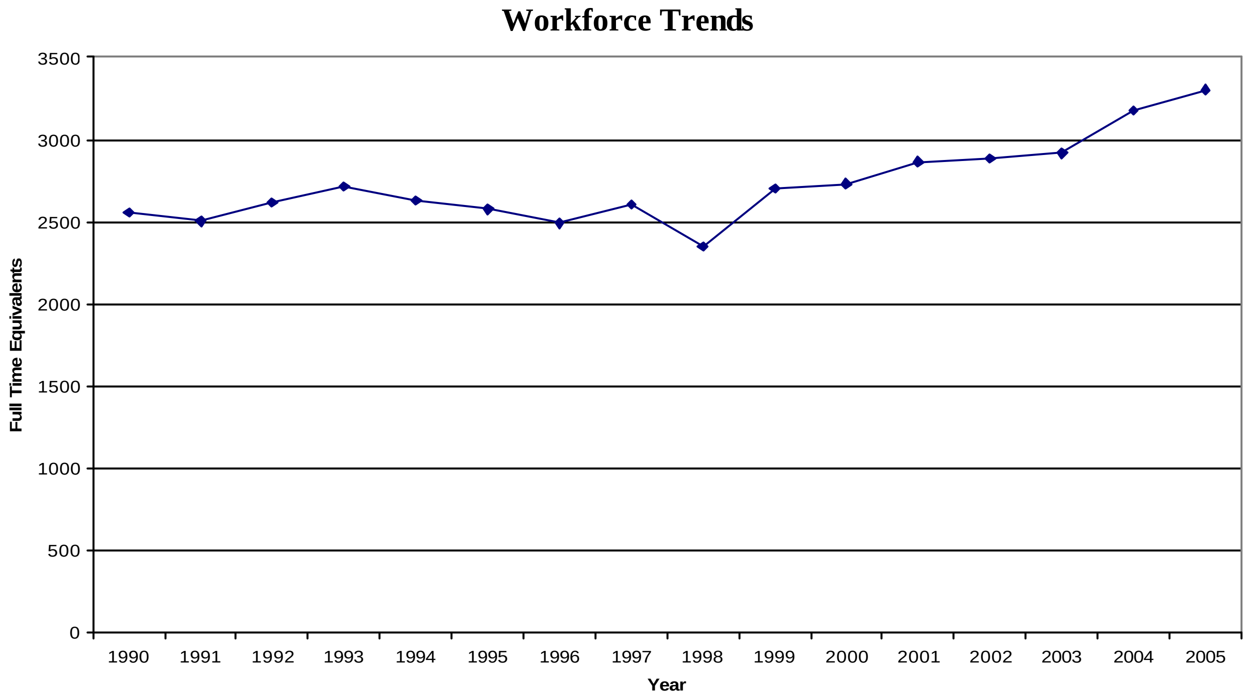
Support for Non-DOE funded work is a vital role our national laboratories, contributing to national security, energy security, environment stewardship, scientific discovery, and more fundamentally, the competitiveness of the U.S. economy. For the Lawrence Berkeley National Laboratory, this is no exception. The Office of Science is supportive of this work and although it is not addressed in any detail within the accompanying Five Year Plans, the Office of Science believes it is sufficiently important and appropriate to address within this strategic laboratory business plan. A brief perspective and financial outlook is therefore provided.

The current LBNL non-DOE funded activities are primarily supported by the National Institutes of Health (NIH), the Department of Defense (DoD), the Department of Homeland Security (DHS), and National Aeronautics and Space Administration (NASA). NIH is the largest non-DOE funding organization and supports research in cancer biology, genomic expression, structural biology, DNA repair, and diagnostic imaging. NIH support is expected to continue to grow for work in biophysics, genome sciences, and instrumentation such as x-ray tomography and crystallography beamlines at the Advanced Light Source. DoD is expected to continue to sponsor breast cancer research, the use of particle beams to simulate the space radiation, and detector development and computational research. It is anticipated that the DHS will sustain programs to develop neutron sources and detectors that scan for nuclear materials, indoor air quality monitoring, cyber-security systems, and other security instrumentation. The laboratory conducts space radiation effects studies, astrophysical research, and detector development for NASA; support for the Joint NASA/DOE Dark Energy Mission is uncertain. Beyond these sponsors, the laboratory is expected to receive support to sustain research for the California Energy Commission, the Environmental Protection Agency and other federal and state agencies, universities and the private sector.

Uncertainties and Risk Management

External Factors: Over the next five years, LBNL will face uncertainties and risks driven by external change. Primary among these is the Federal science budget outlook and unfunded mandates. LBNL will pay close attention to matching the level of science support services to the level of incoming financial resources. With the large user population at scientific facilities, increased security requirements mandated by Homeland Security Presidential Directive-12 may act as a barrier for qualified users to access scientific facilities. Mitigation strategies will need to be developed to handle each one of these risks, to sustain our vitality, core competencies, and mission accomplishments.

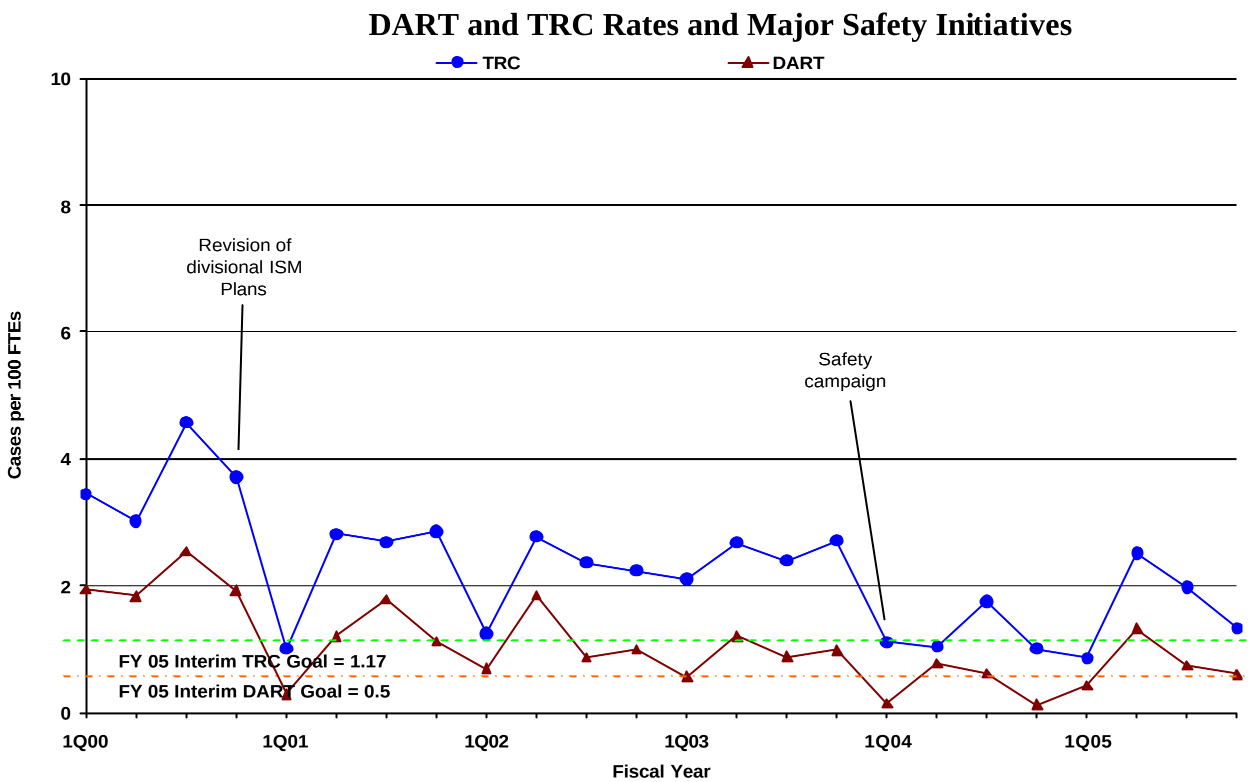
S&T Workforce: LBNL's workforce has the ability to develop new science innovations and to design, construct, and manage projects for complex, state-of-the-art scientific advances. These capabilities were built up in previous major DOE activities, and as a result, teams of highly skilled specialists were formed. With the potential for stable or declining funding, the workforce levels and expertise in areas such as advanced detectors, superconducting magnets, and precision optical instrumentation, face the challenge of "use it or lose it." LBNL will work with the Office of Science to address this risk, including coordinating projects and engaging in underlying engineering and advanced instrumentation research.



Employee Diversity: LBNL plans to strengthen the recruitment and retention of populations currently under-represented in the workforce, particularly African American and Hispanic scientific staff and women in the scientific workforce. LBNL has been developing and implementing new outreach, work environment surveys, and actions tailored to the workforce of every division that enhance the diversity of applicant pools and job hires. New research partnerships with Historically Black Colleges and Universities (HBCUs) strengthen the diversity of the nation's scientific workforce and employ and retain scientists from underrepresented minorities in the programs sponsored by the Office of Science.

To address workforce goals, scientific divisions prepare Division Diversity Plans and Strategic Recruitment plans and engage in extensive outreach activities. Many approaches are applied, tailored to fields of science, and recruitment is statewide when it is necessary to broaden the applicant pool beyond the local area in order to get a diverse qualified pool. Recruitment is nationwide for job groups with high levels of responsibility and/or expertise and therefore a national search is necessary to yield the strongest candidate pool. LBNL is active at regional and national job fairs and in minority scientific societies such as the National Society of Black Physicists and the National Organization of Black Chemists and Chemical Engineers, and the Hispanic Engineers and Scientists. LBNL also provides mentored research experiences and educational outreach that help carry minority students into graduate school and tracks students to follow their developing scientific careers. HBCU faculty are specifically supported and encouraged to access programs of common interest and to contact their peers at LBNL.

Safety: LBNL attention to safety performance and Integrated Safety Management has led to a long term reduction in accidents. An increase in accidents, that occurred in the second quarter of FY 2005, resulting in a Total Recordable Case (TRC) rate of 2.54 per 100 Full Time Equivalents, has been addressed by immediate action and proactive safety management plans. Group meetings, communications, training for safe work performance, and increased management presence in the workplace have resulted in a rate of 1.02 for the fourth quarter, below the Office of Science goal. (These quarterly improvements do not show on the moving average charted below). The overall LBNL TRC rate for FY 2005 was 1.65. As a result of several recent events, and to help ensure continued improvement in lab safety, LBNL is undertaking several initiatives. This includes an external peer review of the lab's safety program and culture, commissioned in early FY06, and it provided a set of findings and specific recommendations for correction. Concurrently, a DOE safety review team is monitoring these actions, working with lab to ensure a strong follow-up, and advising DOE management on adequacy and progress.



Physical Infrastructure: LBNL is located on 203 acres of University of California (UC) land overlooking the UC – Berkeley campus. Established as a Federal laboratory in the 1940s, LBNL has over 1.1M sf of space in 59 buildings; 67% of the building space, as well as many of the utility systems and roads, are 40 years old or older. The site is very hilly with little land suitable for the sitting of new facilities. Due to the lack of adequate space on site, LBNL leases over 120,000 sf off site, and has an additional 72,000 sf of space on the UC Berkeley campus. LBNL's AUI is 0.973 (good).

Maintenance, recapitalization, and modernization are supported with overhead, operating, and GPP funds and with line item funding. LBNL will attain a maintenance investment level of 2% of replacement plant value (excellent) in FY 2006, which will be continued in FY 2007 and the outyears. LBNL's deferred maintenance backlog is $52.9M resulting in an Asset Condition Index of 0.92 (adequate). A deferred maintenance reduction initiative was initiated in FY 2006, and will be continued in FY 2007 with funding of $2.2M. The Department has begun the clean up and removal of the de-activated Bevatron accelerator which, when completed, will provide nearly 10 acres of flat land for re-development.

The FY 2007 GPP funding request is for $4.1M. Funding for one new line item project is requested in FY 2007 – the Seismic Safety Upgrade of Buildings, Phase I. This project will address the seismic vulnerability of laboratory buildings in which high life-safety risks have been identified. LBNL’s future recapitalization and modernization challenges include building replacements and renovations, seismic upgrades, and utility renovations.

DOE Business Plan for the Office of Science's Oak Ridge National Laboratory

Mission and Overview

Oak Ridge National Laboratory (ORNL) is the Department of Energy's largest science and energy laboratory. Managed since April 2000 by UT-Battelle, a partnership of the University of Tennessee (UT) and Battelle Memorial Institute, ORNL was established in 1943 as a part of the secret Manhattan Project. During the 1950s and 1960s, ORNL became an international center for the study of nuclear energy and related research in the physical and life sciences. The 1970s led to an expansion of ORNL's research programs into the areas of energy production, transmission, and conservation. Today, under the Department of Energy's Office of Science, ORNL has the primary mission focus of conducting research in neutron science, energy, high-performance computing, systems biology, materials science, and national security that will lead to innovative solutions to complex problems. As an international leader in a range of scientific areas supporting DOE's basic research, energy, national security, and environmental missions, ORNL is actively engaged in a broad range of national and international partnerships with industry and educational institutions. As a DOE steward of critical national research infrastructure, the laboratory provides access to university, industry and government researchers on a competitive basis. The Laboratory is home to 2,478 facility users and visiting scientists every year. The $1.4 billion Spallation Neutron Source (SNS), scheduled for completion in 2006, will make ORNL the world's foremost center for neutron science research.

Laboratory Focus and Vision

Six core competencies underpin activities at Oak Ridge National Laboratory:

1. Neutron science
2. High performance computing
3. Energy research
4. Advanced materials
5. Complex biological systems
6. S&T for national security

Lab-at-a-Glance

Location: Oak Ridge, TN

Type: Multi-program lab

Contract Operator: UT-Battelle (partnership between University of Tennessee and Battelle Memorial Institute)

Responsible Field Office: Oak Ridge Office (ORO)

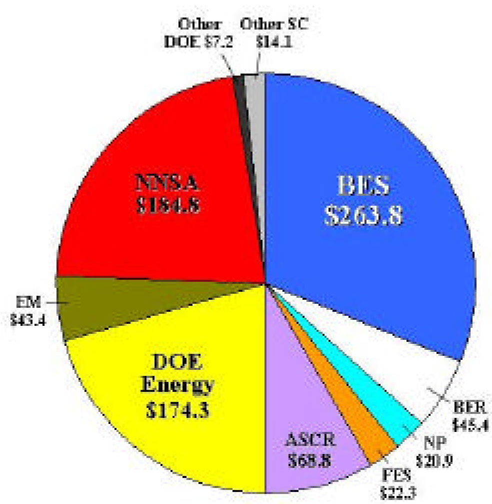
Website: http://www.ornl.gov/

Physical Assets:
- 302 buildings
- 1,100 acres

Human Capital:
- 3,974 employees;
- 1736 Students (Undergraduate and Graduate);
- 2478 Facility Users and Visiting Scientists

FY 2005 Total DOE Funding: $846.2M

FY 2005 DOE Funding by Source
PALS data (BA in Millions):



FY 2005 Non-DOE Funding: $224M

The Office of Science believes that these six competencies will enable ORNL to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the areas of:

- Delivering and sustaining the world's foremost center for neutron scattering
- Sustaining world leadership in computational science and engineering
- Sustaining world leadership in materials science through discovery, synthesis, and characterization of materials at the nanoscale
- Leadership in microbial biology and proteomics, producing bio-based solutions to energy challenges and enabling the new field of "ecogenomics"
- International leadership in energy technology through science
- Delivering "first-of-a-kind" science-based security technologies and implementing nuclear nonproliferation programs.

Business Lines

The following capabilities, aligned by business lines, distinguish ORNL and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of ORNL and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, identify research facilities that convey particular, strategic strengths and capabilities to the Lab. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Typical of our multi-program laboratories, ORNL supports work for several large customers. The Office of Science is the primary sponsor for work in the business lines of Neutron Scattering; Computational Science & Engineering; Materials Synthesis, Design, Characterization and Processing; Molecular Biology and Ecology; and Fusion Science and Technology. In support of these areas, ORNL is one of the world's broadest and most capable materials science and technology laboratories, achieving significant integration between basic and applied technology research. For the business line of Arms Control and Nonproliferation, the Department of Energy's NNSA and the Department of Homeland Security are primary customers, and the Defense Threat Reduction Agency is a secondary customer. In particular, the NNSA contributes significant resources to ORNL to provide technical leadership to prevent the spread of nuclear materials and technology. ONRL is the single largest provider of support for materials protection and control programs. In the Energy Technology business line, primary customers include the DOE's Offices of Energy Efficiency and Renewable Energy, Nuclear Energy, and Electricity Delivery and Energy Reliability. ORNL has, perhaps, one of the world's largest and broadest public energy research and development portfolios. This portfolio includes expertise in buildings, transportation, and industrial end-use efficiency; electric transmission and distribution with strengths in superconducting transmission; and nuclear energy and space nuclear power.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
		Primary Business Lines	
Neutron Scattering	· **Pulsed (SNS) and steady-state (HFIR) neutron beams for research and industrial development;**	By 2008, SNS and instrumentation will provide capability at 10 to 100 times the current state of the art. HFIR will provide unsurpassed	Advance core disciplines of basic energy sciences; Lead nanoscale science revolution; Master control of energy-relevant

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
	· **Next generation instrumentation;** · **Applications for science and engineering** · ***Spallation Neutron Source;*** · ***High Flux Isotope Reactor.***	capabilities for steady-state.	complex systems.
Computational Science & Engineering*	· **Methods and tools for advanced architecture supercomputers;** · **Early research in new technologies and architectures;** · **Advanced science and engineering models.** · ***Center for Computational Science;*** · ***Leadership Computing Facility.***	LCF expected to become the world's leading center for capability computing for civilian science as demonstrated by full plasma simulation, high-resolution climate modeling, and predictive materials modeling.	Advance discovery through computer science and math; Advance scientific simulation through new computational models; Evaluate and apply new supercomputing architectures for science and provide leadership computing resources.
Materials Synthesis, Design, Characterization and Processing	· **Mechanisms that determine materials properties;** · **Synthesis, characterization, and processing of alloys, ceramics, carbon-based/ electronic materials;** · **Instruments for characterizing nanoscale materials;** · ***High Temperature Materials Lab;*** · ***Surface Modification and Characterization Research Center;*** · ***Center for Nanophase Materials.***	Broadest materials science laboratory as reflected in development of new materials for extreme environments and control of materials properties at the nanoscale; Leadership in electron microscopy at extreme resolution and sensitivity	Advance core disciplines of basic energy sciences; Lead nanoscale science revolution; Master control of energy-relevant complex systems.
Energy Technology	· **High-efficiency, low-emission transportation technologies;** · **Energy-efficient industrial and buildings technologies;** · **Electric transmission and grid control technologies;** · **Materials, fuels, and instrumentation for nuclear power;** · ***Buildings Technology Center;*** · ***National Transportation Research Center.***	Largest and broadest public energy R&D portfolio. Leading edge nuclear capability in fuels and materials. Notable strength in superconducting transmission.	Develop technologies that foster a diverse supply of reliable, affordable, and environmentally sound energy and that improve our mix of energy options and our energy efficiency.
Molecular Biology and Ecology	· **Physical and computational methods for bioscience;** · **Genomics and proteomics of microbes and plants;** · **Field ecological, environmental, and subsurface research;** · **Mouse genetics;**	A leader in high-throughput methods for systems biology with ability to characterize molecular complexes and interactions. Mouse facility and bioinformatics enable comparative genomic analyses and understanding of complex biological systems.	Tap power of genomics for our Nation's energy & environment; Unravel mysteries of our Earth's changing climate and protect our living planet; Develop science for remediation of contaminated sites;

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
	· ***Oak Ridge National Environmental Research Park;*** · ***Center for Structural Molecular Biology;*** · ***Center for Comparative and Functional Genomics.***	Leading facilities for ecological, carbon cycle, and subsurface science.	Master convergence of the physical & life sciences for health & medicine.
Fusion Science and Technology	· **Fusion materials;** · **Plasma theory, simulation, and modeling;** · **Advanced torus and stellarator concepts;** · **Fusion technologies (RF and fueling systems);** · **Participation in ITER.**	A leader in advanced concept design, simulation models, and fusion materials Manages the U.S. ITER Project Office in a partnership with PPPL A leader in application of fusion technologies to international tokamak experiments	Understand plasma behavior and determine the most promising confinement configurations; Develop new materials to make fusion energy a reality; Participate in international effort on burning plasmas; Supports the Virtual Laboratory for Technology.
Arms Control & Non-proliferation	· **Safeguarding materials;** · **Detecting illicit production of nuclear materials;** · **Radiological dispersal devices (for DHS).**	Single largest provider of support for materials protection & control. Leader in uranium and enrichment science and RDDs	Provide technical leadership to limit or prevent spread of materials, technology, and WMD expertise.
Secondary Business Lines			
Nuclear Physics	· **Nuclear structure and astrophysics with radioactive beams;** · **Neutron physics;** · **Accelerator R&D in high power targets;** · ***Holifield Radioactive Ion Beam Facility.***	Nation's only facility for producing both proton- and neutron-rich post-accelerated beams. SNS will be world's most powerful source of pulsed neutron and low energy neutrinos for particle physics	Understand the structure of the nucleon and nucleonic matter; Investigate nuclear astrophysics; Investigate symmetries that are the basis of the Standard Model.

***** Within the Computational Science and Engineering Business Line, the laboratory is the lead institution in a partnership with Argonne National Laboratory and Pacific Northwest National Laboratory to establish leadership class computing facilities for open scientific research

Major Activities

Following is a set of major activities that ORNL would like to pursue to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. The Office of Science is examining all of these potential activities and they are at different stages of development. Some are currently underway and some are mere concepts at this time. For those that are still in the conceptual phase, ORNL has indicated significant interest and is viewed to have current supporting research and mission focus to pursue such activities. Budgets, the Office of Science's strong commitment to a fair and competitive funding process and technical advice from its major scientific advisory committees will ultimately contribute to decisions about which activities can be pursued and at which sites. The companion documents, the DOE's Five Year Plans, provide greater insights into these activities in terms of various five-year budget scenarios.

The major activities are:

1. Neutron Scattering at 10X the State of the Art
2. Theory, Modeling, and Simulation
3. Materials Control at the Nanoscale
4. Systems Biology
5. Advanced Energy Technologies

1. Neutron Scattering at 10X the State of the Art

- **Summary:** Sustaining world leadership in the scientific and technological impact of neutron scattering, and in the facilities and instruments that enable that impact.
- **Expectations:** This activity will sustain U.S. leadership in neutron scattering and materials research and development; generate innovative new materials for energy and national security applications; and develop foundational biology data to support bioengineering for energy and health care.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk* as expectations are that SNS will meet design goals and HFIR cold source will function as expected.
  - Market/Competition: *Low risk* but competitive Asian or European neutron scattering center will be developed over time.
  - Management/Financial: *Moderate risk* due to funding uncertainties with second target station and management, regulatory, security, and infrastructure issues with HFIR that could impact reliability and cost.

The focus of the neutron scattering activity is to: deliver the world's most capable neutron scattering center, including the Spallation Neutron Source (SNS) and the cold source at the High Flux Isotope Reactor (HFIR); extend our leadership with new instruments, the SNS power upgrade, and the SNS long-wavelength target station; and build the world's foremost neutron scattering research program. Key elements of the activity include the SNS power upgrade, the heavy-water supplement, a long-wavelength target station, SNS Instruments-Next Generation (SING), eight additional instruments, SNS operations, and HFIR operations.

The corresponding programs and capabilities will enable fundamental discoveries in materials in superconductivity, magnetism, phase transitions, and structure and dynamics. They will enable fundamental advances in biology (membranes, protein structure, and dynamics). And they will facilitate optimization of engineering materials through *in situ* studies and nondestructive measurements.

2. Theory, Modeling and Simulation

- **Summary:** Sustaining world leadership in theory, modeling, and simulation through application of the most powerful computing capability that is possible.
- **Expectations**: This activity will sustain U.S. leadership in computational science and engineering; reduce risk and increase scientific productivity from major Office of Science user facilities, and will result in new energy technologies in such areas as engines, fuel cells, or fission and fusion power reactors.
- **Benefit Perspective:** Potentially *transformational* benefits.
- **Risk Perspectives:**
  - Technical: *Moderate risk* due to uncertainties with regard to present and future architectures and their ability to meet expectations.

- Market/Competition: *High* risk as other DOE labs have large programs and activities in Japan, U.K. and China.
- Management/Financial: *Moderate risk* given strong dependence on stable funding.

The core of this activity is to build, operate, and sustain premier leading-edge computational facilities for the research community; develop multiscale methods for modeling of complex systems; and develop modeling and simulation tools that enable scientific and technological breakthroughs in key application areas. Key elements include the Leadership Class Facility (LCF) hardware and operations; possibly components of advanced architecture R&D; simulation science; and methods, algorithms, and tool development. This activity builds on current capabilities at ORNL.

These investments will transform discoveries in materials, biology, climate science, plasma physics, astrophysics, and other areas. They will fundamentally enable the investigation of experimentally inaccessible natural and engineered systems, from supernovae to the dynamics of the electric grid.

3. Material Control at the Nanoscale

- **Summary:** Understanding and control of material properties at the nanoscale through neutron scattering, computing, and molecular-scale imaging and manipulation.
- **Expectations:** This activity will create the first DOE nanoscale science center and user program and it will result in transformational materials technology options for energy (extreme environments, new functionality, tailored properties, specific reactivity).
- **Benefit Perspective:** Potentially *transformational* benefits.
- **Risk Perspectives:**
    - Technical: *Moderate risk* due to uncertainties in the ability of the Center for Nanophase Materials Sciences (CNMS) to meet expectations.
    - Market/Competition: *Low risk* risks tied to whether the Chinese make heavy investments and assume leadership in nanoscale science.
    - Management/Financial: *Moderate risk* from continuing decline in energy technology investments and inadequate investments in facilities and equipment.

This is one of five Nanoscale Science Research Centers (NSRCs) in development at DOE's Office of Science labs, which will be research facilities for the synthesis, processing, and fabrication of nanoscale materials. The NSRCs will provide specialized equipment and support staff not readily available to the research community and each facility will have a unique focus. The focus of the CNMS will be on developing the capability of atomic level tailoring of nanomaterials to achieve desired properties and functions, based on a basic understanding of how materials respond in the nanoscale form. This activity will exploit leading capabilities in neutron scattering, microscopy, computing, and nanoscale synthesis to provide insight into the structure and properties of nanophase materials at ORNL.

The CNMS will focus research efforts on the connection between properties and structure and dynamics; and it will closely couple and integrate across science and technology, enhancing innovation at the boundaries of disciplines and fields that contribute to basic materials research. Major investments associated with this activity include CNMS operations; molecular imaging/spectroscopy center; science program budgets; and an energy materials budget.

Ultimately, this activity will enable understanding of correlated electron and macromolecular systems and nanostructured materials. Through these investments, there will be significant advances in nanoscale imaging, predictive modeling, and synthesis and processing.

4. Systems Biology

- **Summary:** Understanding and application of protein interactions and other biologically significant molecular interactions in microbial and plant cells and communities.
- **Expectations:** This activity will provide the scientific basis for production of bioproducts and bioenergy; create foundational methods for the emerging field of "ecogenomics" and for developing the knowledge necessary to mitigate the impacts of climate change; and it will develop the techniques and systems biology framework for understanding the cellular response to radiation or other insults.
- **Benefit Perspective:** Potentially *sustaining/substantial* benefits
- **Risk Perspectives:**
  - Technical: *Low risk* tied to difficulty in high-throughput characterization of low-abundant and short-lived complexes; and higher risk regarding personnel recruitment and retention, given the competition from academic, federal and private sectors.
  - Market/Competition: *Moderate risk* due to risks of success with Genomics:GTL facility competition.
  - Management/Financial: *Moderate risk* due to uncertainty of planning for Genomics:GTL facilities given recent National Academies report.

This systems biology activity will develop high-throughput capabilities for protein complex identification and characterization; develop new techniques for molecular imaging in cells; and it will apply the resulting understanding of fundamental biological process to energy and environmental research. This activity includes the development and operation of a potential Genomics:GTL center or similar facility (assuming success in an open, merit-based competition); the Genomics:GTL facility operation and protein complex research; and ecosystem field research and modeling.

Through these investments, it will be possible to significantly improve the identification and characterization of protein complex structure and function, and more generally, to develop a system-level understanding of biological networks (intracellular and intercellular, and inter-organism). This knowledge and capability will ultimately drive the effort to harness the functionalities of biological systems for energy production and environmental clean-up.

5. Advanced Energy Technology

- **Summary:** Apply the knowledge and capabilities of nanoscience, systems biology, and leadership-class computing to create breakthroughs in energy technologies.
- **Expectations:** This activity will result in accelerated innovation in current and new technologies that will reduce U.S. petroleum imports; increase capacity, security, and reliability of the electric grid; decrease energy consumption and net carbon emissions; and improve the efficiency of power production and industrial processes.
- **Benefit Perspective:** Potentially *sustaining/substantial* benefits
- **Risk Perspectives:**
  - Technical: *Low risk* associated with price targets for fuels, engines, or materials.
  - Market/Competition: *Low risk* recognizing that international leadership in energy technology is "up for grabs" in transportation and other areas.
  - Management/Financial: *Moderate risk* due to lack of new investment in energy technology.

This activity will develop new materials for extreme environments through nanoscience and advanced computing; apply genomics and proteomics to bio-processing and the development of biofuels; and employ new materials and advanced computing for a next-generation electric grid. The activity draws upon ORNL's core scientific and instrumental capabilities, and strengths in areas of energy materials research, biofuels- and bioproduct-driven research; and electric grid-thrust research.

With successful deployment of this activity, there will be radical and accelerated innovation in high-performance, low-emission hybrid engines; low-cost, low-net-carbon liquid fuels; solid-state electronics and real-time grid control; and higher temperature, more efficient industrial processes.

Financial Outlook

Detailed information regarding the financial outlook for the Oak Ridge National Laboratory is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors can not be predicted or estimated in advance. The third, programmatic decisions, are developed in accordance with the planning targets reflected in the Department of Energy programmatic Five Year Plans, a companion document to these strategic laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

Support for Non-DOE funded work is a vital role our national laboratories, contributing to national security, energy security, environment stewardship, scientific discovery, and more fundamentally, the competitiveness of the U.S. economy. For the Oak Ridge National Laboratory, this is no exception. The Office of Science is supportive of this work and although it is not addressed in any detail within the accompanying Five Year Plans, the Office of Science believes it is sufficiently important and appropriate to address within this strategic laboratory business plan. A brief perspective and financial outlook is therefore provided.

The major ORNL non-DOE funded activities are primarily supported by the Department of Defense (DoD), Nuclear Regulatory Commission (NRC), Department of Homeland Security (DHS), National Aeronautics and Space Administration (NASA), and the Department of Health and Human Services/National Institutes of Health (DHHS/NIH). The work for DoD is focused on national defense in such areas as sensor technology, materials development, navigation, and bioremediation. The NRC activities revolve around reactor pressure vessel integrity, aging and environmental effects on containment, high-burnup fuel issues for storage and transport of spent fuel, advanced reactor physics, and instrumentation and controls technology. DHS supports research in biological, chemical, and radiological/nuclear countermeasures, and threat, vulnerability, and test assessment while NASA supports activities related to fission power systems for space exploration with an emphasis on human exploration of the Moon and Mars. The DHHS/NIH research is in the areas of bioanalytical chemistry, biomedical engineering and bioimaging, biomaterials, genomics, metabolomics and proteomics.

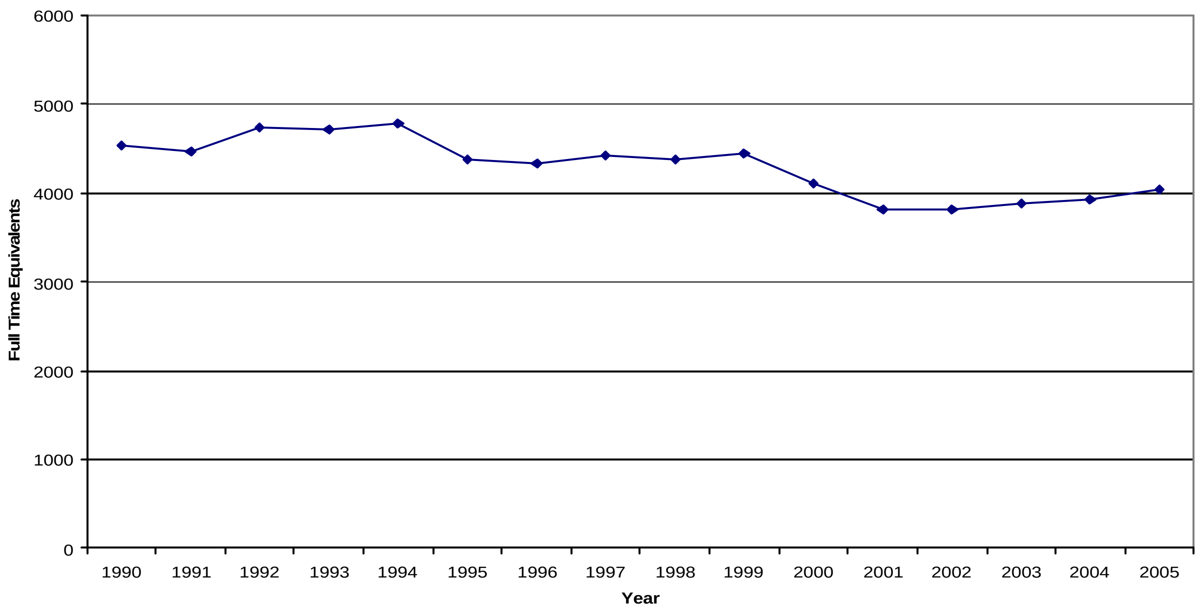
Support from DHS and NASA are expected to remain stable over the next five years while an increase in DoD funding is expected in several key areas, including detection and survival of chemical and biological agents. Growth in NIH funding is anticipated through 2010 in many areas including mammalian genomics. Reactor licensing activities for the NRC Office of Nuclear Reactor Regulation are expected to increase beginning in 2007.

Uncertainties and Risk Management

External Factors: Over the next five years, ORNL will have a number of concerns driven by external forces. One significant issue is increasing energy costs. Additionally, the rising cost of healthcare and workers compensation will continue to impact the laboratory. ORNL carefully watches the earning performance of their pension plan assets to ensure adequate funds are available to cover current and future liabilities. With the large user population for the scientific facilities, Homeland Security Presidential Directive-12 (HSPD-12) will be a challenge to operations. Increasing costs are likely as cyber security is being handled in an increasingly complex regulatory and reporting environment. Finally, ORNL faces a significant challenge in rationalizing its extensive nuclear infrastructure, including consolidation from ten to two nonreactor nuclear facilities, involving the decontamination, decommissioning, and removal of multiple contaminated facilitates.

S&T Workforce: ORNL employs roughly 4000 full-time equivalent (FTE) research and support staff. In keeping with their strategy of the last several years, ORNL intends to increase technical staff more rapidly, and support staff less rapidly, than the overall laboratory budget.

Workforce Trends



Employee Diversity: ORNL will pursue a number of educational outreach activities to ensure long-range goals in increasing the availability of women and minorities in science and technology by developing and enhancing feeder programs for potential employment and strengthening diversity through the following program activities:

- Educational and Research Experiences—For students and teachers of all ages
- Partnerships—UT-Battelle's university partners
- Collaboration—Oak Ridge Associated Universities
- K-12 Program—Enhanced learning opportunities at ORNL
- UT-Battelle Scholarship—UT-Battelle's employee scholarship program
- The GEM and RAM programs—Exposure to world-class R&D for graduate and undergraduate minority students

ORNL will also invest resources by 2007 in support of the targeted recruitment of women and minorities and will participate in the following efforts:

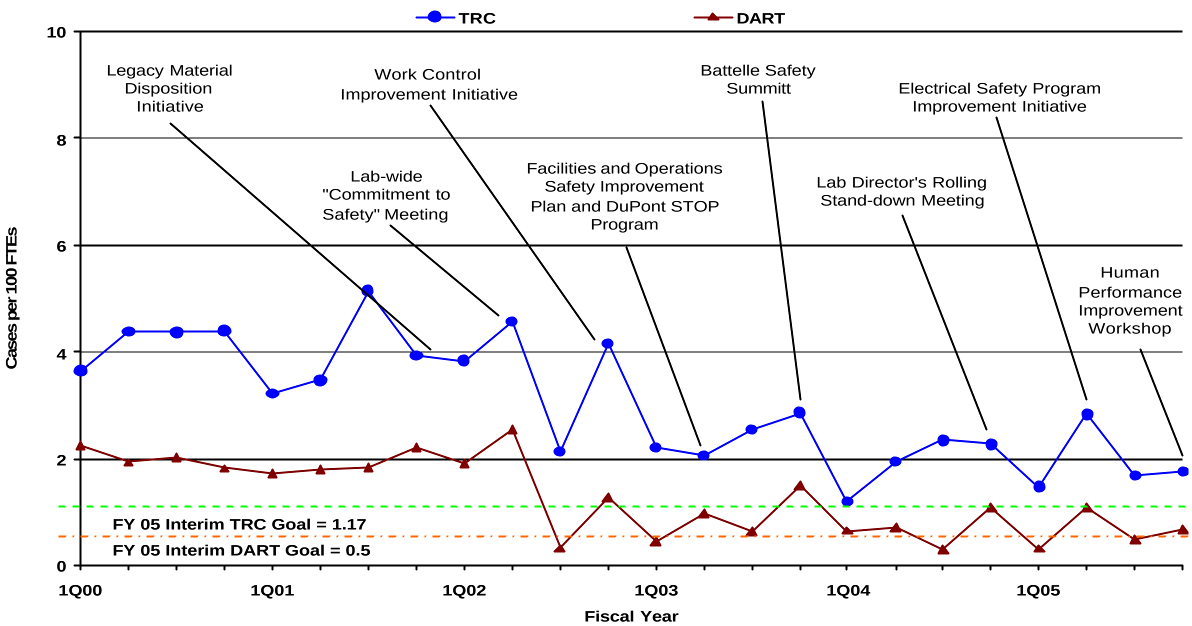
- Leverage our collaboration and participation through co-op and internship programs at Historically Black Colleges and Universities (HBCUs) and Minority Serving Institutions (MSIs).

- Aggressively recruit at minority- and women-targeted Career Fairs and Conferences
- Continue to achieve diversity representation in postdoctoral research, focusing on increasing the numbers of women and minorities.
- Drive recruiting efforts at UT-Battelle's partner universities to attract high-caliber women and minority students.

In addition to the initiatives and facilities, the ORNL Leadership Team has identified a diverse and talented staff as an equally critical asset to the continual growth and health of the Laboratory. ORNL has traditionally had an attrition rate in the 4 to 5% range. (Voluntary terminations are in the 3 to 4% range, and retirements account for about 1.0 %.).

Safety: Substantial progress in improving safety performance has been achieved since 2000, with the Total Recordable Case (TRC) rate, for example, cut by more that 50%. ORNL's efforts to continuously improve safety are on-going through the implementation of initiatives, programs, and projects such as those shown in the figure below. Foremost in this effort are the emphasis to all ORNL staff that "all accidents are preventable" and leadership's commitment to the flow down of safety leadership and performance accountability. Supporting principles include a strong "zero accidents" safety philosophy, an understanding that safety is a shared responsibility, and strategic planning for continuous improvement.

DART and TRC Rates and Major Safety Initiatives*



** Does not include statistics for the Spallation Neutron Source*

Physical Infrastructure: Physical Infrastructure: ORNL is located on a 21,000 acre Federal reservation near Knoxville, TN. Established in the 1940s as part of the Manhattan project, the laboratory has 3.6M sf of space in 256 buildings. Sixty-seven percent of its space as well as most of its utility systems and roads are over 40 years old. ORNL's AUI is 0.977 (good).

Maintenance, recapitalization, and modernization are supported with overhead (maintenance and Institutional GPP), operating, and GPP funds and with line item funding. ORNL will attain a maintenance investment level of 2% of replacement plant value (excellent) in FY 2006, which will be continued in FY 2007 and the outyears. ORNL's deferred maintenance backlog is $52.9M resulting in an ACI of 0.92 (adequate). A deferred maintenance reduction initiative was initiated in FY 2006 and will be continued in FY 2007 with funding of $2.2M.

The proposed FY 2007 funding for the clean-up and demolition of excess facilities funding is $2.5M, including $1M of direct funding. There remains an estimated backlog of $7.3M of clean-up and demolition projects. The FY 2007 GPP funding request is for $8.1M. The laboratory has a strong Institutional GPP program with planned expenditures of $10M in FY 2006 and $8M in FY 2007.

Funding for one new line item project is requested in FY 2007 – Modernization of Wing 4 of the Central Materials and Chemistry Laboratories (the 4500 complex). This project will rehabilitate a facility housing many of the laboratory's chemical laboratory facilities, as well as administrative offices and the medical clinic.

ORNL's future challenges include modernization of the remainder of the 4500 complex, consolidation of ORNL's extensive nuclear infrastructure; replacement of ORNL's waste management infrastructure; and cleanup of ORNL's Central Campus, including demolition of a large number of obsolete structures, many of which are contaminated.

DOE Business Plan for the Office of Science's Pacific Northwest National Laboratory

Mission & Overview

The Pacific Northwest National Laboratory (PNNL) was created in 1965 and has a broad focus in energy security, national security, and the environment. In its early days PNNL brought nuclear science and engineering expertise to the surrounding Department of Energy Hanford Site to tackle projects focused on designing reactors, fabricating reactor fuel, and protecting the environment. Since then, PNNL has evolved into a leading multi-disciplinary national laboratory providing scientific discoveries and developing innovative technologies under DOE's Office of Science. It is unique in the SC complex since a majority of funding does not come from DOE, and SC is a minority funding partner. PNNL's mission focus of environmental science, climate physics, molecular sciences, and measurement technologies takes advantage of their capabilities in interfacial chemical sciences, radiological sciences, biosciences, and analytics to support Office of Science research efforts in the environment and energy security. DOE's National Nuclear Security Administration contributes equally to conduct work in support of nonproliferation and other national security activities. PNNL operates the Environmental Molecular Sciences Laboratory (EMSL), a user facility dedicated to providing advanced and unique resources to scientists and to educating scientists in the molecular sciences field to meet future challenges.

Laboratory Focus and Vision

Six core competencies underpin activities at PNNL:

1. Environmental microbial and cellular biology and applied proteomics
2. Environmental sciences in biogeochemistry, climate, and subsurface science, and integrated assessment of energy and environment
3. Analytical and interfacial chemical sciences
4. Radiological sciences
5. Information analytics and data management/mining applications
6. Sensing and measurement technologies and systems, for energy, national security and environmental applications

Lab-at-a-Glance

Location: Richland, WA

Type: Multi-program lab

Contract Operator: Battelle Memorial Institute

Responsible Site Office: Pacific Northwest Site Office (Paul Kruger)

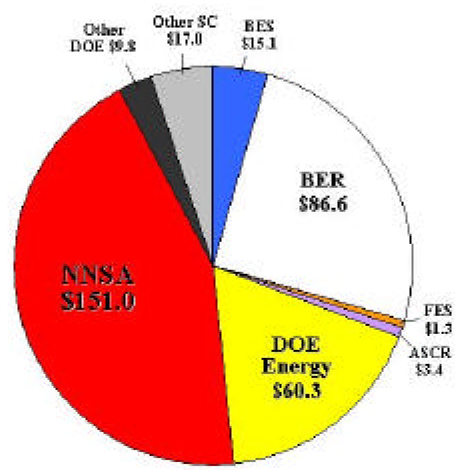
Website: http://www.pnl.gov/

Physical Assets:
- 2.04M gross square feet; DOE owns 760K (Office of Science 200K, EM 560K), Battelle owns 490K, and 790K is leased.
- 380 acres

Human Capital:
- 4200 employees;
- TBD
- TBD

FY 2005 Total DOE Funding: $344.6M

FY 2005 DOE Funding by Source
PALS data (BA in Millions):



FY 2005 Non-DOE Funding: $396M*
** Includes $76M in indirect EM funding*

The Office of Science believes that these seven competencies will enable PNNL to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the areas of:

- Predict, manipulate and design biological systems for biofuels, bioproducts, bioremediation, and biothreat reduction.
- Predict environmental change and damage for rapid, accurate and efficient mitigation of intentional or unintentional release of contaminants.
- Control chemical and physical processes at the nanoscale to increase the performance of chemical and energy-intensive systems.
- Enhance the nation's capabilities in data-intensive, high performance computing to accelerate scientific discovery and security analysis involving very large data sets.
- Create coal to hydrogen and carbon capture technologies that when fully implemented will replace some amount of imported oil by utilizing domestic hydrocarbon resources.
- Develop next-generation threat detection and prevention systems to reduce nuclear proliferation and terrorism.
- Deliver integrated experimental and computational resources through the Environmental Molecular Sciences Laboratory (EMSL) for discovery and technological innovation in environmental molecular sciences.

Business Lines

The following capabilities, aligned by business lines, distinguish PNNL and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of PNNL and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, Identify research facilities that convey particular, strategic strengths and capabilities to the Lab. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Typical of our multi-program laboratories, PNNL supports work for several large customers. In fact, a majority of PNNL's support comes from clients outside of DOE. For the National and Homeland Security Business line, the primary customers are NNSA, DHS, DoD, and the intelligence community. In particular, the NNSA contributes significant resources to PNNL to develop next-generation threat detection and preventions systems in support of nuclear nonproliferation. Secondary customers include National Institute for Allergies and Infectious Diseases (NIAID) and private industry. The advanced analytical capabilities in EMSL are an essential resource for this business line and PNNL brings particular capabilities to bear including decades of expertise in the technical aspects of nuclear materials production and detection (e.g., the nuclear fuel cycle, weapons material production, environmental monitoring, transuranic waste management, and safeguards, detection, and measurement technologies), as well as in such complex social and technical matters as economic diversification and international relations. For the business line of Foundational Science, the primary customers are the DOE's Office of Science, specifically Biological and Environmental Research, Basic Energy Sciences, and Advanced Scientific Computing Research. Secondary sponsors include the National Institute for General Medical Sciences (NIGMS) and the National Heart, Lung and Blood Institute (NHLBI). Finally, for Energy Science and Technology, the third largest business line, primary customers are DOE's Offices of Energy Efficiency and Renewable Energy, Fossil Energy, Nuclear Energy -EERE, DOE-FE, DOE-NE, and DOE-OE; secondary customers include National Aeronautics and Space Administration (NASA), the U.S. Nuclear Regulatory Commission (NRC) and private industry.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Foundational Science	· **Environmental microbiology;** · **Applied proteomics;** · **Climate physics;** · **Chemical physics & analytics;** · **Computational Chemistry;** · **High performance computing;** · ***Environmental and Molecular Sciences Laboratory*;** · ***Life Sciences Laboratory.***	DOE lead for environmental microbiology; PNNL in the top 1% of institutions in ISI citation rate for chemistry, physics, geosciences, and clinical medicine; Fastest time to solution for computational chemistry problems; Unique actinide chemistry and 900MHz NMR spectrometers; extensively used ultra high resolution infrared spectra database.	Fundamental science to deliver high-impact science based solutions in energy, security and environment.
Energy S&T	· **Solid Oxide Fuel Cells;** · **Hydrogen storage and safety;** · **Biobased products and fuels;** · **Power grid technology;** · **Integrated assessment;** · *Applied Process Engineering Laboratory.*	Leader in: Solid State Energy Conversion program; Chemical Hydrogen Storage (co-lead); Bioproducts; GridWise program; and Global climate change technology	Promote clean, secure, reliable and affordable energy
National and Homeland Security S&T	· **Radiation detection;** · **Radioanalytical chemistry & radiochemical processing;** · **Visual analytics;** · **Critical infrastructure simulation & cyber security.**	Over 50 years leadership in ultra-trace detection; Lead for national Radiation Portal Monitoring project: Lead for National Visual Analytics Center; Lead developer of cyber security simulation systems for federal systems.	Reduce proliferation of global nuclear threat and prevent terrorism against the homeland
Environmental S&T	· **Biogeochemistry & subsurface science;** · **Chemical process engineering;** · **Atmospheric sciences & climate modeling;** · **Marine sciences;** · ***Process Science and Engineering Complex.***	Top 1% in citations; More than 100 patents; Leadership in DOE Atmospheric Radiation Measurement Program; DOE's only Marine Sciences Laboratory.	Predict, assess and cost-effectively mitigate environmental damage and threat

Major Activities

Following is a set of major activities that PNNL would like to pursue to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. The Office of Science is examining all of these potential activities and they are at different stages of development. Some are currently underway and some are mere concepts at this time. For those that are still in the conceptual phase, PNNL has indicated significant interest and is viewed to have current supporting research and mission focus to pursue such activities. Budgets, the Office of Science's strong commitment to a fair and competitive funding process and technical advice from its major scientific advisory committees will ultimately contribute to decisions about which activities can be pursued and at which sites. The companion documents, the DOE's Five Year Plans, provide greater insights into these activities in terms of various five-year budget scenarios.

The major activities are:

1. Predictive Biology
2. Predictive Environmental Science
3. Control of Chemical Processes
4. Data-Intensive Computing
5. Energy Conversions
6. Threat Detection & Prevention

1. Predictive Biology

- **Summary:** Reduce from weeks to minutes, and dollars to cents, the requirement for fully characterizing and analyzing a complete proteome, dramatically shortening the timeline for understanding its role in cellular response, similar to the experience with genome sequencing and analysis of the Human Genome Project.
- **Expectations:** Fundamental transformations in biological research toward a quantitative, predictive science will lead to: global-scale, high throughput, high resolution, verifiable analyses of proteins, metabolites, and molecular complexes; real-time multi-spectral images of cellular processes; computational modeling, simulation and visualization of biological processes; and predictive models of the influence of microbial processes on contaminant fate and transport.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* because PNNL core capabilities and technology lead already exist.
  - Market/Competition: *Moderate risk* because while many other organizations will be competing in the same area, PNNL currently has the leading technology and position.
  - Management/Financial: *Moderate risk* given diversity of funding needed.

PNNL's predictive biology activity will create a set of tools to help scientists predict and design biological systems useful for biofuels, bioremediation, and biothreat reduction. A key to unlocking the power of biology for application to energy and security challenges lies in understanding how proteomes – the basic building blocks of biological systems – determine system behavior in response to environmental conditions. Obtaining this understanding will result in a fundamental change in biological research toward a much more quantitative, predictive science. The primary obstacle that prevents a more predictive and quantifiable approach in biological sciences is characterization science – chromatography and mass spectrometry. Next-generation instrumentation under development at PNNL will greatly improve the sensitivity and speed of analytical devices, with reduced size and complexity. A second fundamental issue is the ability to computationally handle and make sense of the large amounts of data that are generated by a quantitative approach. PNNL's activity on data intensive computing is aimed in part at this problem.

2. Predictive Environmental Science

- **Summary:** Enable discoveries in environmental science needed to more accurately predict environmental change and damage by improving our understanding of molecular-level processes and their relationship to local, regional, and global environmental effects.
- **Expectations:** Transformation of environmental assessment and management toward a predictive, systems-based science that will lead to: discovery and application of molecular-level, environmental biomarkers to predict biological response of humans and ecosystems arising from environmental insult; development of computational and bioinformatics tools to identify patterns of biomolecular change in complex, multi-scale systems; understanding of the chemistry and dynamics of aerosols and cloud

physics; and utilization of observational data to develop and validate climate models (global and regional scale)

- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* because PNNL core capabilities already exist.
  - Market/Competition: *Moderate risk* because PNNL is ahead of other organizations in the environmental biomarkers area, but there is competition in the climate change markets
  - Management/Financial: *Moderate risk* given diversity of funding needed.

There are two key thrusts within this activity: environmental biomarkers and climate change. For environmental biomarkers, the absence of experimental and computational methods to identify a suite of biomarkers for complex systems, often in the absence of genomic sequence data, is the major barrier to developing knowledge, tools, data, and advanced models to determine and more accurately predict how ecosystems respond to environmental change. For climate change, the absence of an understanding of aerosol chemistry and dynamics and cloud physics is the major barrier to answering questions about how human activity affects the behavior of clouds and in turn, how clouds influence climate change. This research will enable more reliable and rapid assessment of damage from intentional or accidental contaminate release, more accurately targeted regulatory policy, and more effective mitigating actions in support of energy and environmental policy and security.

3. Nanoscale Control of Chemical Processes

- **Summary:** Control chemical and physical processes in nanostructured materials to achieve a ten-fold increase in the performance of catalytic processes and materials used in energy and security applications.
- **Expectations:** Understanding the fundamentals of how geometric and electronic structure control chemical and physical properties at the nanoscale will lead to: design new catalytic processes with controlled reactivity and selectivity; new nano-structured materials and deployment systems; and new materials for the detection and remediation of dispersed chemical, radiological and biological agents.
- **Benefit Perspective:** Potentially *Substantial* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* because PNNL core capabilities already exist.
  - Market/Competition: *High risk* because many other organizations will be competing in the same area.
  - Management/Financial: *Moderate risk* given diversity of funding needed.

PNNL will develop new experimental methods to study dynamics at single sites under standard operating conditions, synthesize homogeneous nanostructured materials, and develop new multiscale computational methods that accurately describe the influence of condensed phases and interfaces on local properties and processes. These methods will be applied to real-world materials and situations. For example, future energy systems will require an understanding of catalytic processes for efficient production, storage and use of fuels such as hydrogen. In addition, new nanoscale materials will increase our ability to detect and specify radiological, chemical, and biological agents. These methods will increase carbon capture capacity by orders of magnitude over the current levels and reduce the cost to commodity prices.

4. Data-Intensive Computing

- **Summary:** Create a computational problem solving environment especially suited for solving high-performance computational problems involving very large data sets such as those associated with biological science and national security.
- **Expectations:** The ability to work with very large, heterogeneous datasets will lead to: prediction of

microbial systems at the molecular, cellular and community levels; intelligence information from high volume and complex data; real time remedial action schemes to enhance performance, reliability and security of the electrical grid; and large scale discoveries in energy, health, and environment through predictive sciences by merging experiments with both scientific and data intensive computing.

- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *High risk* because success is dependent on improvements in all parts of the computing system.
  - Market/Competition: *Moderate risk* because there are many significant competitors, including other national labs, universities, non-profits and private sector companies.
  - Management/Financial: *High risk* because this will require multiple investors and the management of software/hardware/application development is complex.

PNNL will maximize the discovery of reliable themes and trends in heterogeneous, dynamic data sets from problems in biology, national security, and infrastructure. PNNL will develop a test bed to evaluate pattern-matching, flow-solving hardware and new scalable data-analysis and discovery tools and databases for integration across spatial and temporal scales.

5. Energy Conversions

- **Summary:** PNNL will investigate how to transform coal into hydrogen to mitigate the impact of imported fuels while minimizing environmental consequences.
- **Expectations:** Development of coal to hydrogen conversion technologies will lead to: new catalytic and photocatalytic processes with controlled reactivity and selectivity; novel materials for carbon capture and high-temperature gas separations; computational models of processes from molecular-scale to 3D reactive flow; and bio-based processes for production of hydrogen.
- **Benefit Perspective:** Potentially *Substantial* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk* because existing technical approaches are understood.
  - Market/Competition: *High risk* because industry adoption of technologies is uncertain.
  - Management/Financial: *Low risk* because this activity fits within existing DOE priorities and capabilities.

Substantial innovations in nanoscience and materials, control of chemical conversions, computational capability and modeling, and subsurface science make possible now what was technically infeasible even a decade ago. The primary technical challenge is the successful deployment of new and robust conversion and carbon-management processes given the scale and complexity of the energy infrastructure. The primary challenge for the business community is economic risk of volatile oil prices. Investment in this space may become stranded as the cost of oil may once again drop in response to both additional supplies and reduced demand.

6. Threat Detection & Prevention

- **Summary:** Develop advanced measurement and detection methods, detection systems coupled with next-generation information-analysis, and knowledge-discovery technologies to greatly reduce the threats and potential risks associated with global proliferation of weapons of mass destruction (WMD) and with domestic acts of terrorism.
- **Expectations:** Development of advanced detection and prevention methods will lead to; more effective capabilities to detect, provide early warning of, and characterize clandestine nuclear weapon materials

production; improved safeguarding of special nuclear materials in foreign countries; deployment of integrated approaches for WMD forensics and attribution; and development and implementation of next-generation, multi-threat detection systems

- **Benefit Perspective:** Potentially *Substantial* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* because PNNL core capabilities are strong.
  - Market/Competition: *High risk* because a large number of other players exist.
  - Management/Financial: *Low risk* because the cost/benefit ratio is high.

PNNL will develop advanced measurement and detection methods coupled with next-generation information-analysis and knowledge-discovery systems that greatly improve the Nation's ability to prevent, detect, or minimize the proliferation of WMD, meet the needs of the intelligence community, and enhance national and homeland security. The approach to this challenge has multiple elements. The foundation is a solid understanding of threat scenarios and associated signatures. To enhance detection of radiological materials, PNNL will create, validate, and then use a new, first-principles approach for the discovery of materials that provide high spectral resolution for radiation detection without cryogenic cooling.

Financial Outlook

Detailed information regarding the financial outlook for the Pacific Northwest National Laboratory is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors can not be predicted or estimated in advance. The third, programmatic decisions, are developed in accordance with the planning targets reflected in the Department of Energy programmatic Five Year Plans, a companion document to these strategic laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

Support for Non-DOE funded work is a vital role our national laboratories, contributing to national security, energy security, environment stewardship, scientific discovery, and more fundamentally, the competitiveness of the U.S. economy. For the Pacific Northwest National Laboratory, this is no exception. The Office of Science is supportive of this work and although it is not addressed in any detail within the accompanying Five Year Plans, the Office of Science believes it is sufficiently important and appropriate to address within this strategic laboratory business plan. A brief perspective and financial outlook is therefore provided.

The major PNNL non-DOE federally funded activities are primarily supported by the Department of Homeland Security (DHS), Department of Defense (DoD), and the Department of Health and Human Services (DHHS). For DHS, the laboratory is primarily developing and deploying technologies to counter terrorist threats, including sensor technologies for the detection of chemical, biological, radiological, and nuclear threats; as well as providing capabilities for protecting critical infrastructures. PNNL also leads the Radiation Portal Monitoring Project (RPM) for the DHS Bureau of Customs & Border Protection's program to install radiation detectors at U.S. ports of entry. For DoD, the laboratory is working on improved methods of radar detection and imaging, chem/bio/nuclear sensing for mobile applications, materials development, durable and portable energy sources, and software for cyber security and operational support. PNNL also receives significant funding from DHHS (NIH), the Nuclear Regulatory Commission (NRC), and funding directly from private and public entities under a Private Use Permit. The RPM project is expected to increase by 50-70% over the next 3-4 years before it declines and closes out around FY10. Other WFO funding is expected to increase modestly over FY05 levels in all program areas over the next 5 years.

Uncertainties and Risk Management

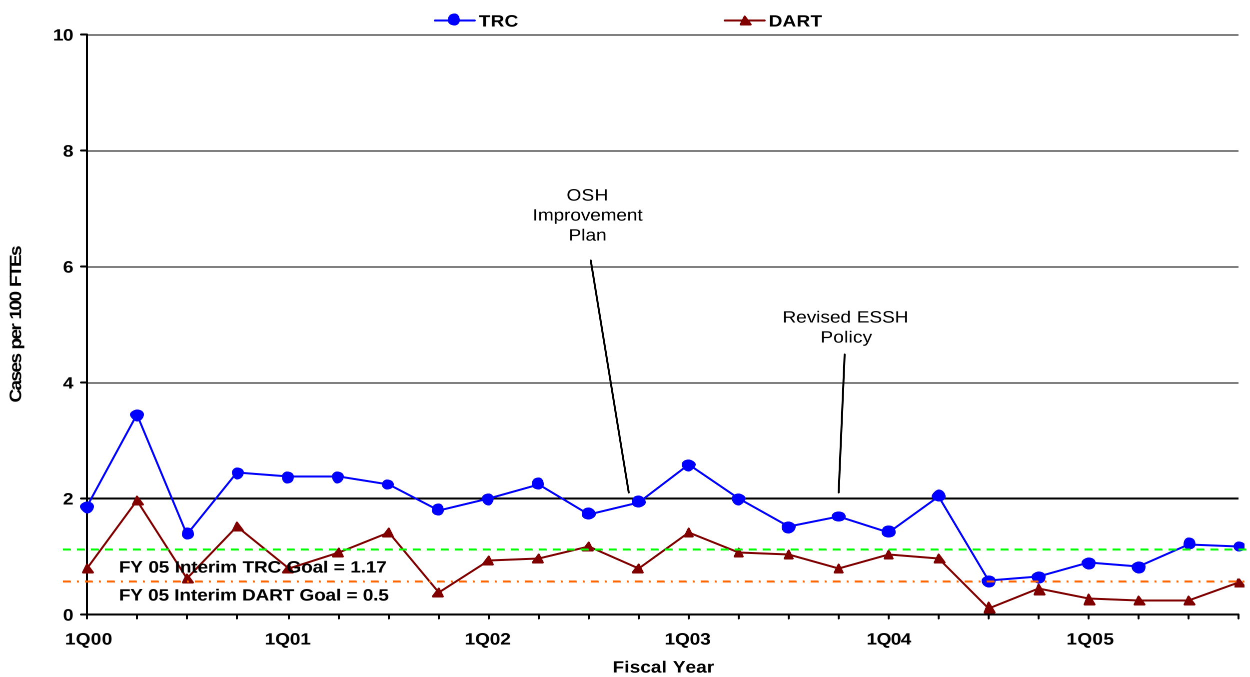
External Factors: The primary risk to PNNL's immediate viability is the requirement to transition out of 30% of its total laboratory space (40% of its laboratory-intensive space), which is located in facilities slated for accelerated cleanup on the Hanford Site. Maintaining and evolving a broad, cross-cutting science base with reductions and refocusing in Federal budgets will also be a challenge.

S&T Workforce: Recruiting and retaining scientific staff and maintaining relationships with external partners (universities, other labs, private industry) are vital to PNNL's core science and technology programs. PNNL shares with other laboratories challenges to recruiting, including a decline in numbers of students graduating in S&T fields from U.S. schools and difficulties in hiring suitable foreign nationals. Nonetheless, PNNL is growing its workforce and has a strong record of staff retention.

Workforce Diversity: As with most DOE labs, PNNL must make significant progress in the recruitment and retention of under-represented populations. PNNL has expanded its diversity goals to new job categories, including post-docs, interns and students, many of whom will go on to take full-time research positions at PNNL or other DOE laboratories. PNNL has begun to use dedicated, diverse recruiters and new recruiting models that are responsive to the market for minority technical employees.

Safety: PNNL is in the second year of a multiyear Safety Performance Improvement Plan to enhance the safety leadership skills of managers, provide more avenues for greater worker involvement (especially around the topic of injury prevention), and continue targeted improvements in the safety program (see figure below). The current effort is built upon PNNL's success in achieving a validated Integrated Safety Management (ISM) program, Voluntary Protection Program (VPP) Star status, ISO 14001 registration, and EPA Performance Track membership. These standards together demonstrate excellence nationally and internationally in integrating environment, safety, and health practices in the workplace. These collective efforts have resulted in DART and total recordable case (TRC) performance that is approaching world-class status. PNNL's current FY2005 DART rate (0.29) meets the FY2005 target and is approaching the DOE/Office of Science FY2007 target of 0.25. Similarly, PNNL's TRC rate of 0.88 is well below the DOE/Office of Science FY2005 target of 1.10 and approaching the FY2007 target of 0.65. In FY2006 and beyond, PNNL plans to incorporate elements of human performance to further strengthen our safety culture and program in a manner that will help us come ever closer to achieving our goal of offering our staff an injury-free career.

DART and TRC Rates and Major Safety Initiatives



Physical Infrastructure: PNNL was established in 1965 in the split-up of the original Hanford Works contract. As part of the split-up, PNNL inherited use of many of the facilities in the Hanford 300 Area, and was provided land south of 300 Area. Battelle has subsequently constructed numerous facilities on its property adjacent to the land south of the 300 Area to conduct its own private as well as DOE work (452,000 sf, 830 people). In addition to federal facilities in the 300 Area, PNNL has one other Federal facility in the land south of the 300 Area, namely, the William R. Wiley Environmental Molecular Sciences Laboratory (EMSL), a national scientific user facility (200,000 sf, 388 people). PNNL also leases space in the Richland area (680,000 sf, 2,204 people). PNNL's AUI for EMSL is 1 (excellent).

With the planned closure and clean up of the Hanford 300 Area, PNNL must vacate its facilities located there near the beginning of the next decade (548,000 sf, 610 people). DOE plans to replace the mission essential facilities with new ones near EMSL. These new facilities, collectively referred to as the Capabilities Replacement Laboratory, include the Federally funded Physical Science Facility (PSF) and three yet-to-be-approved privately financed facilities – the Computer Sciences Facility, the Biological Science Facility and the Life Sciences Facility. The PSF is co-funded by the Office of Science, National Nuclear Safety Administration, and the Department of Homeland Security.

Maintenance, recapitalization, and modernization are supported with overhead (maintenance and Institutional General Plant Projects), operating, and GPP funds and with line item funding. Because of the impending closure of the 300 Area, maintenance investments in the 300 Area are limited to those necessary to ensure safe operations through closure in 2011.

For the remaining Federal facility, namely EMSL, PNNL will attain a maintenance investment level of 2.5% of replacement plant value (excellent) in FY 2006, and 2% in FY 2007 and the outyears. PNNL has no deferred maintenance backlog, thus the ACI is 1 (excellent). The FY 2007 GPP funding request is $4.5M. PNNL has initiated use of Institutional General Plant Project funding to support development of the new campus.

DOE Business Plan for the Office of Science's Princeton Plasma Physics Laboratory

Mission and Overview

The Princeton Plasma Physics Laboratory (PPPL) is the only Department of Energy Lab devoted primarily to plasma and fusion science and is the leading U.S. institution investigating the physics of magnetic fusion energy. Magnetic fusion research at Princeton began in 1951 under the code name Project Matterhorn. Now PPPL is host to the Collaborative National Center for plasma and fusion science. Plasma is hot ionized gas in which nuclear fusion occurs under the appropriate conditions of temperature, density, and confinement in a magnetic field. PPPL's mission focus is to make the scientific discoveries and develop the key innovations that will lead to an attractive new energy source; conduct world-class research along the broad frontier of plasma science and technology; and provide the highest quality of scientific education. For three decades PPPL has been a leader in magnetic confinement experiments using the tokomak approach. To deepen the understanding of plasmas and create key innovations to make fusion power a practical reality, PPPL is leading work on an advanced fusion device, the National Spherical Torus Experiment, and developing other innovative confinement concepts. The lab hosts other experimental facilities used by multi-institutional research teams and also sends researchers and specialized equipment to other fusion facilities in the U.S. and abroad.

Laboratory Focus and Vision

Three core competencies underpin business line activities at the Princeton Plasma Physics Laboratory:

1. Experimental plasma physics in the areas of: construction and operation of unique fusion facilities; diagnostic development and application; radio-frequency plasma heating and experimental research in all facets of physics of magnetized plasmas.
2. Theoretical plasma physics in the areas of: computational turbulence studies; nonlinear MHD studies; understanding fast-ion induced instabilities; and providing national theory coordination for the Spherical Torus and Stellarator initiatives.
3. Computation in the areas of: algorithm development; massive parallelization; portability; visualization; and shared fusion code library.

Lab-at-a-Glance

Location: Princeton, NJ

Type: Single-program lab

Contract Operator: Princeton University

Responsible Field Office: Princeton Site Office

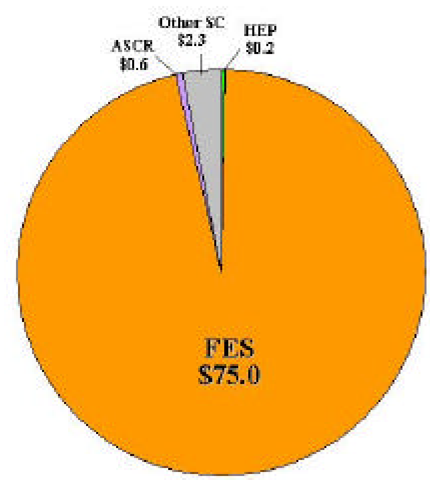
Website: http://www.pppl.gov/

Physical Assets:
- 36 buildings
- 88 acres

Human Capital:
- 408 employees (9/05)
- 35 graduate students
- 119 Facility Users and Visiting Scientists

FY 2005 Total DOE Funding: $78.1M

FY 2005 DOE Funding by Source
PALS data (BA in Millions):



FY 2005 Non-DOE Funding: $1.5M

The Office of Science believes that these three competencies will enable PPPL to deliver its mission focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the areas of:

- Research, experimentation, simulation, engineering and design in burning plasmas;
- Research and experimentation to increase fusion power at given size and field;
- Investigations to achieve compact efficient steady-state operations; and
- Fundamental understanding of plasma behavior, including instabilities, sufficient to provide predictive capabilities for design of fusion energy systems.

Business Lines

The following capabilities, aligned by business lines, distinguish PPPL and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of PPPL and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, identify research facilities that convey particular, strategic strengths and capabilities to the Lab. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Burning Plasma Physics	· **Experimental research in all facets of physics of magnetized plasmas;** · **Constructed and operated the only D-T experiment in the U.S ;** · **Leaders in developing diagnostics, radio frequency and current drive heating system;** · **Engineers who designed and operated fusion experiment with tritium as a fuel;** · **Engineers and designers with expertise in electromagnetic, structural, thermal and neutronics codes;** · *National Spherical Torus Experiment.*	Leading experimental and theoretical/ computational research in all facets of physics of magnetized plasmas; Leaders in developing diagnostics, radio frequency and current drive heating systems; Engineers who designed and operated fusion experiment with deuterium-tritium as a fuel; Engineers and designers with expertise in electromagnetic, structural, thermal and neutronics codes.	Demonstrate with burning plasmas the scientific and technological feasibility of fusion energy.
Increased Fusion Power at Given Size and Field	· **Experimental research in all facets of physics of magnetized plasmas;** · **World leading spherical torus experiment;** · **Most powerful heating systems;** · **High beta (ratio of plasma pressure to magnetic field pressure);** · **Unique world leading diagnostic tools;** · *ITER participation.*	Leading experimental and theoretical/computational research in all facets of physics of magnetized plasmas; World-leading high beta results (ratio of plasma pressure to magnetic field pressure).	Determine the most promising approaches and configurations to confining hot plasmas for practical fusion energy systems.
Compact Efficient	· **Experimental research in all facets**	Leading experimental and	Determine the most promising

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Steady-State Operation	**of physics of magnetized plasmas;** · **Optimized for continuous operations with little recirculating power;** · *National Compact Stellarator Experiment.*	theoretical/computational research in all facets of physics of magnetized plasmas; Successful design of world-leading compact configuration for efficient continuous operation.	approaches and configurations to confining hot plasmas for practical fusion energy systems.
Theoretical and Computational Understanding	· **Computational turbulence studies;** · **Computational macro-stability studies;** · **Understanding fast ion induced instabilities and macrostability;** · **Algorithm development;** · **Massive parallelization;** · **Visualization.**	Leading computation in: plasma turbulence; plasma macro-stability; and fast ion induced instabilities studies; Parallelization and visualization development.	Develop a fundamental understanding of plasma behavior sufficient to provide a reliable predictive capability for fusion energy systems.

Major Activities

Following is a set of major activities that PPPL would like to pursue to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. The Office of Science is examining all of these potential activities and they are at different stages of development. Some are currently underway and some are mere concepts at this time. For those that are still in the conceptual phase, PPPL has indicated significant interest and is viewed to have current supporting research and mission focus to pursue such activities. Budgets, the Office of Science's strong commitment to a fair and competitive funding process and technical advice from its major scientific advisory committees will ultimately contribute to decisions about which activities can be pursued and at which sites. The companion documents, the DOE's Five Year Plans, provide greater insights into these activities in terms of various five-year budget scenarios.

The major activities are:

1. ITER
2. National Spherical Torus Experiment (NSTX)
3. National Compact Stellarator Experiment (NCSX)
4. Collaborative Computing

1. ITER

- **Summary:** An international collaboration based around a fusion tokamak experiment operating at over 100 million °C and producing 500 MW of fusion power for over 400 seconds. ITER will be located in Cadarache, France. Oak Ridge National Lab (ORNL) in partnership with PPPL will host the U.S. ITER Project Office.
- **Expectations:** To provide key knowledge to build the first electricity-generating fusion power station based on magnetic confinement of high temperature plasma - in other words, to capture and use the power of the sun on Earth.
- **Benefit Perspective:** Potentially *Transformational* Benefits - a new non-carbon energy source.
- **Risk Perspectives:**

- Technical: *High risk* - will be pushing many state-of-the-art technologies to their limits.
- Market/Competition: *Low risk* - provided the U.S. participates in the experiment and gains for the U.S. knowledge needed to build fusion power plants in the future.
- Management/Financial: *High risk* - due to the collaboration of multiple countries with different approaches to project management, and the magnitude of funding required.

ITER will be an unprecedented international collaboration of seven partners involved in fusion research worldwide. PPPL will support the U.S. members of the ITER Council to address key risk issues including: risk-based management approaches that lead to cost-effective construction; and a research program structure that fosters integrated international teams, providing the U.S. with wide opportunities regardless of the levels of financial contribution.

An experienced PPPL/ORNL leadership team has been assembled to mitigate the technical ITER risks, which arise from pushing multiple state-of-the-art technologies to their limits, and provide for the successful design, construction and operation of ITER. Members of the broader U.S. Fusion Team will be invited to participate on various tasks assigned to the ITER team. This U.S. team will work with the international ITER team to establish effective management techniques including the application of value engineering.

2. NSTX

- **Summary:** Study the physics principles of spherically shaped plasmas using The National Spherical Torus Experiment (NSTX). Results from this innovative magnetic fusion device will provide unique scientific input to the ITER Project.
- **Expectations:** NSTX will continue to lead the world in developing fusion systems with very high beta (ratio of plasma pressure to magnetic field pressure), allowing cost-effective magnets to contain powerful fusion plasma. NSTX will address issues of fusion science, including energetic particle physics, inaccessible in any other device worldwide. Research on NSTX will also address compact, efficient continuous operation.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* due to the complexity of the devices and the potential for coil failure. Risk is mitigated by having long lead items available to build new components if necessary.
  - Market/Competition: *Low risk* due to a strong lead in the world. Other facilities cannot match its heating, diagnostic, and control capabilities.
  - Management/Financial: *Low risk* due to proven financial and management systems and current operation.

NSTX produces plasma that is shaped like a sphere with a hole through its center, different from the "donut" shaped plasmas of conventional tokamaks. This innovative plasma configuration may have several advantages, a major one being the ability to confine a higher plasma pressure for a given magnetic field strength (allowing it to provide unique scientific input for ITER). This has been demonstrated both experimentally and theoretically. Since the amount of fusion power produced is proportional to the square of the plasma pressure, the use of spherically shaped plasmas could allow the development of smaller, more economical fusion reactors, as well as a cost effective Component Test Facility.

3. NCSX

- **Summary:** A new experimental facility, the National Compact Stellarator Experiment (NCSX), is under construction as the centerpiece of the U.S. effort to develop the physics and determine the attractiveness of the compact stellarator as the basis for a fusion power reactor.

- **Expectations:** NCSX will help lead the world in developing fusion systems that operate continuously with very little power required to sustain the plasma configuration. Research on NCSX will also address the attainment of high beta and thus efficient use of the magnetic field. NCSX will assist researchers in developing the best configuration for holding hot plasma in the magnetic fields.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* due to the complexity of the devices and cutting edge technologies. Risks are mitigated with intentional redundancies in research and production of complex elements.
  - Market/Competition: *Low risk* due to a lack of comparable research elsewhere.
  - Management/Financial: *Moderate risk* due to the complexity of the configuration.

The NCSX will be built at the Princeton Plasma Physics Laboratory in partnership with Oak Ridge National Laboratory. The NCSX is now in design and construction. First plasma is scheduled for 2009. NCSX will lead the world in developing fusion systems that operate continuously with very little power required to sustain plasma configuration.

4. Collaborative Computing

- **Summary:** Maximize potential from ongoing experiments, while assisting in daily research and development of innovations, through collaborations among the U.S. fusion science community in the development of computer codes and sharing computational resources.
- **Expectations:** Collaborative Computing will minimize the technical risks of fusion research throughout the U.S.
- **Benefit Perspective:** Potentially S*ubstantial* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk* due to prior prototype.
  - Market/Competition: *Low risk* due to a lack of similar research elsewhere.
  - Management/Financial: *Low risk* due to relatively small cost and prior experience.

Advanced computing has already been proven useful in optimizing the design of devices used in fusion research, such as NCSX, and the communication of research data among the fusion research community is a practical and necessary aspect of achieving the overall goal of affordable fusion energy. The Computational Plasma Physics Group (CPPG) currently plays a key role in this Fusion Collaboratory. As an example, PPPL's TRANSP code is currently being used worldwide for data interpretation via the Fusion GRID. PPPL has had great success maintaining this large code on a single architecture and making it available through the GRID.

Financial Outlook

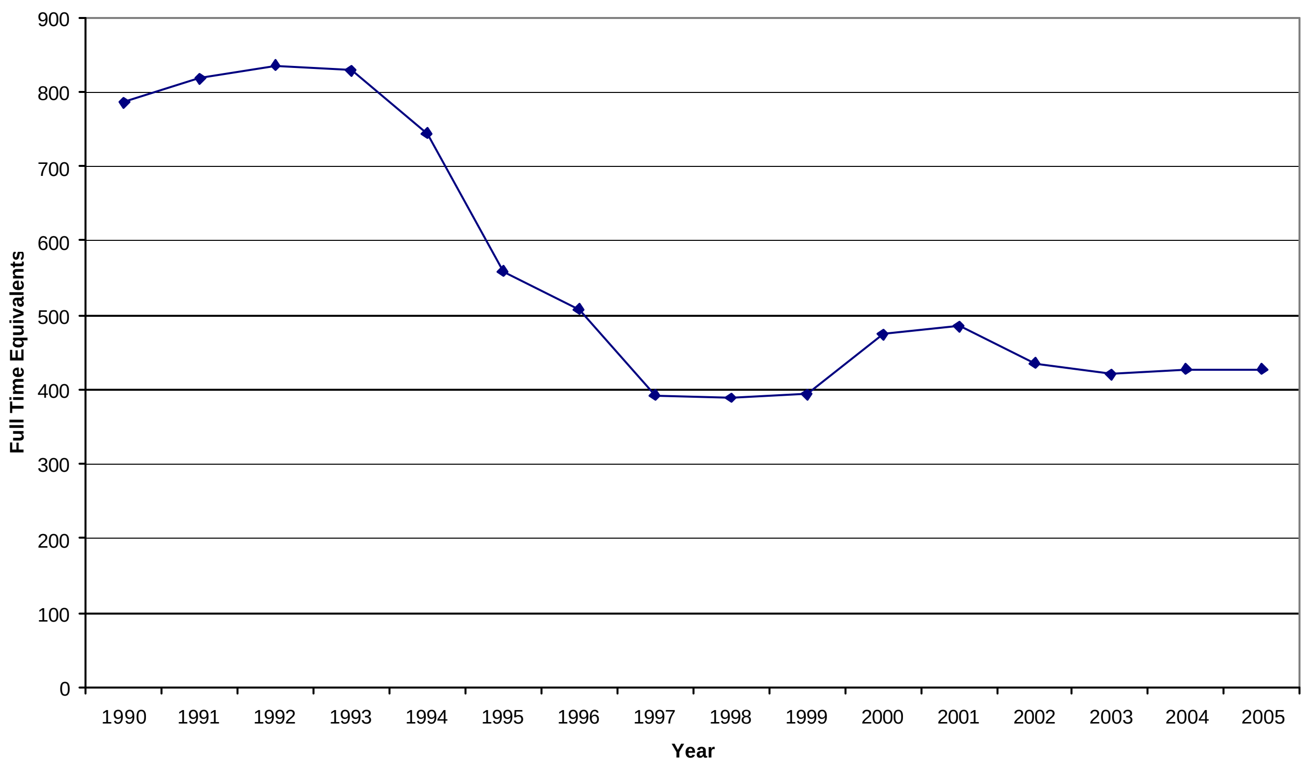
Detailed information regarding the financial outlook for the Princeton Plasma Physics Laboratory is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors can not be predicted or estimated in advance. The third, programmatic decisions, are developed in accordance with the planning targets reflected in the Department of Energy programmatic Five Year Plans, a companion document to these strategic laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

Uncertainties and Risk Management

External Factors: Over the next five years, PPPL will have concerns driven by external forces. Primary among these is the budget outlook for the Laboratory. Other concerns include; the Princeton University prime contract expires in 2006; implementation of Homeland Security Presidential Directive-12 (HSPD-12) and foreign visits and assignments; and meeting the DOE 2% Maintenance Investment Index Goal in FY06.

S&T Workforce: PPPL has faced challenges associated with reductions in laboratory staffing. PPPL recently offered a voluntary separation program in which 29 individuals participated. Staffing scenarios are presented in the historical staffing graph below.

Workforce Trends



Diversity: Diversity continues to be an important goal at PPPL, however, the decline in staff levels has challenged implementation. As with most DOE labs, PPPL must make significant progress in the recruitment and retention of under-represented populations. Critical to the success of this commitment is realization of constrained ideal funding projections as well as success of a diverse workforce development pipeline.

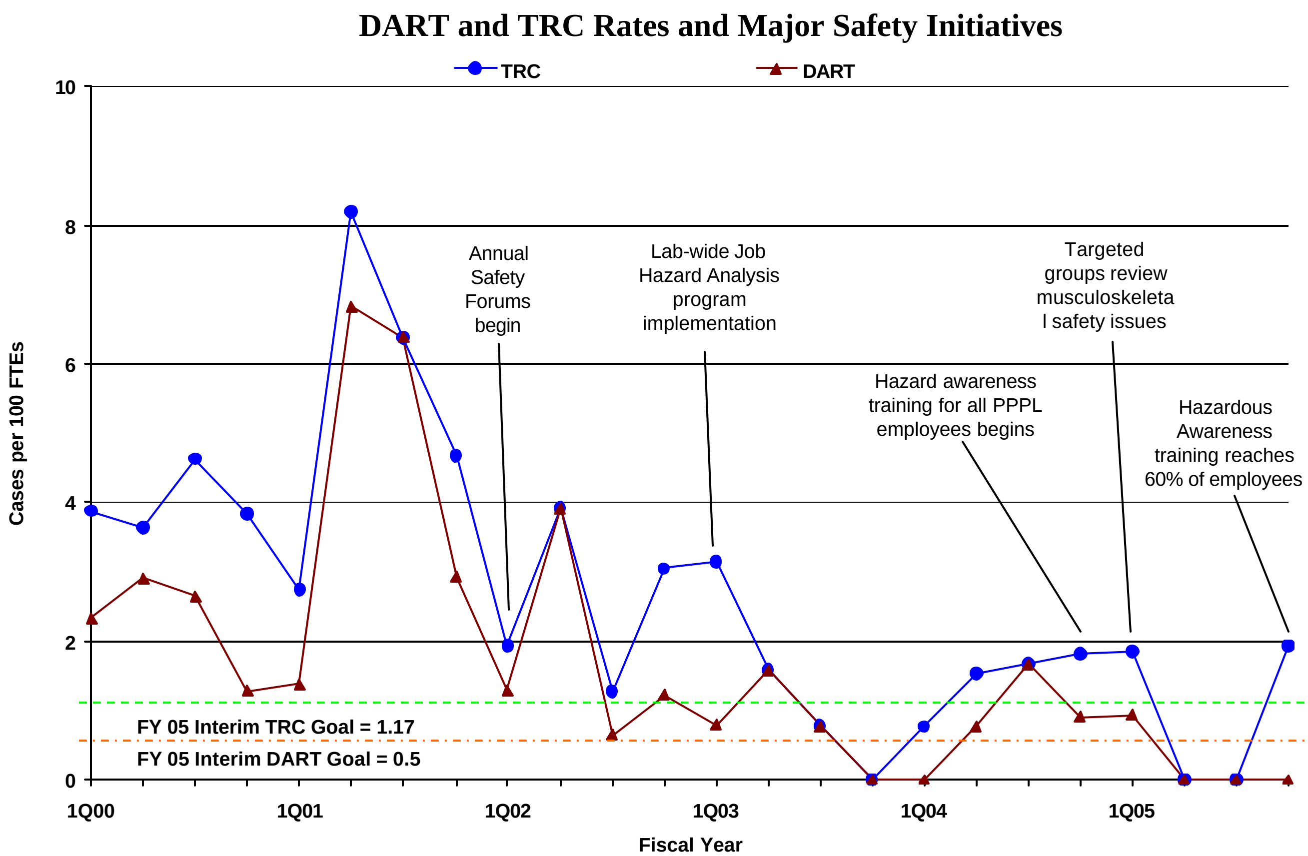
PPPL will continue a number of educational outreach activities to ensure long-range goals in increasing the availability of women and minorities in science and technology by developing and enhancing feeder programs initiatives including:

- Educational and Research Experiences—via the National Undergraduate Fellowship Program and the Student Undergraduate Laboratory Internship Program;
- K-12 Science Education Program—learning opportunities at PPPL encouraging women and underrepresented minorities to explore science as a career;
- Target recruiting of minority and women candidates; and
- Continue to achieve diversity representation in postdoctoral research, focusing on increasing the numbers of women and minorities (based on funding and the ability to hire post docs).

In FY05, PPPL implemented a Staff Search Report requirement before an offer of employment can be extended. The hiring manager, employment manager and deputy director must sign off and agree that an earnest effort was made to diversify the pool of candidates and fill the position with a qualified woman or minority. The goal of this review is to assure that diversity at PPPL is improved. This level of commitment from the Director's Office has sent a clear message about the seriousness and business relevance of the issue of diversity. There is a stated expectation of cooperation and has resulted in more involvement and commitment from senior management and their staffs. PPPL also conducts an annual review of minority and women promotions and salary. No inequities have been found to date, however, if they are identified in the future, PPPL will correct the problem and ensure equity.

The focused activities on recruiting, developing, promoting and retaining will have long-term impacts on ensuring a diverse workplace which recognizes and rewards all staff.

Safety: Safety continues to be a top priority at PPPL. During FY05, PPPL has had four TRC cases and one DART case. PPPL is currently better than the Office of Science average in both of these statistics. The number of incidents at the laboratory has steadily decreased for the past 4 years, and a number of preventive activities are being initiated including: Hazard Awareness Training; small group musculoskeletal safety; small group discussions on electrical safety following the SLAC Arc Flash Incident; emphasis on safety in annual employee performance evaluations; Annual Safety Forum; and the Director has participated in the Management Safety Walkthrough Program. PPPL is planning to apply for the review and certification of the DOE Voluntary Protection Program as Princeton University continues to participate in laboratory safety reviews and the Laboratory's Executive Safety Board.



Physical Infrastructure: PPPL is located on 89 acres of Princeton Universit y land near Princeton University outside Princeton, NJ. Established as a Federal laboratory in the 1960s, PPPL has over 724,000 sf of space in 35 buildings; 35% of the space as well as many of the utility systems and roads, are 40 years old, or older. PPPL's AUI is 0.978 (good).

Maintenance, recapitalization, and modernization are supported with overhead, operating, and GPP funds, and with line item funding. PPPL will attain a maintenance investment level of 1.9% of replacement plant value (excellent) in FY 2006 which will be continued in FY 2007 and the outyears. PPPL's deferred maintenance backlog is $11.5M resulting in an ACI of 0.92 (adequate). A deferred maintenance reduction initiative was initiated in FY 2006 and will continue in FY 2007 with funding of $.396M. The FY 2007 GPP funding request is for $1.8M.

Improvements are being made over the next three years to some existing buildings to prepare them for the National Compact Stellerator Experiment, at the same time that some older buildings are being demolished in order to consolidate staff and reduce costs. PPPL's future modernization challenge is to renovate nine 40 year old buildings to extend their life and increase their versatility and flexibility for upcoming mission work.

DOE Business Plan for the Office of Science's Stanford Linear Accelerator Center

Mission and Overview

The Stanford Linear Accelerator Center (SLAC) was founded in 1962 and has gained international recognition for research and the operation of major user facilities in photon science and particle physics. Operated by Stanford University, SLAC supports the Office of Science research objectives through its primary mission focus of designing, constructing, and operating state-of-the-art electron accelerators and related experimental facilities for use in high-energy physics and synchrotron radiation research. Major user facilities at SLAC include the Stanford Positron Electron Accelerator Ring (SPEAR), a synchrotron light source providing a resource for particle physics and probing the structure of matter at the atomic and molecular scale, and the B-factory, a high energy electron-positron collider. Both facilities make use of the two mile long linear accelerator, or linac, on the SLAC site. SLAC is also the planned site for the Linac Coherent Light Source (LCLS), the world's first x-ray free-electron laser. Approximately 3000 students, postdoctoral researchers, and scientists from the U.S. and abroad make use of SLAC's accelerator-based instrumentation and techniques for their research in photon science, particle physics and particle astrophysics. Five scientists have been awarded the Nobel Prize for work carried out at SLAC and 10 members of the SLAC faculty are in the National Academies.

Lab-at-a-Glance

Location: Menlo Park, CA

Type: Program Dedicated Lab

Contract Operator: Stanford University

Responsible Field Office: Stanford Site Office

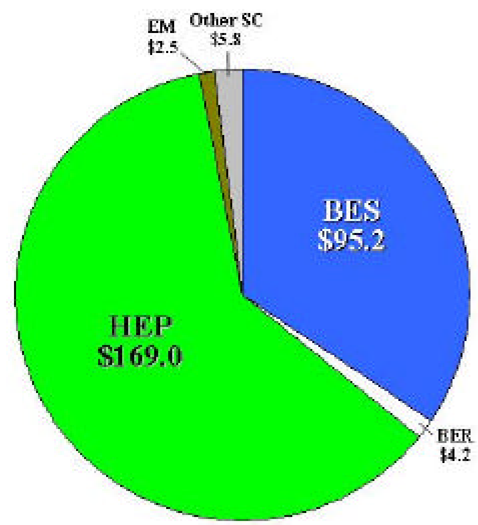
Website: www.slac.stanford.edu

Physical Assets:
- 166 buildings
- 426 acres

Human Capital:
- 1532 full-time employees;
- 100 Students (Undergraduate and Graduate);
- 3000 Facility Users and Visiting Scientists

FY 2005 Total DOE Funding: $277.1M

FY 2005 DOE Funding by Source
PALS data (BA in Millions):



FY 2005 Non-DOE Funding: $43.2M

Laboratory Focus and Vision

Six core competencies underpin activities at SLAC:

1. Developing new and innovative concepts for electron-based accelerators, instrumentation, detectors and computing to both enhance existing facilities and to pioneer the next generation of such facilities.
2. Designing, engineering, constructing, and commissioning complex, cutting-edge electron-based accelerator facilities with rapid delivery of peak performance.
3. Designing, engineering, constructing and operating advanced instrumentation to study objects that span a vast length scale — from subatomic particles to the structure of dark matter in the universe.
4. Efficiently operating, at very high performance levels, world-class scientific user facilities.
5. Designing and operating petabyte computing enterprises for users distributed worldwide.

6. Developing imaginative techniques for data analysis, modeling, and simulation.

The Office of Science believes that these six competencies will enable SLAC to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the areas of:

- Discovering new scientific frontiers within the physical and life sciences by probing the ultra small and ultra fast world of materials, molecules and atoms with high brightness X-rays and
- Understanding the fundamental physics of the birth and evolution of the universe by conducting theoretical studies and experiments in the interrelated disciplines of particle and particle astrophysics.

Business Lines

The following capabilities, aligned by business lines, distinguish SLAC and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of SLAC and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, identify research facilities that convey particular, strategic strengths and capabilities to the Lab. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Photon Science	· **Ultrafast X-ray science;** · **Complex/correlated & magnetic materials science;** · **Molecular, environmental & interface science;** · **Nano- & atomic-scale structural biology;** · **Strong coupling and integration with outstanding research university (Stanford), providing leadership and vision across a range of disciplines.** · ***Stanford Synchrotron Radiation Laboratory, SPEAR 3***	World's brightest, ultra short pulse (80 fs) X-ray source, now pioneering experiments in fs domain (SPPS); Successful SPEAR3 upgrade on time, within budget, makes the Stanford Synchrotron Radiation Laboratory (SSRL) a 3rd generation light source; Will deliver the world's first X-ray free electron laser in 2009 with unprecedented brightness, coherence and short pulses of X-rays (LCLS).	Advance core disciplines of basic energy sciences and biological and environmental research; Contribute to science and technology that advances the energy security and health of our nation; Master convergence of physical and life sciences for health and medicine.
Particle Science	· **CP violation in B mesons, precision particle physics at the electron energy frontier, and non accelerator tests of the Standard Cosmological Model through investigations of Dark Matter and Dark Energy;** · **Strong integration with outstanding research university (Stanford).** · ***B Factory, PEP-II, BaBar***	World's highest luminosity electron-positron storage rings –*shared with KEK;* Collaboration in international effort to build e+e- linear collider – *shared with DESY and KEK;* Major collection of accelerator physics talent.	Explore and discover the laws of nature as they apply to the basic constituents of matter, and the forces between them; Advance accelerator technology for the benefit of particle science and other disciplines for whom accelerators are a primary tool.
LCLS	· **Ultrafast X-ray science;** · **Complex/correlated & magnetic materials science;** · **Molecular, environmental & interface science;**	World's first X-ray free electron laser	Lead nanoscale science revolution; Master control of energy-relevant complex systems.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
	· **Structural biology.** · ***Linac Coherent Light Source***		

Major Activities

Following is a set of major activities that SLAC would like to pursue to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. The Office of Science is examining all of these potential activities and they are at different stages of development. Some are currently underway and some are mere concepts at this time. For those that are still in the conceptual phase, SLAC has indicated significant interest and is viewed to have current supporting research and mission focus to pursue such activities. Budgets, the Office of Science's strong commitment to a fair and competitive funding process and technical advice from its major scientific advisory committees will ultimately contribute to decisions about which activities can be pursued and at which sites. The companion documents, the DOE's Five Year Plans, provide greater insights into these activities in terms of various five-year budget scenarios.

The Major activities are:

1. Linac Coherent Light Source (LCLS)
2. International Linear Collider (ILC)
3. New Initiatives in Particle Astrophysics
4. Foundation: the Ongoing Program
5. Crosscutting – Accelerator R&D and Supporting Technologies

<u>1. Linac Coherent Light Source (LCLS)</u>

- **Summary:** LCLS will produce X-ray laser pulses that are coherent and ultra-short (100-200 femtoseconds and eventually even shorter) to perform atomic-level stop-action photography, revealing the motion of atoms in the midst of chemical processes and physical transformations of materials. Each pulse will be 10^{10} higher in peak X-ray brightness than those from any existing synchrotron sources.
- **Expectations:** The LCLS will allow direct observations of: atoms as they change states of excitation; molecules in the instants of time when new chemical bonds are broken or formed; the interiors of dense plasmas or materials in extreme magnetic fields, in quasi-static and transient conditions; and *single* molecules essential to life processes, determining at or near atomic resolution those structural features critical to their function.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* as LCLS will be the world's first X-ray free electron laser. SLAC will use the world's brightest, ultra-short, pulse X-ray source (SPPS) for ultrafast structural dynamics studies that are central to development of ultrafast X-ray science – the foundation for the LCLS activity.
  - Market/Competition: *Low risk* as LCLS will be best in class. However, two competing facilities (one at SPring-8, in Japan, and the other at DESY, in Germany) are currently expected to begin operation in 2010 and 2012 respectively. The number of experiment stations at the DESY facility, and hence the capacity to serve users, will outstrip that of the LCLS somewhere around 2013. SLAC's strategy for managing this risk is embodied in expansion plans for LCLS.
  - Management/Financial: *Moderate risk* as the LCLS takes advantage of the existing infrastructure at SLAC. However, the early productivity of the LCLS depends on the timely funding and completion of additional LCLS scientific instruments that are part of a proposal for a "major item of equipment"

project.

A strategic component for the photon science business line is the development of a completely new class of "unconventional" light sources based upon electron linacs rather than circular storage rings. The first step in this direction is the SPPS experiment which uses the SLAC linac to deliver 80 femtosecond (fsec) pulses of electrons that then produce X-rays. The SPPS collaboration is gaining first experience with the application of X-ray scattering and absorption techniques to study properties of materials on this very short time scale. The next major step is the construction of the LCLS. The LCLS, scheduled to become operational in 2009, takes advantage of the existing infrastructure at SLAC by initially utilizing the last 1/3 of the existing 3 km linear accelerator. LCLS will produce X-ray laser pulses that are coherent, ultra-short (a few 100s down to a few femtoseconds and eventually even shorter) and having 10^{10} higher peak X-ray brightness than those from any existing X-ray synchrotron sources. LCLS is a research tool with discovery potential that comes along perhaps once in a generation.

The science program of LCLS will evolve and grow as driven by scientific opportunity and demand. Recognizing this inevitability, significant performance enhancements are being planned into the project for implementation beyond the baseline design without requiring any significant reconstruction of conventional facilities (and hence fully preserving the initial capital investment). Examples of these are the production of much shorter (femtosecond and below) bunches, the implementation of seeding approaches for the control of temporal coherence, and infrastructure that will readily accommodate a five- to ten-fold growth in the number of photon beam lines.

2. International Linear Collider (ILC)

- **Summary:** The Linear Collider will allow physicists to make the world's most precise measurements of nature's most fundamental particles and forces by colliding individual fundamental particles rather than particles with a complex structure such as protons or anti-protons. The physics investigations envisioned at the ILC are both broad and fundamental, and will both require and support a leading-edge program of research for many years.
- **Expectations:** The International Linear Collider (ILC) represents the future of the field of high energy physics. Physicists now know enough to predict with very high confidence that the linear collider, operating initially at energies up to 500 GeV, will be needed to understand how forces are related and the way mass is given to all particles.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate to High risk*–The technical challenges in the project are exemplified by the transverse beam sizes at collision (a few nanometers), by the requirement of providing very high electric field gradients to achieve the large energies, and by the exceptional control of the beams needed during the acceleration process.
  - Market/Competition: *Low risk* as there would be only one such international facility.
  - Management/Financial: *High risk* due to large project costs, technical risk, and international project management issues.

The shared goal for the consortium of laboratories around the world working on the International Linear Collider (ILC) is to complete the design of a new electron-positron linear collider with energy in the range of 0.5-1.0 Tera electron volt (TeV).The immediate goal for the worldwide ILC effort is to establish all technical components, costs, engineering designs, and management structures to enable a go/no-go decision to start construction. There are many scientific, technical, and economic challenges to this project that must be addressed before a decision to proceed. SLAC, with its long history in linear accelerator R&D, while not the proposed host laboratory, will play a critical role in the development of the design of the ILC project should it proceed.

For high energy physics, the energy frontier is the source of new discoveries, confirmations and surprises. The precision afforded by the ILC will lead to discoveries that push the limits of what we know in the worlds of cosmology and elementary particles and enable new phenomena discovered by the Large Hadron Collider, now under construction in Switzerland, to be more fully explored.

3. New Efforts in Particle Astrophysics and Neutrino Physics

- **Summary:** Development of particle astrophysics and neutrino physics activities based on the capabilities of the Large-aperture Synoptic Survey Telescope (LSST) and Enriched Xenon Observatory (EXO), providing the foundation for future investment and innovation to support the central mission to explore and discover the laws of nature as they apply to the basic constituents of matter, and the forces between them.
- **Expectations:** LSST would allow the US to be a world leader in the study of dark energy and dark matter. EXO will reveal new properties of the neutrino with unmatched sensitivity.
- **Benefit Perspective:** Potentially *Substantial to Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate to High risk*– The technical risks for the LSST activity is moderate. EXO carries moderate to high technical risk.
  - Market/Competition: *Moderate to High risk* – There are varying degrees of competition for the specific elements of the activities.
  - Management/Financial: *Moderate risk* –Management risk for these activities is driven by the need to establish and execute a stable multiagency research investment plan.

Recent discoveries have revealed that 95% of the Universe is made of new forms of matter and energy that are outside of our current understanding. We do not know what most of the Universe is made of. To explore these new and as yet undiscovered forms of matter and energy will require observatories on the ground and in space dedicated to probing the fundamental structure of the cosmos. The Gamma-Ray Large Area Space Telescope (GLAST), part of the SLAC ongoing program, is a space-based detector. LSST is a proposed land based telescope to probe the dynamics of the Dark Energy that is forcing the universe to expand at ever higher speeds. LSST is only one of many proposals, both ground-based and space-based, that aim to understand Dark Energy, and not all of these will be supported. The Enriched Xenon Observatory is an underground detector that will search for a rare type of nuclear decay that will lead to a fuller understanding of the neutrino. EXO will use an innovative new technology to see if the neutrino is its own antiparticle and provide a direct measurement of its mass. A 200 kg prototype of the EXO experiment will begin operations in 2007; further development of the EXO concept will depend on the success of the prototype and other ongoing R&D. There are also several competing technologies being explored world-wide to directly measure the neutrino mass and it is likely that DOE will only support one technology for a large-scale experiment. Other Federal agencies, such as NSF and NASA, are expected to be the lead agency for many if not all of these efforts.

4. *Foundation: The Ongoing Program*

- **Summary:** Enhance and maintain the necessary capabilities to support the growing and evolving needs of the Stanford Synchrotron Radiation Laboratory through operation of state-of-the-art facilities including the SPEAR3 synchrotron light source, the B-factory and the Large Area Telescope/Gamma-Ray Large Area Space Telescope (LAT/GLAST).

- **Expectations:** The B-factory will sustain the current world leading studies of Charge-Parity (CP) violation in heavy flavors. New SPEAR3 capabilities will provide the photons and instrumentation for research over a range of scientific disciplines, serving the well-established and growing needs of SSRL's research community. The GLAST/LAT project will be completed on schedule and launched into space in 2007.
- **Benefit Perspective**: Potentially *Substantial to Transformational* Benefits for B-factory and LAT/GLAST; *Significant/Sustaining* Benefits for SPEAR3
- **Risk Perspectives:**
  - Technical: *Low* technical risk is seen for continued operation of the B-factory and SPEAR3*;* *Moderate* technical risk for the LAT/GLAST
  - Market/Competition: *Moderate to High risk* – There is significant market competition in B-Physics from a similar facility in Japan. SPEAR3 is one of several new machines worldwide in its intermediate energy class. The market risk will be mitigated by continued innovation in the user support and beam line development programs. LAT/GLAST market risk is *Low* because it is a unique space mission.
  - Management/Financial: *Moderate to High risk* – The B-factory and SPEAR3 business lines clearly depend on sustained funding for core operations from DOE's Office of High Energy Physics and Office of Basic Energy Sciences.

Accelerator based particle science will be gradually reduced in the future as the primary accelerators on the site become facilities for cutting edge photon science. Expanded operation of SPEAR3 beam will allow this upgraded facility to be available to academic, national laboratory, and industrial user base for "conventional" synchrotron radiation. Large Area Telescope/Gamma-Ray Large Area Space Telescope (LAT/GLAST), a space-based detector, will allow the study of dark energy. Maintaining the operation of the B-factory will allow this successful matter-anti-matter experiment to continue and the facility will then ramp down.

Stanford Positron Electron Accelerator Ring-3 (SPEAR3), SLAC's new 3rd generation synchrotron light source, was installed and commissioning completed in March 2004. The upgrade of its existing complement of beam lines is nearly complete. This upgrade capitalizes on the major investment in SPEAR3 and optimizes synergy with LCLS in technical and scientific areas. SPEAR3 is living up to expectations, and investments are being repaid in capabilities that will be equal to the best available for quite a few years. A BES survey of light sources has determined that SSRL has the largest potential for beamline development of any of the four BES light sources. SLAC is developing plans for new SSRL beamlines based on proposals for new activities and to more robustly support the growing user base.

To make progress in understanding the fundamental mystery of why the universe is dominated by matter and not anti matter, a comprehensive study of the CP violation in heavy flavor is necessary. The B-factory activity is a chain of particle accelerators feeding a particle detector, BaBar. The BaBar experiment, using the most advanced particle detection and computing technology, has made major progress towards understanding why the universe is made exclusively of matter and what happened to the antimatter that must have existed in equal quantities as matter at the creation of the universe.

The Large Area Telescope on the Gamma Ray Large Area Telescope mission, a space based detector, will measure the energy and direction of celestial gamma-rays with good resolution over a wide field of view to study the mechanism of particle acceleration in astrophysical sources, determine high energy behavior of gamma ray bursts and transient sources, and search for dark matter candidates. This is important to understanding the laws of nature as they apply to the basic constituents of matter and the forces between them.

6. Crosscutting – Accelerator R&D and Supporting Technologies

- **Summary:** Build on initiatives cross-cutting to the Photon Science and Particle Science Business Lines
- **Expectations:** Critical investments that underpin the other business lines and activities. R&D investments in accelerator R&D and scientific computing have paid off handsomely in terms of facility performance and scientific output for the B-factory and SPEAR3, to name two recent examples. Future investment is essential to fully recognize the value of the investment in the LCLS construction.
- **Benefit Perspective:** *Substantial/Sustaining* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* – The technical risks for picosecond pulses from the SPEAR3 and LCLS Injector Test Facility part of the accelerator research activity may all be considered low to moderate. However, risk is high for future accelerators. Risks in the computing activity are considered moderate.
  - Market/Competition: *Low risk* – The facilities and personnel resources at SLAC are unique for this type of accelerator R&D. The market competition risk is moderate to high in the area of computing for data intensive science.
  - Management/Financial: *Moderate risk* as this research is somewhat vulnerable to the future funding prospects for accelerator research within the Office of Science.

Accelerator Research at SLAC is focused on three different time scales. Research focused on significant improvement in facility performance or current facility construction projects typically has immediate impact. In the midterm, the program includes R&D aimed at potential future facilities such as the ILC and a possible upgrade of the LCLS. Over the long-term, to make the next generation of accelerators feasible and affordable in decades to come requires fundamental R&D into advanced acceleration mechanisms. Such R&D will search for paths to high-energy and high brightness beams well beyond the reach of the ILC and LCLS II. This proof of principle research requires dedicated facilities for R&D. To continue this kind of research which has been very productive, SLAC will propose to replace the Final Focus Test Beam (scheduled to be dismantled for the construction of the LCLS) with a new 30 GeV facility, SABER, capable of delivering high quality, high energy, short pulse electron beams to the user community for advanced accelerator investigations.

Design and operation of petabyte computing enterprises is a core competency at the laboratory. Scientific computing is an enabling tool for discovery in many areas of research at SLAC. SLAC is currently a leader in specific areas of the “science of scientific computing” in support of experimental detector and accelerator simulation. SLAC is also a leader in “computing for data intensive science” specializing in huge memory systems for data analysis and scalable data management initially driven by the B-factory’s science program. SLAC’s goals are to develop those leadership areas, further integrating them to apply across different areas of science, and, in targeted areas, developing new paradigms from the hardware to the science in the areas of data intensive science. The petabyte computing capability would have a significant, favorable impact on certain structural biology molecular experiments that require collection of large amounts of data. Computing and simulations are also integral to enabling the most rapid scientific progress on LCLS and SPEAR3, especially in the areas of molecular imaging, high energy density matter and femtochemistry/biology.

Financial Outlook

Detailed information regarding the financial outlook for the Stanford Linear Accelerator Center is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors can not be predicted or estimated in advance. The third, programmatic decisions, are developed in accordance with the planning targets reflected in the Department of Energy programmatic Five Year Plans, a companion document to these strategic laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

Support for Non-DOE funded work is a vital role our national laboratories, contributing to national security, energy security, environment stewardship, scientific discovery, and more fundamentally, the competitiveness of the U.S. economy. For the Stanford Linear Accelerator Center, this is no exception. The Office of Science is supportive of this work and although it is not addressed in any detail within the accompanying Five Year Plans, the Office of Science believes it is sufficiently important and appropriate to address within this strategic laboratory business plan. A brief perspective and financial outlook is therefore provided.

The current SLAC non-DOE funded activities are primarily sponsored by NASA, NIH, private foundation, and collaborative partners. All of the activities complement the DOE support of the research programs and/or the operation of experimental facilities at SLAC, and are well-aligned with the SLAC mission and its science-oriented business lines. Funding from NASA and some of the funding from NIH are under joint-agency partnerships with the DOE. NASA provides funding, together with DOE and an international collaboration, for the fabrication of the Large Area Telescope (LAT), of the NASA Gamma-Ray Large Area Space Telescope (GLAST) mission, for particle astrophysics research. The NIH funding is in support of the macromolecular crystallography program within the SSRL Structural Molecular Biology program. The Moore Foundation funding provides for the fabrication of a new SPEAR3 beam line for macromolecular crystallography and a KECK foundation grant funds research in the area of ultrafast X-ray science. SLAC's collaborative partners, in the U.S. and from abroad, provide support to the fabrication and operation of experimental facilities for Photon Science and Particle Science research.

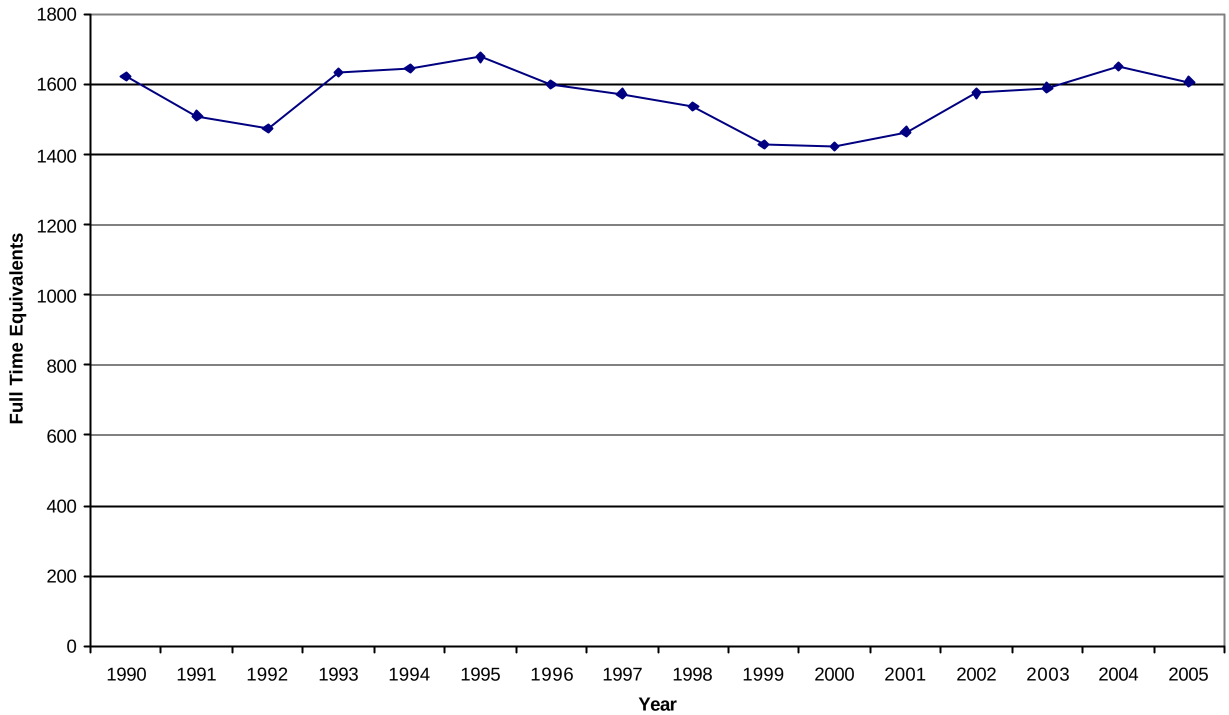
FY2005 saw the peak year of the NASA-LAT fabrication effort which constituted over 50% of the SLAC non-DOE funded activities. As the LAT progresses through its testing phase to prepare for the launch in 2007, the NASA supported effort at SLAC will be decreasing, to almost zero in FY2008. Depending on SLAC's success in securing third-party funding for new activities in the next five years, the non-DOE funded activities at SLAC could decrease by FY2008 to about 20% of the level of FY2005 with NIH being the primary sponsor.

Uncertainties and Risk Management

External Factors: Over the next five years, SLAC will have a number of concerns driven by external forces. Primary among these is the budget outlook for the Laboratory. With the large user population for the scientific facilities, the possible implications of foreign visits and assignments requirements provide challenges to operations. Risk mitigation strategies will need to be developed to handle each one of these significant items.

S&T Workforce: SLAC will conduct a detailed workforce analysis in 2006. Although no major skill mix mismatches are seen now, SLAC will need to enhance its workforce in: engineering and engineering management for major projects and lasers, laser physics and laser safety.

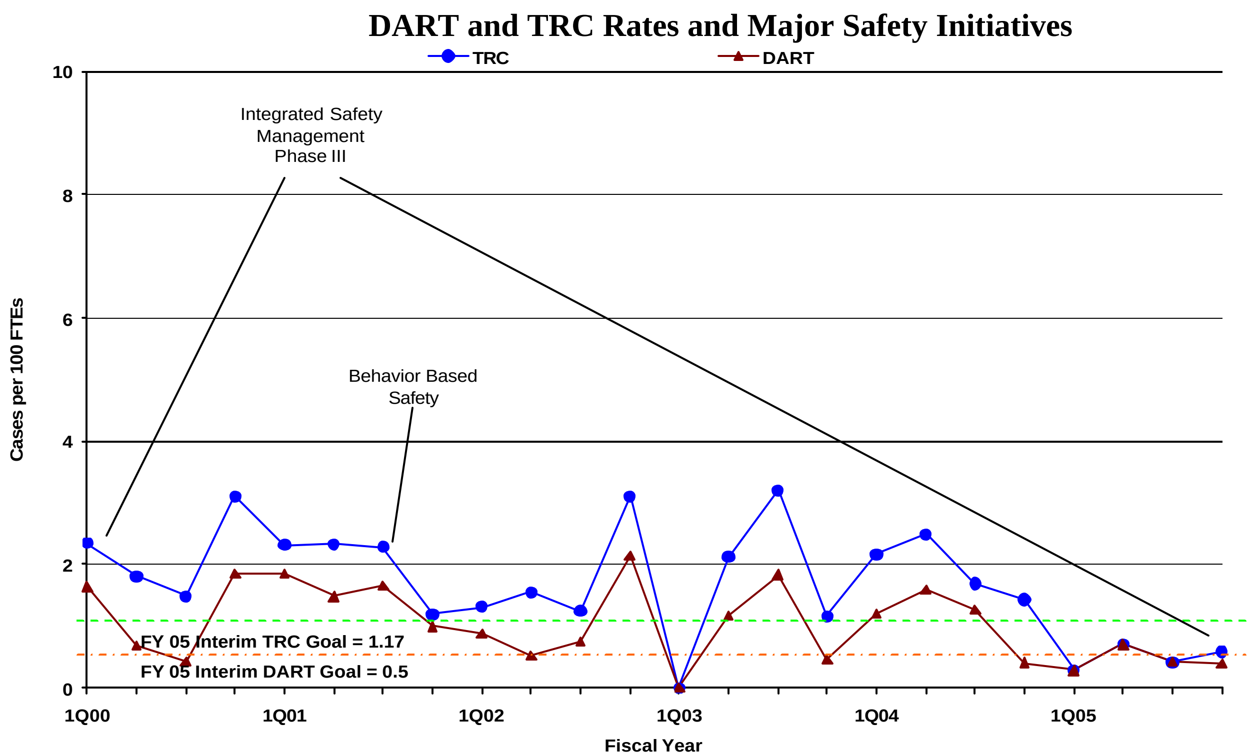
Workforce Trends



Employee Diversity: SLAC is reviewing current policies for value in attracting and retaining women and minorities in the workforce. SLAC has engaged recruitment firms specializing in diverse candidates for leadership, scientific and technical positions, developed a more robust community outreach program, and a more aggressive recruitment at the research staff level to encourage diversity.

SLAC's plans for improving the numbers of women and minorities in scientific and technical positions include actively participating in Office of Science programs designed to attract women and minorities to S&T careers. SLAC will also increase outreach and recruitment efforts by: recruiting through national minority organizations; initiating broad contact with professional colleagues and appropriate societies to identify qualified women and minority candidates for all faculty positions; for non-faculty senior manager positions, assure that the applicant pool is diverse through contact with colleagues and professional organizations, including those that represent minority groups; and engaging, as necessary and appropriate, a search firm that specializes in minority and female candidates.

Safety: SLAC has been in the process of reinvigorating its safety culture as a part of the overall strategy to improve safety performance. Areas of focus have included improved line management accountability, walkthroughs by senior managers and supervisors, training and more frequent communications on safety, and greater visibility of disciplinary actions. DART and TRC rates are noted in following table.



Physical Infrastructure: SLAC is located on 452 acres of Stanford University land adjacent to Stanford University campus in Palo Alto, CA. Established as a Federal laboratory in the 1960s, SLAC has over 1.7M sf of space in 107 buildings: 55% of the space as well as many of the utility systems and roads are 40 years old or older. SLAC's AUI is 1 (excellent).

Maintenance, recapitalization, and modernization are supported with overhead, operating, and GPP funds and with line item funding. SLAC will attain a maintenance investment level of 0.9% of replacement plant value (RPV) in FY 2006. While this level is a full 1% lower that most SC labs, it reflects SLAC's unique set of accelerator facilities (e.g., tunnels and interaction halls) which comprise over one-half of its RPV. SLAC is developing sustainment models tailored to these facilities to determine the annual maintenance funding needed to assure long term availability for mission activities. It is expected that the annual required maintenance investment level will be substantially less than the 2% SC guideline for maintenance investment.

SLAC's deferred maintenance (DM) backlog is $21.3M resulting in an ACI of 0.98 (excellent). Because of the large DM backlog, a deferred maintenance reduction initiative was started in FY 2006, and will be continued in FY 2007 with funding of $.792M. The FY 2007 GPP funding request is for $3.6M.

One line item project is currently underway –Safety and Operational Reliability Improvements. This project includes underground utility upgrades (replacement of deteriorated sections of pipes for cooling water, low conductivity water, drainage, natural gas, compressed air, and fire protection) and seismic upgrades to bring various building structures to better assure worker safety in the event of an earthquake. .

SLAC's future recapitalization and modernization challenges include additional seismic upgrades and utility renovations.

DOE Business Plan for the Office of Science's Thomas Jefferson National Accelerator Facility

Mission and Overview

The Thomas Jefferson National Accelerator Facility (TJNAF), located in Newport News, Virginia is a program-dedicated laboratory for Nuclear Physics under the Department of Energy's Office of Science. Built, managed and operated by the Southeastern University Research Association (SURA) for Office of Science, TJNAF began operations in 1995 with the completion of the Continuous Electron Beam Accelerator Facility (CEBAF), a unique international electron-beam user facility for the investigation of nuclear and nucleon structure based on the underlying quark structure. TJNAF research and engineering staff are world experts in superconducting radio-frequency technologies. CEBAF has an international user community of over 2,000 researchers and research has resulted in scientific data for 110 experiments, more than 147 *Physics Letters* and *Physical Review Letters* published, and 322 publications in other refereed journals. Collectively, there have been over 10,000 citations for work done at CEBAF. Research at TJNAF and CEBAF has also contributed to thesis research material for about one-fourth of all U.S. Ph.D.'s awarded annually in Nuclear Physics.

Lab-at-a-Glance

Location: Newport News, VA

Type: Program Dedicated Lab

Contract Operator: Southeastern University Research Association (SURA)

Responsible Site Office: Thomas Jefferson Site Office

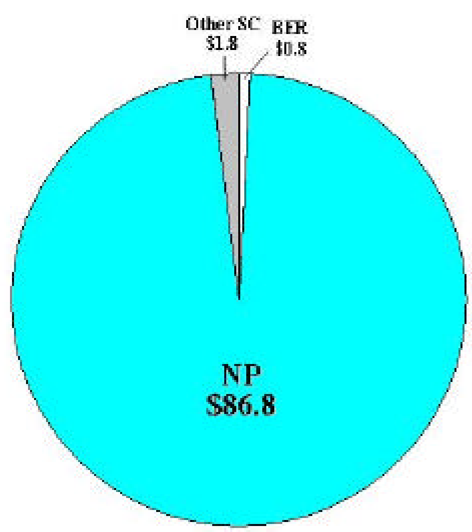
Website: http://www.jlab.org

Physical Assets:
- 97 Buildings
- 206 Acres

Human Capital:
- 617 Employees;
- 315 Students (Undergraduate and Graduate);
- 2,200 Facility Users and Visiting Scientists

FY 2005 Total DOE Funding: $414.9M

DOE Funding by Source (in Millions):



FY 2005 Work for Others: $11.2M

Laboratory Focus and Vision

TJNAF has a central role in the field of nuclear physics, both in the U.S. and worldwide. TJNAF's present and future program relies on maintaining core competencies in:

1. Hadronic Physics
2. Superconducting Accelerator Technologies

The Office of Science believes that these core competencies will enable TJNAF to deliver its mission and customer focus, to perform a complementary role in the DOE laboratory system, and to pursue its vision for scientific excellence and pre-eminence in the areas of nuclear physics:

- The structure of the nuclear building blocks including: the nucleon's charge and magnetization distribution; the degrees-of-freedom governing the nucleon's excitation; the internal structure of the nucleon in the valence region; and the experimental and theoretical tools necessary to carry out a program of nucleon tomography.
- The structure of nuclei including: the nuclear interior

with controlled impurities; short-range component of the nucleon-nucleon interaction in nuclei; the neutron radius of ^{208}Pb; and the underlying quark-gluon structure of the nucleus.

- Symmetry tests in nuclear physics including the weak charge of the proton to test predictions of the Standard Model.
- Enabling technologies and emerging fields - photon science and electron-light ion colliders – including advance radiofrequency superconductivity, 2K cryogenic engineering technology (ERL), advanced high power free electron lasers, energy recovering linacs, and electron-light ion collisions at ultra-high luminosity.

Business Lines

The following capabilities, aligned by business lines, distinguish TJNAF and provide a basis for effective teaming and partnering with other DOE laboratories, universities, and private sector partners in pursuit of the laboratory mission. These business lines and the distinguishing capabilities outlined in the table below provide an additional window into the mission focus and unique contributions and strengths of TJNAF and its role within the Office of Science laboratory complex. Items in italics within the column, Distinguishing Capabilities, identify research facilities that convey particular, strategic strengths and capabilities to the Lab. Descriptions of these facilities can be found at the website noted in the Lab-at-a-Glance section of this Plan.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Nuclear Physics – 6 GeV Research	· **Continuous beams of polarized high-energy electrons for studies of the quark structure of matter;** · **State-of-the-art Equipment & Detectors;** · ***Continuous Electron Beam Accelerator Facility, Hall A, Hall B (CLAS), Hall C***	World-wide unique user facility for studies of nuclei and nucleons using the electromagnetic probe, with spatial resolutions from large nucleus to a fraction of a nucleon's diameter; Highest intensity in the world for highly polarized continuous electron beams with the energy and helicity correlated properties necessary to explore the details of nucleon structure; Detector and data acquisition capabilities coupled with these beams provide the highest luminosity capability in the world for these experiments.	Explore Nuclear Matter- from Quarks to Stars – Understand the structure of the nucleon and nucleonic matter
Nuclear Physics – Theory Center	· **High Performance Computing Effort in Lattice Quantum Chromodynamics (LQCD).**	World-recognized theory group; Software development used worldwide (Chroma); First calculations of moments of GPD's.	Understand the structure of the nucleon and nucleonic matter; Deliver Computing for the Frontiers of Science.
Superconducting Radio Frequency (SRF) and Related Accelerator Physics	· **Experience building SRF for CEBAF & SNS;** · **Energy Recovery Techniques;** · **World-wide unique capability in 2K Cryogenic technology;** · ***The Testlab and Applied Research Center.***	Large-grain Niobium operating at an accelerating field of 45 MV/m -world record achieved with minimal processing; Benchmarking exercise, concluded that JLab is a world leader par with DESY; World record in Energy Recovery Linac Technology demonstrated via operating a 1MW class electron beam with 10 mA current and 100 MeV energy with only tens of kilowatts of klystron power.	Understand the structure of the nucleon and nucleonic matter; Provide the Resource Foundations that Enable Great Science.

Business Lines	Distinguishing Capabilities	Distinguishing Performance	Mission Relevance
Photon Science and Technology	· **ERL-based Free Electron Laser;** · **Potential kW to MW class lasers;** · **Micromachining;** · ***Infrared Free Electron Laser.***	Unique assets of ultra-fast pulses with broad tunability at unprecedented power levels with continuous/high repetition rate operation; World record of 10 kW average power laser at infrared wavelengths with a few hundred femtosecond pulse length.	Provide the Resource Foundations that Enable Great Science.

Major Activities

Following is a set of major activities that TJNAF would like to pursue to support aspects of the DOE mission and build on core strengths and capabilities of the laboratory. The Office of Science is examining all of these potential activities and they are at different stages of development. Some are currently underway and some are mere concepts at this time. For those that are still in the conceptual phase, TJNAF has indicated significant interest and is viewed to have current supporting research and mission focus to pursue such activities. Budgets, the Office of Science's strong commitment to a fair and competitive funding process and technical advice from its major scientific advisory committees will ultimately contribute to decisions about which activities can be pursued and at which sites. The companion documents, the DOE's Five Year Plans, provide greater insights into these activities in terms of various five-year budget scenarios.

The major activities are:

1. 12 GeV Upgrade of Continuous Electron Beam Accelerator Facility (CEBAF)
2. Excited Baryon Analysis Center
3. Lattice Quantum Chromodynamics (LQCD)
4. International Linear Collider

1. 12 GeV Upgrade

- **Summary:** Upgrade CEBAF, a unique research facility and world leader in hadronic physics. The scope of the proposed project includes doubling the accelerator beam energy, adding a new experimental Hall and associated beamline, and upgrading the equipment in existing experimental Halls.
- **Expectations:** The Upgrade will allow experimental study of the confinement of quarks and address the question, "why are quarks never found alone?" Confinement is a remarkable and not understood feature of quantum chromodynamics (QCD) and is one of the major gaps in our understanding of nature. Gluonic excitation, in the form of exotic mesons, is a prediction of QCD that is expected to provide key insights into the nature of confinement. The only planned or existing facility that can test this prediction is the 12 GeV CEBAF.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk* – superconducting radio frequency (SRF) work on other projects has significantly reduced the technical risks of this project.
  - Market/Competition: *Low risk* – CEBAF is a unique facility.
  - Management/Financial: *Moderate risk* - due to federal budget uncertainties.

CEBAF occupies a racetrack-shaped footprint. Each straight section contains a linac made up of 20 cryomodules. To recirculate the beam, magnetic transport channels making up the curved sections, the socalled arcs, connect these linacs. Several factors contribute to make the 12 GeV Upgrade cost effective. First, on average, the existing critical components of the accelerator exceed their design specifications by 50% resulting in the capability to run at 6 GeV electron beam energy rather than the originally specified 4 GeV. Second, continued efforts have led to the development of a new cryomodule type capable of exceeding the original CEBAF specifications by a factor of five. Third, for reasons of project construction history, each linac contains five empty slots with most of the ancillary provisions ready to accept the new high performance cryomodules. Fourth, the radius of the arcs was generously designed to avoid serious emittance degradation that might have precluded ever achieving higher energies.

In the new experimental Hall D, a tagged coherent bremsstrahlung beam – created using the full 12 GeV beam energy - and solenoid detector will be constructed for a program of gluonic spectroscopy to experimentally test our understanding of quark confinement. Additional experimental equipment proposed for the Upgrade project will optimize the scientific capabilities and takes full advantage of apparatus developed for the present program. All three existing Halls will be able to receive the full 5-pass beam energy. Critical Decision Zero (CD-0) was approved in March 2004. Approval of Critical Decision One (CD-1) for the 12 GeV Upgrade is anticipated in FY 2006. As part of the preparation for the CD-1 decision, the DOE conducted a Review of the Science of the 12 GeV Upgrade in April 2005. The committee concluded that the science capabilities are very compelling and noted two specific areas as having "discovery potential". The next step toward CD-1 was the successful completion of an Independent Project Review of the cost and schedule convened by DOE in July 2005. The review committee concluded that all requirements for CD-1 approval were complete.

2. Excited Baryon Analysis Center

- **Summary:** World-recognized theory group provides critical foundation for experimental program; activity in Excited Baryon Analysis Center allows enhanced analysis and understanding of experimental results.
- **Expectations:** Success in this activity will lead to a profound understanding of the spectrum of excited baryons and hence the nature of confinement, including the way excited hadronic matter modifies the nonperturbative QCD vacuum.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *High risk* **-** It is an extremely challenging problem for theoretical physics.
  - Market/Competition: *Moderate risk* – Other groups are also working in this area.
  - Management/Financial: *Moderate risk* - This effort requires a sustained commitment. Human Capital is critical to this effort.

Office of Science's Strategic Plan for Nuclear Science states that connecting the observed properties of baryons with the underlying framework provided by QCD is one of the central challenges of modern science. In order to address these questions it is essential to have a clear understanding of the spectrum of excited states of the nucleon. However, it has become clear over the past few years that the analysis of data for the production of such states at TJNAF and elsewhere requires a far more coherent and advanced theoretical understanding than had been anticipated. With this in mind, a proposal to establish an Excited Baryon Analysis Center was submitted to DOE. The key idea is to build a network of all relevant theoretical and experimental groups world-wide to agree on a coherent program of data analysis. In parallel with the development of new theoretical tools to deal with the complex, multi-particle final states encountered in this field one would need a team of phenomenologists working with the relevant experimental groups to apply the state of the art theoretical models to their data.

It is an extremely challenging problem for theoretical physics to deal with multi-particle final states in a manner consistent with the constraints of unitarity, crossing and analyticity. One cannot guarantee success but it is clear that success is not possible without serious, sustained theoretical effort at the highest level, in cooperation with those involved in data analysis. This can only be carried out at a national laboratory, such as TJNAF, with significant investment.

3. Lattice Quantum Chromodynamics (LQCD)

- **Summary:** Expand existing High Performance Computing Effort in Lattice Quantum Chromodynamics (LQCD) essential to understand QCD in the confinement regime and contribute to national scientific computing enterprise.
- **Expectations:** Success will mean that TJNAF has calculated the consequences of nonperturbative QCD with unprecedented accuracy in order to test its predictions against the precise new data provided by the 12 GeV Upgrade.
- **Benefit Perspective:** Potentially *Transformational* Benefits
- **Risk Perspectives:**
  - Technical: *Low risk*- Progress in this area has been promising
  - Market/Competition: *Moderate risk* - Risk reduced through collaboration and the unique capabilities of CEBAF, though Brookhaven Lab is also involved in QCD studies
  - Management/Financial: *Low risk* – Small additional investments could have a substantial impact in this effort.

Lattice QCD currently provides our only means of solving QCD in the low-energy regime. Dr. Nathan Isgur recognized, in 1998, the crucial role that lattice QCD must play in hadronic and nuclear physics by founding, together with Prof. John Negele of MIT, the Lattice Hadron Physics Collaboration (LHPC). Subsequently, under the auspices of the Department of Energy's SciDAC activity, the US theory community has developed the computational infrastructure to employ lattice QCD to solve a spectrum of problems in nuclear and particle physics. TJNAF (particularly Drs. R. Edwards and D. Richards of the Theory Center) plays a pivotal role in this SciDAC activity and is now exploiting this role to address key questions across the TJNAF program.

The Jefferson Lab Theory Center will continue to play central roles in the SciDAC activity over the next four years with a focus on exploiting the technology to the world's most precise computations of hadron properties. A White Paper outlining the highest priority calculations which need to be made and the synergy between those calculations and the TJNAF program at 6 GeV and 12 GeV was submitted to DOE earlier this year. To optimize the physics output in relation to the 12 GeV Upgrade, this activity requires an additional $0.5M per year over current levels from FY07 through FY12 for lattice QCD hardware. An additional national advantage is that TJNAF will explore the limits of clusters of commercial computers for high performance computing. Already, there are hints that these clusters may be more cost effective than specialized machines.

4. International Linear Collider (ILC) R&D

- **Summary:** Develop enabling technologies in support of International Linear Collider (ILC). Since the announcement in 2004 of the technology choice for the ILC, TJNAF has been actively engaged in preliminary discussions on the ILC project and as a member of numerous ILC Working Groups including a recent formal role in the ILC Global Design Group and in MOUs with the principal ILC coordinating lab in the US, FNAL.
- **Expectations:** The TJNAF's experience and expertise in Superconducting Radiofrequency (SRF) technology will enable future scientific accelerators (ILC, etc.), as well as accelerators for basic science, defense, bioscience and nano-technology, and potential commercial materials processing (Free Electron Laser).
- **Benefit Perspective:** *Significant/Sustaining* Benefits
- **Risk Perspectives:**
  - Technical: *Moderate risk* – Work for CEBAF Upgrade, SNS, and DOD has given TJNAF a great deal of experience and world-leadership in this technology. The 12 GeV Upgrade will further enhance this

position.

- Market/Competition: *High risk* – Many U.S. and international labs are interested in this part of the ILC effort. TJNAF is currently in a leadership position but this could change and international negotiations will be a factor.
- Management/Financial: *High risk* - Due to tight federal budgets and the high project costs and long construction period for the ILC should it be built.

TJNAF has submitted multiple proposals to the Office of Science's High Energy Physics (HEP) division in support of ILC dealing with new materials R&D involving single crystal/large grain niobium, studies of cavity processing and their control to make robust production of cavities with predictable performance, development of specific value-engineered high gradient superconducting cavities and cryomodules, and preparations for industrialization of SRF technology in support of the ILC. This scope of work will substantively reduce the project's technical risks and costs and will be the hallmark of TJNAF's contributions to this challenging international project. Simultaneously, intense effort on high gradient and low-loss cavity R&D has already led to the ground-breaking large- and single-grain cavity fabrication and testing leading to the achievement of the highest gradient possible in niobium.

TJNAF has established a productive partnership with Fermilab (FNAL) relative to their Superconducting Module Test Facility (SMTF) activity, supporting development and growth of an SRF infrastructure that will benefit FNAL as the primary HEP lab taking ILC responsibility at large. It is TJNAF's vision to remain an essential partner and collaborator and be the consolidator of SRF developments in support of the ILC, including the eventual industrialization of the technology. TJNAF plans to design and prototype a model-integrated cryomodule production plant suitable for technology transfer to US industry.

Also, TJNAF is leveraging its SRF core competency in a major activity, a 100 kW IR upgrade to its ERL-based 10 kW Free Electron Laser funded by DoD. Additionally, SRF ERL-based technology R&D for an electron light ion collider and light source is ongoing. An electron light ion collider at a center-of-mass energy of 30 GeV could achieve an ultra-high luminosity of 10^{35} $cm^{-2}s^{-1}$ reaching the limit where possible color glass condensates of quarks and gluons could be observed and study quark-gluon plasma not only at high temperatures but at high densities. An ERL-based light source would provide the highest achievable spectral brilliance of photons and shortest pulses achievable not only at x-ray wavelengths but also at longer wavelengths of infrared and THz.

Financial Outlook

Detailed information regarding the financial outlook for the Thomas Jefferson National Facility is subject to 1) competition and merit review, 2) the availability of appropriated funds and 3) programmatic decisions. The first two factors can not be predicted or estimated in advance. The third, programmatic decisions, are developed in accordance with the planning targets reflected in the Department of Energy programmatic Five Year Plans, a companion document to these strategic laboratory business plans. In addition, because of the Office of Science commitment to competition and merit review, there is often a time lag between programmatic decisions and the determination of which research provider can best deliver the greatest value in conducting the research. Thus, it is not always apparent how programmatic decisions unfold for particular laboratories. Nevertheless, some decisions, such as the plans for large scientific user facilities, show clear paths to individual labs and therefore inform their business plans.

Support for Non-DOE funded work is a vital role our national laboratories, contributing to national security, energy security, environment stewardship, scientific discovery, and more fundamentally, the competitiveness of the U.S. economy. For the Thomas Jefferson National Facility, this is no exception. The Office of Science is supportive of this work and although it is not addressed in any detail within the accompanying Five Year Plans, the Office of Science believes it is sufficiently important and appropriate to address within this strategic laboratory business plan. A brief perspective and financial outlook is therefore provided.

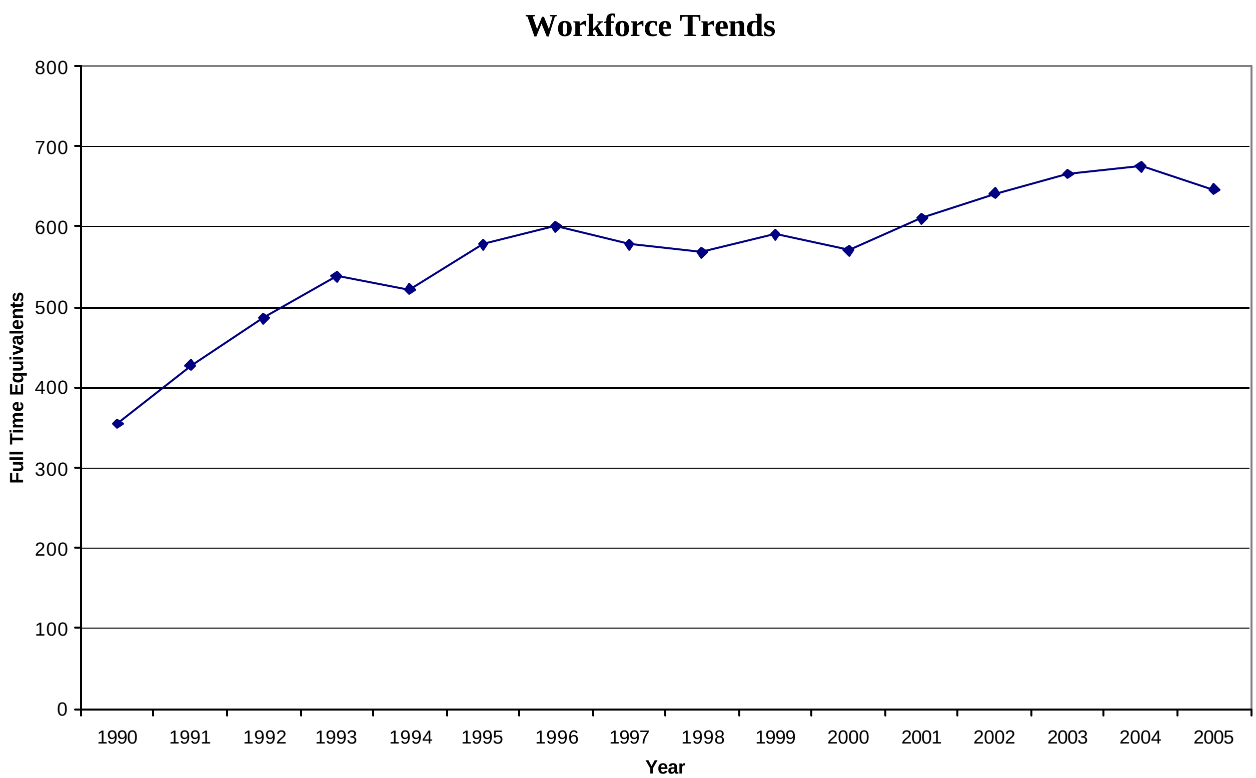
The current TJNAF non-DOE funded activities are primarily funded by the Department of Defense (Navy, Air Force and Army) and focus on technology development to scale Free-Electron Lasers (FELs) to 100kW-MW power class, to study laser materials damage and atmospheric propagation, to construct and commission a 1kW UV FEL for materials science and processing, and to commission a far-infrared (THz) beam-line and User Lab for THz spectroscopy and imaging.

TJNAF's world-class FEL provides an accelerator physics/technology test bed which allows them to enhance CEBAF's performance and capabilities. This is a tremendous benefit to their in-house Nuclear Physics program and to DOE as a unique repository of technology expertise available to other science and technology facilities throughout the nation. Over the next five years and beyond, TJNAF anticipates continued and possibly increased funding from the DoD, allowing the laboratory to continue to build on their investment and ensuring continued world leadership on the frontiers of FEL, Energy Recovered Linac (ERL) and superconducting radiofrequency (SRF) technology.

Uncertainties and Risk Management

External Factors: TJNAF, as an integral part of the national lab system, provides unique and complementary capabilities to the other labs in the system contributing to the DOE missions and to the overall national S&T agenda. The Lab is poised to lead the world in experiment and theory of nuclear confinement physics and related accelerator and SRF technologies. The internationally based nuclear physics program complements the work being done at the Relativistic Heavy Ion Collider (RHIC) at Brookhaven National Laboratory, while enabling a program of hadronic physics research that is unique in the world to answer key questions about the structure of matter at its most fundamental (quark and gluon) level. There are, however, major risks to this future- scientific, technical, management and financial. If the funding for the 12 GeV Upgrade project is not available, there is a pipeline of first class 6 GeV experiments in place for the next decade. TJNAF will continue to pursue alternative approaches to make the 12 GeV Upgrade a reality. TJNAF has a history of effectively leveraging Work for Others (WFO) to benefit Nuclear Physics and the Office of Science. DOD investments toward a world-class Free Electron Laser (FEL) provide an accelerator physics/technology testbed with potential for basic energy sciences. In addition, joint activities, are poised to capitalize on FEL capabilities for laser bioscience. TJNAF will continue to build on the investment by DOD and others to remain on the frontier of FEL and ERL technology.

S&T Workforce: The success of TJNAF's scientific program is anchored by the leadership of its key managers and depends on its ability to attract and retain a diverse world-class workforce. TJNAF utilizes a comprehensive staffing plan that identifies, prioritizes and projects programmatic labor needs. Through careful monitoring of hiring and attrition TJNAF's workforce trending in the out years demonstrates constant effort in the indirect functions. Programmatic needs point to a small increase in labor force.



Employee Diversity: TJNAF, as with all national DOE laboratories, must make significant progress in the recruitment and retention of underrepresented populations, particularly African American and Hispanic scientific staff. In particular, TJNAF is committed to pacing the rapidly increasing representation of women and underrepresented minority science and engineering Ph.D.'s graduating from tier 1 universities. TJNAF's existing education activities range from K-12 (most notably the BEAMS program, which serves as a national model) to graduate education and laboratory affiliations (joint faculty positions, post docs and graduate students) that emphasize Minority Serving Institutions (MSI's).

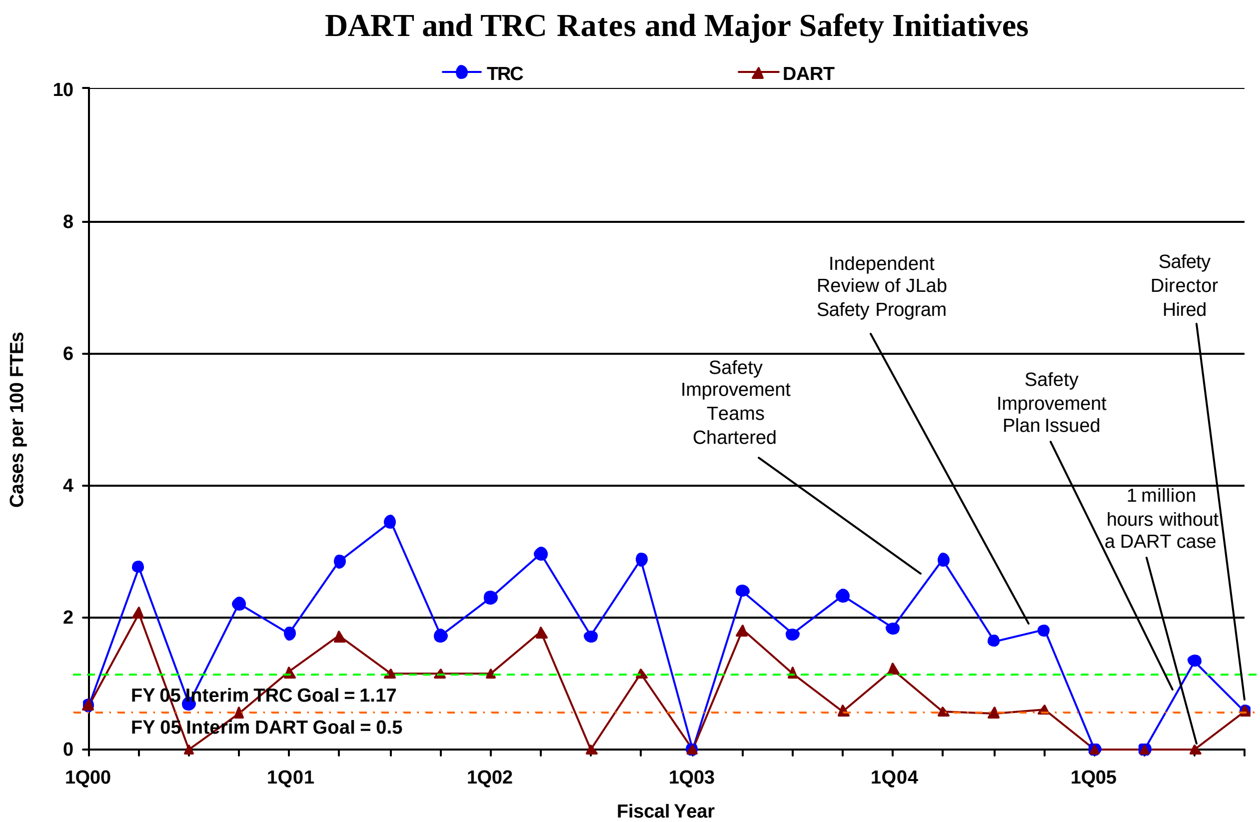
TJNAF, in alliance with its M&O contractor, Southeastern Universities Research Association's network of more than 60 member universities, (5 of which are MSI's), will collaborate on recruiting, improving and retaining workforce diversity and strength. Efforts will include utilizing an inventory of potential diverse candidates in all scientific areas and in particular for senior role model scientific and management fields; identifying and cultivating potential employees early via summer schools and focused workshops; insisting on qualified diverse candidates for postings; encouraging employee affinity groups; and addressing exit issues critical to retaining a diverse workforce.

Safety: TJNAF has moved aggressively to improve its safety performance through a multi-activity initiative. The Lab's new safety challenge "Accidents are preventable, zero injuries are the TJNAF's goal." began in 2004 analyzing its safety performance with the help of an expert outside contractor and initiated the following action items:

- Instituted organization changes including the addition of the Associate Director of Safety reporting to the Lab Director and a member of the senior management team
- Articulated the safety challenge at all levels of the organization
- Chartered integrated teams to improve electrical safety and material handling

- Conducted a safety culture survey to baseline and guide safety initiatives
- Emphasized timely reporting of minor injuries/incidents
- Developed and rolled out a comprehensive safety strategy
- Established a Worker Safety Committee for routine floor level feedback

A review of current lagging indicators (Total Recordable Case, TRC, Rate and Days Away/Restricted/Transferred, DART, Rate) show significant improvement and compares well with results at other Office of Science labs. TJNAF has logged over 1 million hours without a lost workday away injury in FY 2004 and 2005. For this improved performance, the Lab credits its multi-pronged approach and its capability to convince an increasing number of Lab employees that management has a genuine concern for their safety and well-being.



Physical Infrastructure: TJNAF is located on a 163 acre Federal reservation in Newport News, Va. The reservation, including three facilities (97,000 sf), was transferred from NASA to DOE in 1987. Subsequently, DOE constructed 311,000 sf of new facilities, including the Continuous Electron Beam Accelerator and support facilities. In total, TJNAF has 408,000 sf with 76% less than 20 years old. TJNAF's AUI is 1 (excellent).

TJNAF will attain a maintenance investment level of 2% of replacement plant value in FY 2006 which will be which will be continued in FY 2007 and the outyears. TJNAF's deferred maintenance backlog is $9.6M, resulting in an ACI of 0.92 (adequate). A deferred maintenance reduction initiative was implemented in FY 2006 and will be continued in FY 2007 with funding of $396,000. The FY 2007 GPP funding request is $0.8M.

A 61,000 square foot addition to CEBAF Center was completed in January 2006. It provides an expanded computer center, cafeteria, and offices and made it possible to demolish 32,000 square feet of existing trailer space.

TJNAF's future recapitalization and modernization challenges include: a shortage of technical, experimental, and storage space; a renovation of the Test Laboratory to improve process flow; updating of building equipment and code updates; and, new office space to consolidate staff and allow termination of leasing office space offsite.

SECTION 2

DOE Non Science Laboratory Plans

This document provides supporting information to the five year budget plans for the Department of Energy's five remaining Federal Funded Research Development Centers (FFRDCs) laboratories (as listed on the National Science Foundation's FY 2006 Master List of FFRDCs) and the National Energy Technology Laboratory. For each Laboratory contained in this document there are:

- A primary mission statement as it relates to the Laboratory's lead Program Secretarial Office (LPSO)
- A statement of secondary missions to support other Department of Energy (DOE) program offices and other Federal agencies
- Core competencies
- Long term vision
- Major initiatives
- Reallocations to support lab priorities

FFRDC Title	Savannah River National Laboratory (SRNL), Aiken, SC, is managed by Washington Savannah River Co., LLC.
Lead Program Secretarial Office	Office of Environmental Management

Primary Mission

Conduct applied research and development to meet the science and technology needs of the Savannah River Site (SRS) and the Nation.

Secondary Missions

- SRNL contributes to the Department's Science mission by providing research in actinide chemistry, vitrification, materials sciences, remote systems, and modeling to support Department missions.

- SRNL supports NNSA's mission by providing project management, material, control, and accountability, and physical protection technical expertise for several International Radiological Threat Reduction (IRTR) project teams.

Core Competencies Supporting Missions

SRNL provides experience, technical expertise and facilities to EM to support and pursue scientifically defensible bases for cost effective, timely site cleanup, and closure.

- Chemical and Radiochemical Processing
- Environmental Science and Technology
- Analytical Chemistry
- Engineered Specialty Systems
- Materials Science
- Hydrogen and Tritium Science and Technology
- Sensor Development
- Computational science and advanced computing

Facilities Supporting Missions (*Facilities are responsibility of LPSO, unless otherwise noted.)*

SRNL is the only R&D laboratory for which EM has Program Secretarial Officer (PSO) responsibility. SRNL provides experience, technical expertise and facilities to EM to pursue scientifically defensible bases for cost effective, timely site cleanup, and closure.

- **The SRNL Technical Area complex**, located in the Upper 700-A Area, at the northern boundary of the site, consists of numerous laboratories, office and storage facilities totaling 635,000 sq. ft., including 118,000 sq. ft. of radiological controlled space. The main laboratories are located in **Building 773-A,** a Hazard Category 2 facility that is designed and rated to handle various quantities of radioactive and non-radioactive materials. Many laboratories in the Technical Area are state-of-the-art design and have unique capabilities to perform the site's national defense mission. These facilities include: atmospheric technology, underground radioactivity measurement facility, ultra low-level radioactivity measurement facility, SRNL standards laboratory, chemistry and analytical laboratories, glove box facilities and intermediate cells, high-level shielded cells, robotics laboratory, thermal fluids laboratory, scientific glass shop, and scientific computing resource center. An on-site technical library supports research scientists and engineers.

- **The lower 700 Area**, a short distance from the SRNL Technical Area Complex, has facilities that house much of the scientific engineering, and materials fabrication shops and offices. Facilities include electronics fabrication shops, test and evaluation facilities, engineering facilities, and metallographic facilities.
- **Aiken County Technical Laboratory (ACTL) and Hydrogen Technology Research Laboratory (HTRL) at the Savannah River Research Campus (SRRC). SRRC** is a county-owned facility from Aiken County, SC leased by SRNL. ACTL houses research laboratories for SRNL's environmental biotechnology and immobilization technology groups, which provide unique resources to augment SRNL Technical Area facilities. HTRL is a world-class facility for hydrogen storage, separation, production, and materials development work.

The SRNL's laboratory facilities are maintained consistent with applicable standards and requirements to support site missions. The facilities are generally sound. Critical renovations have been planned and implemented to maintain facility habitability and operability.

Long Term Vision

SRNL's core competencies and facilities will support its pursuit to be a modernized DOE site, recognized for performance and excellence in support of our national security and as a responsible steward of the environment.

Major Activities

Environmental Management Applied Research -- The environmental cleanup program, one of the largest, most diverse, and technically complex in the world, is responsible for 114 DOE sites across the U.S. To address this remediation challenge, Environmental Management (EM) technology investments focus especially on needs of the four major cleanup sites: Savannah River, Oak Ridge, Hanford, and Idaho. To meet compliance agreements, major investments continue in applied research that enhances cleanup in high-level waste (HLW) stabilization; groundwater, surface water, and soils remediation; deactivation and decommissioning of legacy facilities; and transuranic, plutonium, and spent nuclear fuel waste stabilization and disposition. SRNL provides technical solutions to technical barriers for accelerating cleanup of DOE legacy nuclear weapons production sites and materials and provides technical assistance for resolving challenging environmental cleanup problems. In the next 5 years, as EM's corporate laboratory, SRNL will use its applied research technological leadership across the DOE complex for achieving life-cycle cost reductions, improving safety performance, and developing and applying innovative solutions to remediation challenges.

National and Homeland Security — For Defense Programs, SRNL works on hydrogen processing and weapons technology development; for nuclear material management, its work involves plutonium surveillance, monitoring, and spent nuclear fuel. In addition, SRNL addresses nuclear nonproliferation, homeland security, nuclear forensics, and defense and space technologies. SRNL has developed metal-hydride-based and tritium processing applications for the replacement facility and the consolidation and tritium extraction facility projects. Both facilities are one of a kind hydrogen handling facilities. SRNL evaluates performance, safety and reliability of stockpile gas transfer systems for: tritium effects on materials; burst testing data archives, thermal shock inert testing, function test metallography, ultra-sensitive micro ultrasonic testing, production process enhancements and monitoring, special pinch welding development and monitoring, and special stress studies and monitoring.

Civilian Hydrogen Energy – As a dual-use application SRNL is adapting its long-standing capabilities in solid state hydrogen storage materials and system development for safe and efficient hydrogen storage systems for use in the automobile industry. In addition, civilian applications of hydrogen include sensor and separations technology development. In partnership with major automobile manufacturers, SRNL and the companies jointly are developing a lighter-weight, cost-effective hydrogen fuel storage system for hydrogen-powered cars. Adjacent to SRS in a research park, the Aiken County Council completed in late 2005 a $9.7 million complex using third-party funding. The National Center for Hydrogen Research includes a Hydrogen Technology Research Laboratory for unclassified work in hydrogen storage, separation, production and materials development. In addition to partnering with industry, a coalition of South Carolina universities (University of South Carolina, Clemson University's International Center for Automotive Research, South Carolina State University's Transportation Center) is integrating its pertinent skills and capabilities with those of SRNL. In addition to DOE funding, there is cost-sharing from several major companies; the South Carolina General Assembly is funding endowed chair positions in hydrogen fuel research.

Research Triangle with Universities -- A strategic research exchange program with the major research universities in South Carolina will be pursuing collaborative efforts. The Governor and the legislative delegation have sanctioned this exchange program. The strategic areas in which collaboration is expected to occur are: hydrogen production demonstration; homeland security center; ecological and energy demonstration park; center for chemical process modeling and simulation; and a nuclear research training reactor.

Laboratory Title National Energy Technology Laboratory (NETL), operated by the U.S. Department of Energy (DOE).

Lead Program Secretarial Office Office of Fossil Energy

Primary Mission

NETL contributes to the Department's energy mission by implementing research, development, and demonstration programs to resolve the environmental, supply, and reliability constraints of producing and using fossil resources.

Secondary Missions

Program Directed (single mission) Laboratory

Core Competencies Supporting Missions

NETL shapes, funds, and manages contracted research in 47 states and more than 40 foreign countries. NETL devotes the majority of its funding to R&D partnerships with industry, university, and other government entities – work that is augmented by onsite research in the areas of computational and basic sciences, energy system dynamics, materials science, and geological and environmental systems. NETL's research portfolio includes more than 1,400 projects, with a total award value of nearly $8 billion and private sector cost sharing of almost $4 billion. Three core competencies underpin activities at NETL:

1. Expertise in the science and engineering of technologies to produce and use coal, oil, and natural gas.
2. Proven capability to work effectively with the private sector to structure and implement cost-shared energy and environmental research, development, and demonstration programs leading to significant improvements in fossil-energy production and use.
3. In-depth knowledge of the chemistry and physics of solid, liquid, gaseous fuels and their transformations, and materials science.
4. Materials expertise that addresses both performance of engineering materials in plants, structures, vehicles, and equipment; and the ability to conduct research that allows a fundamental understanding of how the composition, microstructure, melting, and fabrication of the materials relate to their performance.

Facilities Supporting Missions *(Facilities are responsibility of LPSO, unless otherwise noted.)*

NETL has 1,200 employees at its five sites: Albany, Oregon; Fairbanks, Alaska; Morgantown, West Virginia; Pittsburgh, Pennsylvania; and Tulsa, Oklahoma. Together, these sites have 119 buildings and 16 major research facilities on nearly 250 acres. Major R&D facilities include:

- **Alloy and Reactive Metal Melting and Processing Facility**, which allows the optimization of ferrous, non-ferrous and reactive metals melting, and subsequent production of prototypes of these alloys and materials for high temperature applications.
- **CT Scanner Facility**, which allows researchers to watch fluid flow through cores at various pressure and temperature conditions. It is being used to study flow of carbon dioxide in rock cores,

and will also be used to refine fracture flow models that are useful in both enhanced oil recovery and sequestration research.

- **Geological Sequestration Core Flow Lab**, a multipurpose facility for simulating the effects of depths and temperatures likely to be encountered during sequestration in various geologic formations, and the effects of CO_2 on the permeability of the strata.
- **Geophysical Test Facility**, has been established at NETL to calibrate a suite of surface geophysical instruments that are being used to characterize flow of contaminated ground water at depths of up to 150 feet.
- **High-Performance Computer Clusters**, which compare to supercomputers listed in the top 500 in the world, as well as access to supercomputing capabilities through partnerships with regional science consortiums, allow NETL scientists to perform computational chemistry analysis and sophisticated computer modeling, providing answers where actual scientific data would be costly and difficult to obtain.
- **High Pressure Water Tunnel**, a unique facility which simulates deep brine conditions to study gas-water interactions for carbon sequestration research.
- **Hydrogen Testing Research Facility**, a unique facility for the study of membrane separation of hydrogen from coal-derived synthesis gas. The facility is able to evaluate membranes from NETL and NETL sponsored work under temperature and pressure conditions that would be found in a commercial gasifier.
- **Mercury Capture Research Facility**, an important small-scale facility that is used to test sorbents that could be used to eliminate mercury emissions from power plants.
- **Methane Hydrates Laboratory**, a facility that is able to produce and decompose, in a controlled fashion, methane hydrates in various media, including sediment cores from hydrate deposits, with the goal of understanding production parameters, such as flow rates and heat flux, which will allow methane hydrate resources to be exploited.
- **Modular Carbon Dioxide Capture Facility**, a facility for investigating carbon capture technologies.
- **Omicron Analysis and Surface Imaging System**, a custom-built analysis and imaging instrumental system that allows researchers to image individual atoms and determine the elemental composition of the first few atomic layers of surfaces relevant to fossil energy applications.
- **Reciprocating Engine Laboratory**, focuses on research to enable high efficiency, cleaner burning engines for America's future.
- **Severe Environment Corrosion Erosion Research Facility**, which provides researchers the opportunity to assess materials performance limits in a variety of severe service environments typically encountered in fossil energy power systems.
- **SimVal High Pressure Combustion Facility**, a facility designed to investigate physical processes needed to model low-emission turbine combustion flames, including hydrogen.
- **Turbine/Fuel-Cell Hybrid Systems Research Facility**, a facility used to study the interaction between fuel cells and turbines, and to develop control strategies for the reliable operation of fuel cell/turbine hybrids.
- **Visualization Laboratory**, allows development of leading edge software and systems to help researchers better understand their data using advanced visualization technologies.

Long Term Vision

NETL will deliver cutting-edge research and development, focused on the clean production and use of our Nation's domestic fossil energy resources, to meet the increasing demand for affordable energy without compromising the quality of life for future generations of Americans. NETLs' core competencies and facilities will support its pursuit of addressing the challenges put forth by the National Energy Policy:

- Enhance America's energy security;
- Improve the environmental acceptability of energy production and use;
- Increase the competitiveness and reliability of U.S. energy systems; and
- Ensure a robust U.S. energy future.

Major Initiatives

Clean Coal Power Initiative (CCPI) – Within President Bush's Coal Research Initiative, the CCPI is a cooperative, cost-shared program between the government and industry to demonstrate and accelerate the commercialization of advanced technologies to ensure reliability of an affordable electric supply while simultaneously protecting the environment. Under the Initiative, the nation's power generators, equipment manufacturers and coal producers help identify the most critical barriers to coal's use in the private sector and select technologies that will economically meet environmental standards while increasing the efficiency and reliability of coal power plants.

FutureGen – The FutureGen project is a public/private partnership to demonstrate technology that will establish the capability and feasibility of co-producing electricity and hydrogen from coal with essentially zero emissions, including carbon sequestration and gasification combined cycle, both integral components of the coal-fueled power plant of the future. The 275-megawatt prototype plant will serve as a large scale engineering laboratory for testing new clean power, carbon capture, and coal-to-hydrogen technologies. The project, a direct response to the President's Climate Change and Hydrogen Fuels Initiatives, will employ cutting-edge technology in nearly every aspect, and will be the cleanest fossil fuel-fired power plant in the world. FutureGen is important to demonstrating the future of coal use to meet the Nation's energy security and environmental challenges.

Power Plant Improvement Initiative (PPII) – The PPII was established to further the commercial-scale demonstration of clean coal technologies at existing and new electric generating facilities. The goals of PPII are geared toward demonstrating near-term advances in technologies to increase the efficiency, lower the emissions, and improve the economics and overall performance of coal-fired power plants, and will build on the successes gained through the Clean Coal Technology Demonstration Program. Projects focus on more effective and lower cost emission controls, and improving the by-product utilization, performance and reliability of power plants.

FFRDC Title Idaho National Laboratory (INL), Idaho Falls, ID, is operated by Battelle Energy Alliance, LLC

Lead Program Secretarial Office Office of Nuclear Energy, Science and Technology

Primary Mission

INL supports the Office of Nuclear Energy, Science and Technology by working to ensure the nation's energy security with safe, competitive and sustainable energy systems and unique national and homeland security capabilities.

Secondary Missions

The Office of Environmental Management owns most of the facilities at the Idaho Nuclear Technology and Engineering Center (INTEC) and the Radioactive Waste Management Complex (RWMC) and manages the Idaho Cleanup Project (ICP). The goal of the ICP is to complete cleanup work by 2012 to protect the Snake River Plain Aquifer.

The Office of Naval Reactors, within the National Nuclear Security Administration, owns the Naval Reactors Facility (NRF), which provides support to the U.S. Navy's nuclear-powered fleet.

The U.S. Department of Defense funds the Specific Manufacturing Capability (SMC) operated in NE-owned facilities. The mission of the SMC is to provide facilities, equipment and trained personnel to manufacture armor packages for the U.S. Army's M1A2 main battle tank.

Core Competencies Supporting Missions

Four core competencies underpin activities at INL:

- **Nuclear reactor design, reactor demonstration, and reactor safety.** Having designed, constructed, and operated 52 nuclear reactors during its 55-year existence, the INL understands reactor operations and safety and is recognized internationally for its expertise in nuclear energy.

- **Processing and managing radioactive and hazardous materials.** INL operates nuclear facilities used to process and manage radioactive and hazardous materials in a safe and environmentally compliant manner. From its experience as a major processor of DOE and U.S. Navy spent nuclear fuels, the laboratory has expertise in processing, handling, using, transporting, storing, and disposing of radioactive and hazardous materials.

- **Development, modeling, testing, and validating engineered systems and processes.** INL has an experienced engineering and technical work force to develop, model, test, and demonstrate a variety of engineered systems and processes to solve specific DOE-related problems. These include supporting national security through performing essential research, delivering critical technology solutions, and providing indispensable prototyping and testing services to identify and defeat threats to the security of the nation. For example, INL operates a state of the art

Supervisory Control and Data Acquisition Test Bed which researches and develops solutions that will strengthen the computer systems operating the electric power grid from attacks by viruses, hackers, and terrorism.

Facilities Supporting Missions

INL consists of an 890-square-mile area in Southeast Idaho, typically referred to as the "site," along with laboratories and administrative buildings located approximately 25 miles east in the city of Idaho Falls. There are three primary NE facility areas at INL. Two are located on the INL site; the third is located at Idaho Falls:

- **The Reactor Technology Complex (RTC).** RTC is the focal point for designing, testing and proving new technologies to enable the expansion of nuclear power. This mission involves multiple technological options aimed at helping to develop a new generation of safe, more efficient, environmentally sound nuclear reactors with enhanced proliferation-resistance. The primary focus of RTC is the continued operation of the Advanced Test Reactor (ATR) which conducts irradiated material testing, nuclear safety research, and nuclear isotope production. The ATR has become central to DOE's efforts to develop fuels and materials for Generation IV systems, which can contribute to the safe and economical production of electricity and possibly hydrogen.

- **The Materials and Fuels Complex (MFC).** MFC has led the development of advanced nuclear reactor technology for nearly 60 years. Breakthroughs in the type of fuel used in nuclear-generated power, improved fuel disposition technologies, and the proven demonstration of a fast spectrum nuclear power plant (EBR-II) have all been achieved at MFC. MFC is used for conducting research and development on new reactor fuels and related materials. Work at MFC will also include supporting the important work of nonproliferation: harnessing more energy with less risk. MFC facilities are important in carrying out DOE nuclear energy missions.

- **The Science and Technology Campus (STC).** STC is the collective name for INL's administrative, technical support, computer and laboratory facilities, where researchers work on a wide variety of advanced scientific research and development projects. The name of this cadre of facilities indicates both basic science research and the engineering that translates new knowledge into products and processes. Key STC facilities include the government-owned offices and research laboratories at the INL Research Center (IRC) and the Information Operations and Research Center (IORC). A new Science and Technology Facility and a new Center for Advanced Energy Studies (CAES) are planned within this campus environment. The CAES facility is designed to promote education and excellent research and development.

The major IFM support complex on the INL site is the Central Facilities Area (CFA), which consists primarily of administrative and support facilities, which provide medical, fire suppression, transportation, security, communications, electrical power, instrument calibration, and health physics services for the Site.

Other major facilities at the site not belonging to NE include the Critical Infrastructure Test Range Complex (CITRC), the Idaho Nuclear Technology and Engineering Center (INTEC), the Naval Reactors

Facility (NRF), the Radioactive Waste Management Complex (RWMC), and Test Area North (TAN), all of which contribute to the multi-program mission of INL.

Long Term Vision

Within ten years, INL will be the preeminent nuclear energy laboratory, with synergistic, world-class, multi-program capabilities and partnerships.

Major Activities

To achieve its long term vision, INL's strategic plan identifies pivotal areas of R&D that must be pursued.

- **Generation IV Reactor R&D.** The goal of NE's 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. INL will lead the research, development and demonstration effort and will form partnership with other national laboratories, universities, international partners, and the private sector to maximize technical interchange and obtain the maximum benefit from the resources invested.

- **Advanced Test Reactor (ATR).** The ATR is essential to ongoing and planned national security and energy research programs at the Idaho National Laboratory. The ATR Life Extension Program has the following objectives: upgrades, reconstitution of the Nuclear Safety Design Basis for the reactor, replenishing spare parts inventories, restoring systems, and replacing systems and equipment with modern, more reliable components that are carefully integrated into the reactor's operation and safety basis. In the longer term, Generation IV fast reactor fuel, reactor system development, and materials testing research goals may be achieved through use of the ATR.

- **Advanced Fuel Cycle Initiative.** The goal of NE's Advanced Fuel Cycle Initiative is to develop, demonstrate and optimize an integrated fuel cycle that effectively addresses the proliferation, waste, safety, and economic concerns caused by the current and future use of civilian nuclear power. These activities are accelerated beginning in FY 2007 under the President's Advanced Energy Initiative, which includes the Global Nuclear Energy Partnership (GNEP). INL will take part in developing fuel separations technology, fuel development and testing, and systems analysis, and is actively investigating the relative benefits, costs, risks, and safety issues associated with recycling used nuclear fuel under a GNEP approach, compared to the "once through" fuel cycle currently in place.

Reallocations to Support NE priorities (Target Scenario)

- INL facilities and infrastructure Base Operations will be conducted as efficiently as possible to maximize support of programmatic goals while meeting environment, safety and health requirements.

- Minimum essential Routine Maintenance and Repair will be accomplished for nuclear and non-nuclear safety related and safety significant systems and components.

    - The Routine Maintenance and Repair expenditure will be below the minimum 2% to 4% of Replacement Plant Value (RPV) guideline for Department of Energy (DOE) facilities.

    - The Deferred Maintenance backlog will grow precluding the possibility of achieving a sustainable backlog of 5% RPV by 2010.

- The ATR Life Extension Program will be conducted in accordance with the program baseline.

- The ATR Gas Test Loop Line Item Construction Project (LICP) cannot be conducted.

- The Materials and Fuels Complex (MFC) Remote Treatment Project (RTP) LICP cannot be conducted.

- There will be limited conduct of the Idaho Facilities and Infrastructure Recapitalization Program (IFIRP) through General Plant Projects (GPP).

- There will be limited significant capital equipment purchases.

- The actual annual scope of work for Idaho Facilities Management will be reduced significantly from that established in the November 2005 INL Ten Year Site Plan (TYSP) that is required by the DOE Order 430.1B, *Real Property Asset Management*.

FFRDC Title National Renewable Energy Laboratory, Golden, Colorado, is operated by Midwest Research Institute in partnership with Battelle

Lead Program Secretarial Office Office of Energy Efficiency and Renewable Energy

Primary Mission

NREL develops renewable energy and energy efficiency technologies and practices, advances related science and engineering, and transfers knowledge and innovations to address the Nation's energy and environmental goals.

Secondary Missions

NREL contributes to other DOE missions, including the

- Office of Electricity Delivery and Energy Reliability mission to modernize the electricity grid – NREL provides its technical capabilities in electric generation, systems modeling and integration, and control to remove the technical barriers associated with interconnecting, monitoring and controlling distributed energy resources in the context of the overall grid system.
- Office of Science mission to advance the frontiers of energy-related knowledge – NREL contributes to advancement of scientific knowledge in areas such as photosynthesis, solid-state theory, nanoscience, and optoelectronics; provides fundamental solar radiation measurement capabilities to provide data that supports climate change and meteorological research; and works with students and teachers to educate the next generation of scientists and engineers.
- National Nuclear Security Administration's national security mission – NREL works work with scientists and engineers in institutes of the Newly Independent States of the former Soviet Union to turn their capabilities from weapons production to development of renewable energy and energy efficiency technologies.
- Office of Policy and International Affairs – NREL brings its renewable energy and energy efficiency capabilities to bear in supporting international R&D and technology utilization collaborations and in support of clean energy technology export initiatives.

Core Competencies Supporting Missions

In conducting its mission, NREL's role spans three major interrelated areas: foundational science; applied engineering; and technology utilization - all of which are conducted within the context of market relevance and impact on the Nation's energy security, environmental, and economic vitality goals. Four core competencies underpin activities at NREL:

- **Renewable Electricity Science and Technology** – Encompasses fundamental knowledge of the phenomena and characteristics of renewable resources (solar, wind, biomass, geothermal, and ocean current), foundational science and technology to convert these resources to electricity, and development of measurement and modeling tools that enable characterizing, designing, and evaluating options in the context of their application.

- **Renewable Fuels Formulation and Use –** Draws on the fundamental knowledge of the phenomena and characteristics of renewable resources, science and technology to convert the resources to carbon and non-carbon fuels (including Hydrogen), fuel formulation chemistry, fuel storage, evaluation of options for delivery, technology to develop flexible fuel systems, and testing of fuels in mobile and stationery systems.
- **Integrated Energy System Optimization –** Engineering design, test, and evaluation of renewable energy technologies to integrate and optimize performance in the context of larger, energy using systems, such as buildings, vehicles, electricity supply systems, and fuel conversion systems.
- **Energy Analysis** - Technical analyses and modeling to identify technology improvement opportunities, understand the prospective benefits of technology options, and the impact of alternative policies on technology development and utilization.

Facilities Supporting Missions

- **Solar Energy Research Facility** – Primary focus is on foundational research in photovoltaic materials, nanoscience, and solid state theory; design and development of advanced solar cell concepts, and measurement and testing to determine the performance of cells and modules.
- **Outdoor Test Facility** – Closely related to the Solar Energy Research Facility, this facility enables long-term monitoring of PV module and system performance for reliability research.
- **Science and Technology Facility** (under construction) – This capability will support research on thin-films and nanostructures in an environment designed to enable accelerated transition from lab to commercial production. The centerpiece of the building will be the Process Development and Integration Laboratory (PDIL) specifically designed to accommodate a new class of thin film deposition, processing and characterization tools applicable to a variety of applications including photovoltaics and hydrogen storage and fuels cells.
- **Research Support Facility** (initiating design in FY 2006) – This new facility (which was congressionally directed) will provide showcase facilities to house NREL research and management support staff. This facility will push the state of the art in facility design and construction, and the aim is to achieve a LEED platinum certification
- **Biomass Research Facilities** – The Thermochemical Users Facility and the Alternative Fuels User Facility are development and testing facilities that addresses the two major pathways for converting biomass to fuels: thermochemical conversion; and biochemical conversion. Facilities provide the capabilities to rapidly analyze and characterize biomass properties, including the capability to visualize the biomass surface; develop and test pretreatment options; develop cellulose enzymes and strains; and to integrate, scale-up, and demonstrate processes at the pilot scale.
- **Thermal Test Facility** –In addition to providing state-of-the-art capabilities to develop and test advanced heating, ventilating and air conditioning systems, the facility itself serves as a large-scale building energy research project.
- **National Wind Technology Center** – unique, large-scale facilities to test and evaluate advanced wind turbines, blades, and control systems. Includes a blade structural test facility, a megawatt dynamometer test stand, and full-scale turbine test sites.
- **Distributed Energy Test Facility** – a working laboratory for interconnection and systems integration testing. This state-of-the-art facility includes generation, storage, and interconnection technologies as well as electric power system equipment capable of simulating a real-world electric system.

- **Renewable Fuel Laboratory** – This high-altitude, heavy-duty engine and vehicle laboratory is the first in the United States dedicated to researching and developing renewable and synthetic fuels and lubricants for heavy-duty transportation applications.
- **Solar Radiation Research Laboratory** – This unique research facility continually measures solar radiation and other meteorological data and disseminates the information to government, industry, academia, and international laboratories and agencies. These data are used for climate change studies, atmospheric research, and renewable energy conversion system testing.

Long Term Vision

NREL will be the world's pre-eminent institution for advancing renewable energy and energy efficiency technologies from concept to adoption to provide cost-effective, no regrets options for powering our homes, businesses, and vehicles.

NREL's core competencies and facilities will support DOE in addressing the major energy challenges articulated in the National Energy Policy and re-emphasized in the President's recent Advanced Energy Initiative:

- Reducing dependence on foreign sources of energy; and
- Ensuring affordable, reliable, secure, and clean sources of energy.

Major Initiatives

NREL directly supports the office of Energy Efficiency & Renewable Energy in accomplishing the goals of the major initiatives outlined in the President's Advanced Energy Initiative. In addition, NREL's strategic roadmap identifies several initiatives that will enable reaching its long-term mission.

- **Hydrogen Production and Manufacturing R&D** – NREL is integrating and enhancing its capabilities to support critical research and development needs associated with producing hydrogen from renewable resources as well as the manufacturing process R&D required to produce the infrastructure for a hydrogen economy. In FY 2005, NREL supported DOE in working with other Federal agencies to develop its *Roadmap on R&D for the Hydrogen Economy*. The Roadmap identifies critical challenges facing the manufacture of hydrogen systems today, with a focus on fuel cell, production, delivery and storage technologies. In partnership with industry and other laboratories, NREL will bring its unique capabilities to bear in addressing critical R&D will play a pivotal role in developing the needed hydrogen production and manufacturing to move the Nation towards a hydrogen energy economy.
- **Accelerating Solar Technology** – NREL is supporting the Solar America Initiatives to accelerate the market competitiveness of photovoltaic solar electricity by 2015 through applied research to improve current silicon technology and by developing thin films and thin film processing technology that will have lower costs (.10 to .15 $/kWh) and improved performance with current generation of solar cells. Additionally, NREL is exploring foundational concepts that will lead to solar cells with efficiencies approaching 60 percent. Advances in nanoscience, conducting polymers, computational science, combinatorial chemistry, and biological processes are being integrated to develop and test proof of principle around new solar cell concepts. This translational research at the interface between basic science and applied research has high potential to yield breakthroughs that will

advance the goals of the President's Solar America Initiative.

- **Biofuels Initiative** – This initiative is focused on enhancing and using capabilities to conduct translational research at the interface between basic biological science and applied biomass research in support of the President's Biofuels Initiative. By tapping the potential at this interface, NREL will work in partnership with other labs to deliver breakthrough concepts that will expand the resource potential of biomass through high-yield crops, reduce the cost of ethanol below current goals to enable cellulosic ethanol to compete without incentives in the marketplace, and provide for efficient use of biofuels in optimized vehicles.
- **Renewable Energy Knowledge Initiative** - As the leading institution for renewable energy R&D, NREL is a focal point for information on renewable energy resources and technologies. The purposed of this initiative is to enhance our ability to mine, capture, and provide access to the vast knowledge resource that derives from our RD&D and to ensure availability of objective and credible information to the research community and to decision makers working to advance or use these technologies.

Reallocations to Support EE priorities

Close out Geothermal Program activities and reassign laboratory space and staff as appropriate to support thermal systems research related to solar, biomass, net-zero energy buildings, and/or vehicle systems research.

FFRDC Title Lawrence Livermore National Laboratory (LLNL), Livermore, CA, is managed by the University of California

Lead Program Secretarial Office National Nuclear Security Administration

Primary Mission

LLNL has a primary role in the NNSA mission for assuring the safety, security and reliability of the nation's nuclear weapons stockpile and the prevention of the spread and use of nuclear weapons, as well as other weapons of mass destruction.

Secondary Missions

- LLNL contributes to the Department's Science mission by providing research that bolster the Laboratory's core competencies and contribute special expertise to solving important national problems. For example, bioscience research both contributes to the national security mission and leverages the Laboratory's physical science and engineering capabilities while contributing to efforts such as the artificial retina. Other research areas include: fusion energy research; lasers and electro-optics; computer science and simulation; materials science; astrophysics and space science; and accelerator technology.

- LLNL is on the EPA's National Priorities List. Environmental restoration activities at the LLNL sites are directed at controlling contaminated groundwater migration, and identifying and effectively remediating soil and groundwater where contaminants (volatile organic compounds) exceed regulatory limits. The Livermore Site is considered one operable unit and Site 300 has eight operable units. Waste management activities are directed at compliant storage, treatment, and off-site shipment for disposal of both legacy and newly generated hazardous and radioactive waste. Cleanup activities for the Livermore site are scheduled to be completed by the end of FY 2006 and at Site 300 by the end of FY 2008. The NNSA will assume responsibility for remaining cleanup work and subsequent long term stewardship beginning in FY 2006.

Core Competencies Supporting Missions

LLNL is a national laboratory focusing on nuclear weapons design to promote innovation in the development of our nation's nuclear stockpile through creative science and engineering. Principle activities include stockpile surveillance, stockpile refurbishment, and integrated program management. Eight core competencies underpin LLNL activities:

1. Physics
2. Computing
3. Biology
4. Engineering
5. National Security
6. Lasers and Optics
7. Chemistry and Materials Science
8. Energy and Environment

Facilities Supporting Missions *(Facilities are responsibility of LPSO, unless otherwise noted.)*

LLNL is located on a one-square-mile site in Livermore, California; with a larger (10 square miles) remote explosives testing site (Site 300) situated 18 miles east of the main Livermore site. Major User Facilities include:

- **National Ignition Facility** is the largest, most energetic laser in the world—when complete, it will have 60 times more energy than any laser in existence.
- **Center for Applied Scientific Computing** conducts collaborative scientific investigations that require the power of high-performance computers and the efficiency of modern computational methods.
- **Center for Microtechnology**, where broad spectrums of microtechnologies are used to develop microsystems for specific applications ranging from communications to field instrumentation to medicine.
- **Forensic Science Center** houses a variety of state-of-the-art analytical tools ranging from gas chromatograph–mass spectrometers to ultratrace chemical and DNA techniques.
- **Center for Accelerator Mass Spectrometry** houses the most versatile and productive accelerator mass spectrometry facility in the world. It provides an exceptionally sensitive technique for measuring concentrations of isotopes in small samples, typically less than 1 milligram, and the relative abundance of isotopes at low levels.
- **Site 300 Experimental Test Facility** is a high-explosives firing facility.

Long Term Vision

LLNL's core competencies and facilities will support its pursuit of excellence and scientific pre-eminence by:

- Providing stewardship of the U.S. nuclear weapons stockpile by maintaining the weapons' safety, security, and reliability and developing new capabilities if needed;
- Countering significant emerging security threats and the proliferation and use of weapons of mass destruction; and ,
- Developing advanced technologies to address sources of international insecurity and international risk.

Major Activities

Warhead Life Extension – The laboratory is responsible for the W80 Mod 3 Life Extension Program scheduled for completion in 2017.

Reliable Replacement Warhead (RRW) - The laboratory is participating in an 18-month design competition for exploring RRW feasibility options, to be presented tot he Nuclear Weapons Council for a decision to proceed in November 2006. If approved to proceed, RRWs will relax Cold War design constraints that maximized yield to weight ratios and will allow design of replacement components that are easier to manufacture, are safer and more secure, eliminate environmentally dangerous materials, and increase design margins, thus ensuring long-term confidence in reliability and a correspondingly reduced chance of a need to resort to nuclear testing. These modified warheads will support existing military capabilities, will be carried on the same delivery systems, and will hold at risk the same targets as the variants they replaced. RRW is seen as the "enabler" for transformation to a more responsive nuclear weapons infrastructure.

National Ignition Facility (NIF) – Construction continues on the NIF facility for its use for ignition and other high energy density physics experiments in support of the Stockpile Stewardship Program. The NIF is a 192-beam laser due for completion in FY 2009 with first experiments scheduled for 2010.

Nuclear Materials Consolidation and Disposition **–** The NNSA is accelerating efforts for warhead dismantlement and consolidation of special nuclear materials across the nuclear weapons complex. Both of these efforts will contribute to improved physical security at NNSA sites by reducing the number of facilities requiring the highest levels of protection. The Secretary has established a Department-wide coordination committee to develop an overarching plan for materials consolidation and disposition. NNSA's consolidation activities will be incorporated into the Department-wide plan. In addition, the NNSA is working with the Office of Environmental Management to develop disposition paths for excess nuclear materials at the national laboratories and other NNSA facilities. Removal of these excess materials will improve the safety and operational efficiency of the laboratories, and may allow additional downsizing of high-security areas. The Lawrence Livermore National Laboratory currently has programmatic requirements for significant quantities of nuclear materials, but the NNSA will be reviewing options eliminating or transferring these requirements.

Long-Term Remedial Actions (LTRA) – Activities will commence in FY 2007 and include but are not limited to: facility operation and maintenance of contaminated ground water treatment systems; soil vapor and groundwater monitoring; and, well field operations and maintenance.

Reallocations to Support NNSA priorities

The NNSA uses a disciplined multi-year planning, programming, and budgeting and evaluation (PPBE) process to develop its five-year resource estimates for the NNSA programs in support of national security priorities. The NNSA program managers then make funding allocations to the NNSA sites to ensure that site activities are in support of programmatic priorities. This ensures that the core competencies of each site are brought to bear in meeting NNSA mission requirements. It is important to note however that unlike other DOE programs, NNSA manages by program and not by site. Therefore, resource projections by site are strictly estimates and are subject to change by NNSA based on program execution considerations. Also, the FY 2007-2011 budget does not explicitly consider the results of the recent study of the Nuclear Weapons Complex by the Secretary of Energy Advisory Board. The Recommendations are still under study, and implementation will be considered in future PPBE cycles.

To meet NNSA priorities at LLNL during the FY 2007-2011 planning period, funding profiles have been adjusted from the FY 2006 baseline for the following major programs. These adjustments are within an overall 2 percent annual out-year increase for the planning period; program and site allocations may be rebalanced during the FY 2008-2012 PPBE cycle.

Resources have been increased for:

- Inertial Confinement Fusion and High-Yield Campaign - supports increases in experimental programs including a planned NIF experiment in FY 2010.
- Readiness in Technical Base and Facilities - addresses ongoing facility related issues.
- Facilities and Infrastructure Recapitalization Program - gets back on track to restoring mission-critical facilities and infrastructure.
- Nuclear Weapons Incident Response - supports the Render Safe R&D program.

- Pit Manufacturing and Certification Campaign – supports technology development of pit manufacturing processes necessary to establish the capability to manufacture stockpile pits.
- Nonproliferation and Verification R&D – increases efforts to develop proliferation detection technology.

Resources have been decreased for:

- Advanced Simulation and Computing Campaign - due to a shift from development to full-use status for ASC Purple and BlueGeneL
- Construction – reflects completion of three major projects: National Ignition Facility; the Engineering Technology Complex Upgrade; and Tritium Facility Modernization.

FFRDC Title Los Alamos National Laboratory (LANL), Los Alamos, NM, is managed (as of June 1, 2006) by the Los Alamos National Security LLC.

Lead Program Secretarial Office National Nuclear Security Administration

Primary Mission

LANL has a primary role in NNSA mission for assuring the safety, security and reliability of the nation's nuclear weapons stockpile and the prevention of the spread and use of nuclear weapons, as well as other weapons of mass destruction.

Secondary Missions

- LANL contributes to the Department's Science mission by providing research that bolsters the Laboratory's core competencies and contributes special expertise to solving important national problems. LANL engages in a wide spectrum of fundamental and strategic research such as materials science, neutron and accelerator science, high-performance computing, biosciences; nuclear physics, high-energy physics, and astrophysics; fusion energy; computation, modeling, and simulation; and biological and environmental research.

- As a result of the development and production of nuclear weapons, beginning during World War II radiological, hazardous and high explosive wastes have contaminated the soils and groundwater at LANL. Within the currently defined EM scope for environmental restoration, there are approximately 1,800 release sites at LANL requiring cleanup and/or regulatory closure as well as legacy waste management that include storage, treatment, and disposal of transuranic and mixed low-level waste. Under the accelerated cleanup plan legacy waste removal has been accelerated to 2010 and completion of cleanup corrective actions to 2015. It is anticipated that responsibility for the remaining cleanup work will be transferred to the NNSA in FY 2007.

Core Competencies Supporting Missions

LANL is a design laboratory for the safety and reliability of the nuclear explosives package in the Nation's nuclear weapons. LANL possesses unique capabilities in neutron scattering, enhanced surveillance, and plutonium science and engineering. Five core competencies underpin activates at LANL:

1. High-performance computing
2. New and exotic advanced materials
3. Bioscience and biotechnology
4. Earth and environmental science
5. Physics and theory

Facilities Supporting Missions (*Facilities are responsibility of LPSO, unless otherwise noted.)*

LANL is located on approximately 25,000 acres, adjacent to the town of Los Alamos, New Mexico, which is approximately 25 miles northwest of Santa Fe. LANL is home to more than 50 cross-disciplinary user facilities including:

- **Los Alamos Neutron Science Center (LANCE)**, is the nation's most powerful source of pulsed particles.
- **The Manuel Lujan Jr. Neutron Scattering Center** at the LANCE is a SC user facility focusing on nuclear physics research.
- **National High Magnetic Field Laboratory**, a general user facility open to all researchers, on a proposal review basis, who wish to perform experiments in high magnetic fields.
- The **Dual Axis Radiographic Hydrotest facility (DARHT)** supports the NNSA Science Campaign to provide models, scientific understanding, and experimental data necessary to develop certification methodologies to execute the Directed Stockpile Work and other campaign missions.
- **Center for Integrated Nano Technologies** is a SC facility scheduled for operation by FY 2008 and will be a nanoscience research center jointly located at SNL and LANL that will focus on exploring the path from scientific discovery to integration of nanostructures into the micro and macro worlds.

Long Term Vision

LANL's core competencies and facilities will support its pursuit of excellence and scientific pre-eminence by:

- Ensuring the safety and reliability of the nuclear weapons in our country's stockpile; and,
- Promoting basic and applied research to solve complex scientific and technological problems in support of the Laboratory's national security and threat reduction missions.

Major Activities

Warhead Life Extension – The laboratory is responsible for the B61 Alt357 and the W76 Mod-1 life extension program.

Reliable Replacement Warhead (RRW) – The laboratory is participating in an 18-month design competition for exploring RRW feasibility options, to be presented tot he Nuclear Weapons Council for a decision to proceed in November 2006. If approved to proceed, RRWs will relax Cold War design constraints that maximized yield to weight ratios and will allow design of replacement components that are easier to manufacture, are safer and more secure, eliminate environmentally dangerous materials, and increase design margins, thus ensuring long-term confidence in reliability and a correspondingly reduced chance of a need to resort to nuclear testing. These modified warheads will support existing military capabilities, will be carried on the same delivery systems, and will hold at risk the same targets as the variants they replaced. RRW is seen as the "enabler" for transformation to a more responsive nuclear weapons infrastructure.

DARHT – A major focus is the refurbishment and commissioning of the 2nd axis of the DARHT facility. The facility will use three-dimensional imagery of imploding mock primaries, with sufficient time and space resolution to help resolve uncertainties in primary performance.

Nuclear Materials Consolidation and Disposition – The NNSA is accelerating efforts for warhead dismantlement and consolidation of special nuclear materials across the nuclear weapons complex. Both of these efforts will contribute to improved physical security at NNSA sites by reducing the number of facilities requiring the highest levels of protection. The Secretary has established a Department-wide coordination committee to develop an overarching plan for materials consolidation and disposition. NNSA's consolidation activities will be incorporated into the Department-wide plan. In addition, the NNSA is working with the Office of Environmental Management to develop disposition paths for excess nuclear materials at the national laboratories and other NNSA facilities. Removal of these excess materials will improve the safety and operational efficiency of the laboratories, and may allow additional downsizing of high-security areas. The NNSA completed the transfer of Category I/II nuclear materials from the Los Alamos National Laboratory TA-18 facilities to a more secure location at the Nevada Test Site, TA-55 at Los Alamos National Laboratory, and the Y-12 National Security Complex.

Reallocations to Support NNSA Priorities

The NNSA uses a disciplined multi-year planning, programming, and budgeting and evaluation (PPBE) process to develop its five-year resource estimates for the NNSA programs in support of national security priorities. The NNSA program managers then make funding allocations to the NNSA sites to ensure that site activities are in support of programmatic priorities. This ensures that the core competencies of each site are brought to bear in meeting NNSA mission requirements. It is important to note however that unlike other DOE programs, NNSA manages by program and not by site. Therefore, resource projections by site are strictly estimates and are subject to change by NNSA based on program execution considerations. Also, the FY 2007-2011 budget does not explicitly consider the results of the recent study of the Nuclear Weapons Complex by the Secretary of Energy Advisory Board. The Recommendations are still under study, and implementation will be considered in future PPBE cycles.

To meet NNSA priorities at LANL during the FY 2007 - FY 2011 planning period, funding profiles have been adjusted from the FY 2006 baseline for the following major programs. These adjustments are within an overall 2 percent annual out-year increase for the planning period; program and site allocations may be rebalanced during the FY 2008-2012 PPBE cycle.

Resources have been increased for:

- Pit Manufacturing and Certification Campaign – supports increasing pit manufacturing capability to 30-40 pits per year.
- Readiness in Technical Base and Facilities – addresses ongoing facility related issues.
- Facilities and Infrastructure Recapitalization Program - gets back on track to restoring mission-critical facilities and infrastructure.
- Nuclear Weapons Incident Response to support the Render Safe R&D program.
- International Nuclear Materials Protection and Cooperation - accelerates installation of radiation detection equipment abroad.
- Construction – reflects start-up of three new projects: TA-18 Infrastructure Reinvestment; TRU Waste Facility; and Chemistry and Metallurgy Research (CMR) Replacement.

Resources have been decreased for:

- Directed Stockpile Work - due to completion of the B61 LEP.

- Fissile Materials Disposition - due to transition from construction planning activities to actual construction at another site.

FFRDC Title	Sandia National Laboratories (SNL), Albuquerque, NM, Sandia Corporation, a subsidiary of Lockheed Martin Corp.
Lead Program Secretarial Office	National Nuclear Security Administration

Primary Mission
SNL has a primary role in the NNSA mission for assuring the safety, security and reliability of the nation's nuclear weapons stockpile and the prevention of the spread and use of nuclear weapons, as well as other weapons of mass destruction.

Secondary Missions
- SNL contributes to the Department's Science mission by providing research that bolsters the Laboratory's core competencies and contributes special expertise to solving important national problems. This includes research in: fusion energy sciences; scientific computing; basic energy sciences – materials, geosciences, engineering sciences, and nanoscience; and biological and environmental research.

- Soil and minor groundwater contamination by radioactive and hazardous materials resulted from past research, development, and testing operations at SNL. EM activities are conducted under Resource Conservation and Recovery Act authority administered by the State of New Mexico. The EM cleanup of over 260 release sites with contaminated soil and water will be completed in FY2006. The NNSA will assume responsibility for the remaining cleanup work and subsequent long term stewardship activities in FY 2006.

Core Competencies Supporting Missions
SNL develops technologies to sustain, modernize, and protect our nuclear arsenal, prevent the spread of weapons of mass destruction, defend against terrorism, protect our national infrastructures, ensure stable energy and water supplies, and provide new capabilities to our armed forces. Five core competencies underpin activities at SNL:
1. Computational and information sciences
2. Microelectronics and photonics sciences
3. Materials and process sciences
4. Engineering sciences
5. Pulsed-power sciences

Facilities Supporting Missions (*Facilities are responsibility of LPSO, unless otherwise noted.)*
SNL occupies nearly 9,000 acres on the Kirtland reservation and has additional facilities in Livermore, California (400 acres), Kauai, Hawaii (120 acres) and Tonopah, Nevada (600 square miles). SNL has 25 user facilities available for use by approved U.S. industry, universities, academia, other laboratories, state and local governments, and the scientific community.
They include:
- **Combustion Research Facility** is a SC facility that conducts a broad range of basic and applied research and development in combustion science and technology, aimed at improving the nation's ability to use and control combustion processes.

- **Explosives Components Facility**, a state-of-the-art facility that provides a full range of chemical, material, and performance analysis capabilities for energetic materials and explosive components.
- **Intelligent Systems and Robotics Center**, which contains the Robotic Manufacturing Science and Engineering Laboratory, a 73,000-square-foot facility built to bring together all of Sandia's robotics researchers in an environment conducive to technology transfer.
- **Primary Standards Facility**, which develops and maintains primary standards that are traceable to national standards and calibrates and certifies customer reference standards.
- **Shock Technology and Applied Research Facility**, a state-of-the-art facility which can provide a full range of projectile/ target interactions.
- **Center for Integrated Nano Technologies** is a SC facility scheduled for operation by FY 2008 and will be a nanoscience research center jointly located at SNL and LANL which will focus on exploring the path from scientific discovery to integration of nanostructures into the micro & macro worlds.
- **The Microsystems and Engineering Sciences Applications (MESA) Complex** at SNL Albuquerque is a state-of-the-art national complex scheduled for completion in 2009 that will provide for the design, integration, prototyping and fabrication, and qualification of microsystems into weapon components, subsystems, and systems within the stockpile.

Long Term Vision

Sandias' core competencies and facilities will support its pursuit of excellence and pre-eminence in:

- Nuclear Weapons - ensuring the stockpile is safe, secure, reliable, and can support the United States' deterrence policy.
- Nonproliferation and Assessments - reducing the proliferation of weapons of mass destruction, the threat of nuclear accidents, and the potential for damage to the environment
- Military Technologies and Applications - addressing new threats to national security
- Energy and Infrastructure Assurance - enhancing the surety of energy and other critical infrastructures
- Homeland Security - helping to protect our nation against terrorism

Major Activiities

Warhead Life Extension – The laboratory supports the life extension program for the B61 Alt357, W76 Mod-1, and the W80 Mod3.

Reliable Replacement Warhead (RRW) – The laboratory is participating in an 18-month design competition for exploring RRW feasibility options, to be presented tot he Nuclear Weapons Council for a decision to proceed in November 2006. If approved to proceed, RRWs will relax Cold War design constraints that maximized yield to weight ratios and will allow design of replacement components that are easier to manufacture, are safer and more secure, eliminate environmentally dangerous materials, and increase design margins, thus ensuring long-term confidence in reliability and a correspondingly reduced chance of a need to resort to nuclear testing. These modified warheads will support existing military capabilities, will be carried on the same delivery systems, and will hold at risk the same targets as the variants they replaced. RRW is seen as the "enabler" for transformation to a more responsive nuclear weapons infrastructure.

Microsystems and Engineering Sciences Applications (MESA) – The laboratory will continue construction on the MESA facility with a target completion date of 2009. MESA will provide for the design, integration, prototyping and fabrication, and qualification of Microsystems into weapon components, subsystems and systems within the stockpile.

Tonopah Test Range (TTR) - The laboratory is working with the other weapon design laboratories to complete a future options strategy for the TTR. Following receipt of the strategy, NNSA will select a course of action consistent with the stockpile requirements and ongoing responsive infrastructure activities.

Nuclear Materials Consolidation and Disposition **–** The NNSA is accelerating efforts for warhead dismantlement and consolidation of special nuclear materials across the nuclear weapons complex. Both of these efforts will contribute to improved physical security at NNSA sites by reducing the number of facilities requiring the highest levels of protection. The Secretary has established a Department-wide coordination committee to develop an overarching plan for materials consolidation and disposition. NNSA's consolidation activities will be incorporated into the Department-wide plan. In addition, the NNSA is working with the Office of Environmental Management to develop disposition paths for excess nuclear materials at the national laboratories and other NNSA facilities. Removal of these excess materials will improve the safety and operational efficiency of the laboratories, and may allow additional downsizing of high-security areas. The Sandia National Laboratories complex in Albuquerque is currently executing a plan to remove all Category I and II nuclear materials from the site by 2008.

Reallocations to Support NNSA priorities

The NNSA uses a disciplined multi-year planning, programming, and budgeting and evaluation (PPBE) process to develop its five-year resource estimates for the NNSA programs in support of national security priorities. The NNSA program managers then make funding allocations to the NNSA sites to ensure that site activities are in support of programmatic priorities. This ensures that the core competencies of each site are brought to bear in meeting NNSA mission requirements. It is important to note however that unlike other DOE programs, NNSA manages by program and not by site. Therefore, resource projections by site are strictly estimates and are subject to change by NNSA based on program execution considerations. Also, the FY 2007-2011 budget does not explicitly consider the results of the recent study of the Nuclear Weapons Complex by the Secretary of Energy Advisory Board. The Recommendations are still under study, and implementation will be considered in future PPBE cycles.

To meet NNSA priorities at Sandia during the FY 2007 - FY 2011 planning period, funding profiles have been adjusted from the FY 2006 baseline for the following major programs. These adjustments are within an overall 2 percent annual out-year increase for the planning period; program and site allocations may be rebalanced during the FY 2008-2012 PPBE cycle.

Resources have been increased for:

- Directed Stockpile Work - supports the W76-Mod 1 and W80-Mod 3 LEPs.

- Readiness in Technical Base and Facilities – addresses ongoing facility related issues.
- Facilities and Infrastructure Recapitalization Program – gets back on track to restoring mission-critical facilities and infrastructure.

Resources have been decreased for:

- Construction – reflects completion of construction of two major projects: MESA and Test Capabilities Revitalization.