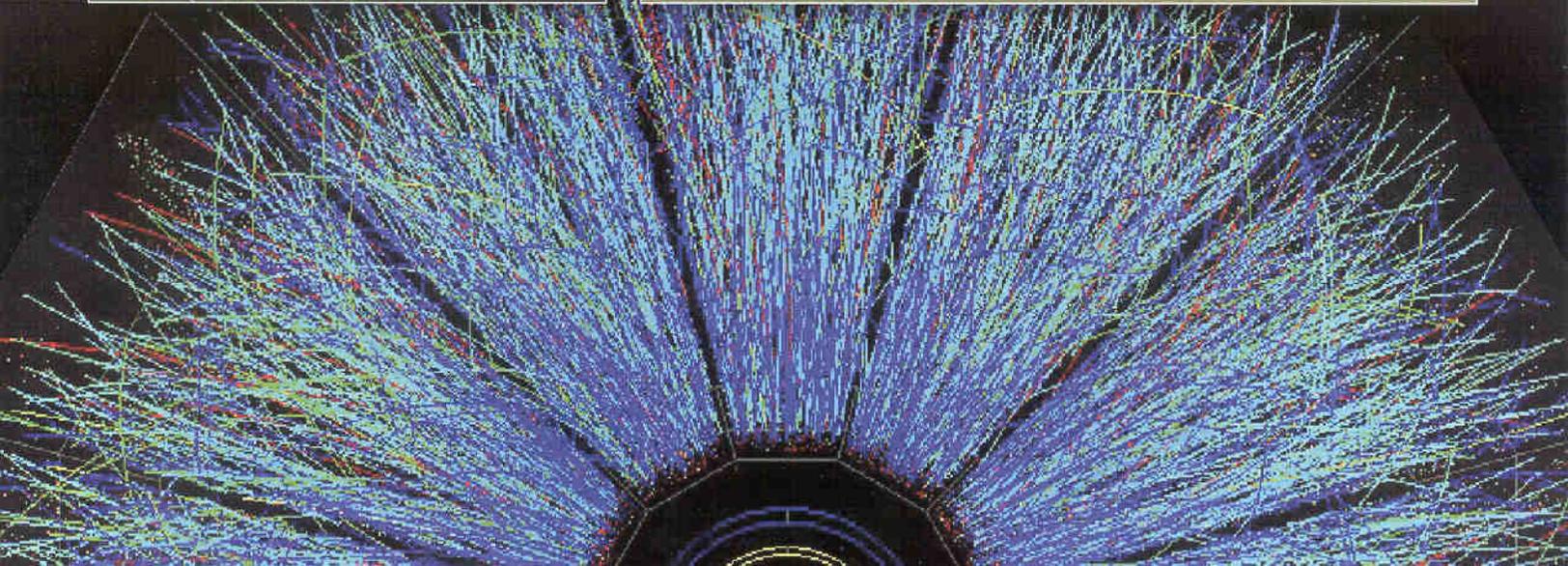


BROOKHAVEN NATIONAL LABORATORY
Year End Self-Evaluation

Fiscal Year 2005 • December 1, 2005

BROOKHAVEN SCIENCE ASSOCIATES • Under contract with the U. S. Department of Energy
Prime Contract Number AC02-98CH10886 • Brookhaven National Laboratory





managed by Brookhaven Science Associates
for the U.S. Department of Energy
www.bnl.gov

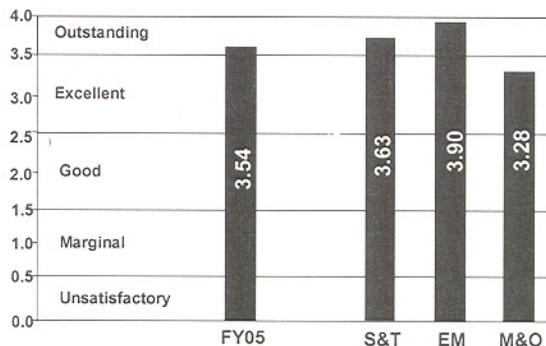
December 1, 2005

Mr. Michael Holland
Brookhaven Site Manager
U.S. Department of Energy
Building 464
Brookhaven Site Office
Upton, NY 11973-5000

Dear Mr. Holland:

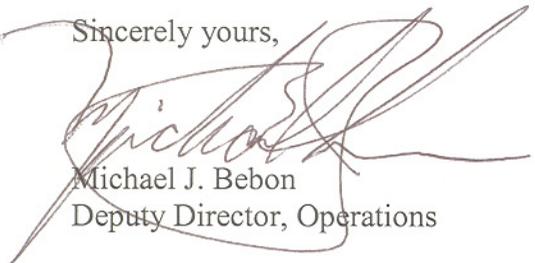
BSA has completed its Year-End 2005 Self-Evaluation. The evaluation report is attached for your review and consideration. Based on our self-evaluation, BSA has determined that the overall performance of the Laboratory for Fiscal Year 2005 is "**Outstanding**" with an overall score of 3.54.

The graphic on the right depicts BSA's performance for Fiscal Year 2005 for the three Critical Outcomes: Science and Technology, Environmental Management, and Laboratory Management and Operations. We continue our emphasis on identifying, driving and sustaining areas of improvement.



Please refer to the Executive Summary to obtain an overview of our performance and a description of the report structure.

Sincerely yours,


Michael J. Bebon
Deputy Director, Operations

cc: P. Chaudhari J. Tarpinian
P. Bond R. Lebel

Attachment: Fiscal Year 2005 Self-Evaluation Report

**TABLE OF CONTENTS FOR THE FISCAL YEAR 2005
SELF-EVALUATION REPORT**

1. Executive Summary
2. Appendix B Structure and Scores
Appendix B Performance Measures with their respective ratings and scores
3. Critical Outcome – 1, Performance Summary
Significant Achievements and Accomplishments in BNL's Science and Technology
4. Critical Outcome – 2, Performance Summary
Performance Summary for Critical Outcome 2: Environmental Management
5. Critical Outcome – 3, Performance Summary
Performance Summary for Critical Outcome 3: Laboratory Management and Operations
6. Acronym List

Executive Summary

This is the Brookhaven Science Associates (BSA) Year End Self-Evaluation Report for FY2005 for Brookhaven National Laboratory (BNL). It reflects BSA's assessment of how the Laboratory performed against each of the performance measures in the Prime Contract between BSA and the Department of Energy (DOE) for operating Brookhaven National Laboratory.

BSA has adjectivally rated its FY2005 performance as *Outstanding*. Based on the results of this self-evaluation, BSA calculates an overall performance score of **3.54 out of a possible 4.0 points**. The score breakdown by critical outcome is shown here:

BSA FY2005 SUMMARY EVALUATION				
CO #	TITLE	WEIGHTING	BSA RATING	BSA SCORE
	Brookhaven Science Associates: Overall	100%	<i>Outstanding</i>	3.54
1.0	Science and Technology	60%	<i>Outstanding</i>	3.63
2.0	Environmental Management	8%	<i>Outstanding</i>	3.90
3.0	Laboratory Management and Operations	32%	<i>Excellent</i>	3.28

An executive summary chart of BSA FY2005 performance is included following this section. The chart lists all FY2005 Critical Outcomes and Objectives with the associated weights and scores. Tables detailing weights and scores down to the performance measure/metric level are included in the tabbed sections for Critical Outcomes 2.0 and 3.0. Detailed performance descriptions, which serve as substantiation for the BSA rating and score, are included in each of the tabbed sections for Critical Outcomes 1.0, 2.0 and 3.0. A different reporting format (landscape) is used for Critical Outcome 3.0 since performance information in this format has been presented quarterly to the DOE Brookhaven Site Office (BHSO) during FY2005. These meetings have facilitated a continuous dialogue between BHSO and BNL on areas of improvement.

FY2005 BSA Critical Outcome Performance

Science and Technology: *Outstanding* (3.63)

This Critical Outcome consists of 5 Objectives; Quality (30%), Relevance to DOE Mission (10%), Success in Constructing and Operating Research Facilities (25%), Research Program Management (30%), and Nanoscience Initiative (5%). The numbers in parentheses represent the relative weights of the individual Objectives to the Critical Outcome. For a detailed executive summary of the Science and Technology evaluations as well as the year-end evaluation see the section entitled Critical Outcome 1 – Performance.

BSA continues to maintain *Outstanding* performance in Science and Technology. The quality of our research is unparalleled. Remarkable results (the “perfect liquid”) continue to emanate from the Relativistic Heavy Ion Collider. The Laboratory continues to work diligently to align its programs and personnel with the strategic mission of our customers. Improving on program relevance is a continuous communication and alignment process that BSA believes is vital to its continued success. BSA believes that it has improved within the *Outstanding* rating of relevance. The Laboratory maintains its *Outstanding* rating in success in operating and maintaining our world-class facilities and instruments. BSA also acknowledges that elements of our Research Program Management require attention and is responding to our customer issues and concerns. We continue to better define and manage to those program management elements and values in order to be in complete alignment and integrated with our customer’s technical/quality, risk, cost, and schedule requirements and expectations. The Nanoscience Initiative introduced to support expanding programs and level of effort achieved a *Good* rating overall due to difficulties in the initial construction bid process for the Center for Functional Nanomaterials (CFN). These difficulties have been overcome and construction of the CFN is now on schedule and within budget.

Environmental Management: *Outstanding* (3.90)

During FY2005, all 16 Critical Outcome work packages were completed in accordance with the Environmental Management Performance Baseline completion criteria. BSA also planned and implemented a comprehensive and first-of-a-kind transition plan that guided Brookhaven cleanup from the construction phase into long-term surveillance and maintenance in a highly organized and controlled manner. This high standard of performance satisfied all nine DOE Gold Chart completion milestones. BSA aggressively managed and coordinated Core Team work activities during FY2005. By the end of the fiscal year, the Core Team was close to reaching a consensus for the HFBR end state. BSA successfully launched preliminary BGRR planning activities. BSA completed a substantial campaign of high-risk work in the field during FY2005 without a single lost work injury. Nonetheless, BSA agrees with BHSO's assertion that there is room for improvement in nuclear facility and rail transportation safety, and BSA has proactively taken steps to ensure that future work is completed on an event-free basis.

Laboratory Management and Operations: *Excellent* (3.28)

The Objectives associated with this Critical Outcome include Corporate Leadership; Business Processes; Management System Planning, Assessment and Improvement; Improved ESH&Q - Operations Services; Site Infrastructure Facilities and Operations; and Communications and Trust. The relative weight of this Critical Outcome is 32% of the overall Laboratory score. The overall performance for this Critical Outcome is ***Excellent***.

The Corporate Leadership Objective consists of three measures: Strategic Partnerships, Laboratory Leadership, and Diversity. The relative weight of this Objective is 25% of this Critical Outcome. The overall rating for this objective is ***Outstanding***.

The Business Processes Objective consists of three measures: Phase IV of Benchmarking Study, Cyber Security, and Procurement Operations. The relative weight of this Objective is 17% of this Critical Outcome. The overall rating for this Objective is ***Excellent***.

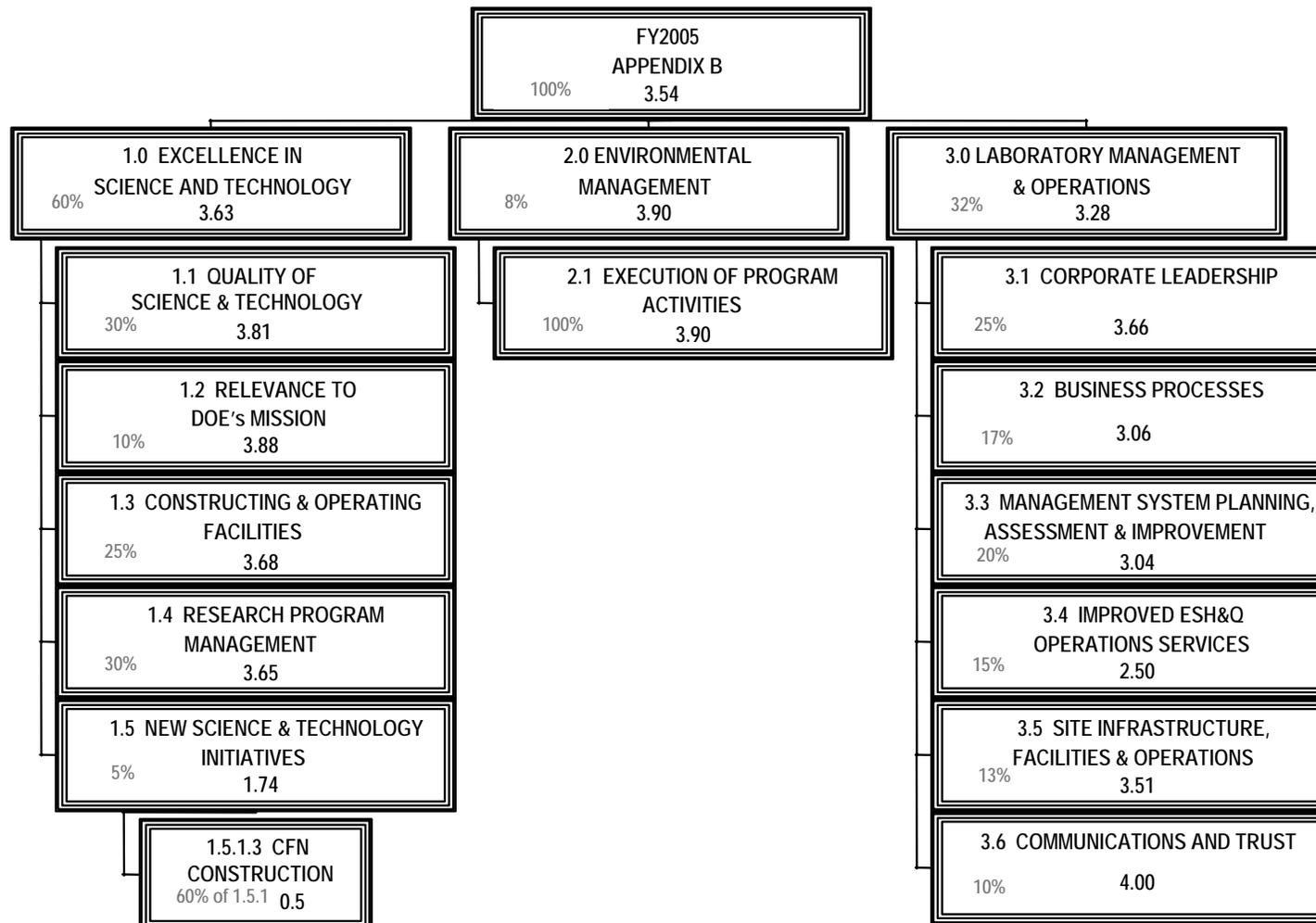
The Management System Planning, Assessment and Improvement Objective consists of two measures: Management System Maturity Determinations and Third Party Assessment of Program. The relative weight of this Objective is 20% of this Critical Outcome. The overall rating for this Objective is ***Excellent***.

The Improved ESH&Q - Operations Services Objective consists of one measure: OSHA Reportable Injury Management. Despite not achieving DOE/SC's interim injury rate goals, BNL showed marked improvement exemplified by working 1.5 million hours without a lost workday or restricted workday case. The relative weight of this Objective is 15% of this Critical Outcome. The overall rating for this Objective is ***Good***.

The Site Infrastructure, Facilities, and Operations Objective consists of five performance measures: Alternative Financing (AF), Project Management, Maintenance Investment Index, Energy Contract, and Infrastructure Maintenance. The relative weight of this Objective is 13% of this Critical Outcome. The overall rating for this Objective is ***Outstanding***.

The Communications and Trust Objective consists of one performance measure: Community, Education, Government, and Public Affairs Management. As in previous years this Objective is evaluated by an independent third-party peer review team, the Communications and Trust Advisory Panel. The relative weight of this Objective is 10% of this Critical Outcome. The Overall rating for this Objective is ***Outstanding***.

FY2005 Year End Self-Evaluation - Appendix B Structure & Scores



Measure evaluated by BHSO quarterly

MEASURE 1.5.1.3 CFN Construction

Unsatisfactory: 0.5

Summary of Performance Measure

The objective of this measure is to award the building construction contract within the cost baseline to ensure there is sufficient contingency within the changing climate of construction.

Specific Status of Metric

- The CFN construction package was issued for bid. Three bids were received; all ~30% above the baseline of \$33M.
- An extensive and thorough value engineering activity took place that maintained the building's functionality, TEC, TPC and reduced equipment scope by ~\$4.8M. The revised estimate was \$38.5M.
- The CFN construction package was offered again for bids and the successful bid was ~\$470K below the revised estimate.
- A recovery plan was developed and implemented that maintains the baseline CD-4a and CD-4b dates, with 2 months and 4 months of float time, respectively.

Accomplishments

- Integrated Project Team (IPT) developed CFN Recovery Plan which is being implemented and maintains CD-4a and CD-4b with float.
- The DOE awarded the CD-3 on 8/5.
- The building construction contract was placed with E.W. Howell on 8/8.
- BNL issued a construction "Notice to Proceed" on 8/19.
- Site preparation started on schedule.
- Scanning Transmission Electron Microscope (STEM) procurement was awarded (\$2.8M) on 9/29.
- Technical equipment specifications preparation effort ahead of schedule.
- In addition to the normal construction safety oversight, a dedicated construction safety inspector was hired to oversee the CFN construction site.
- Mike Harrison, who had served as Associate Project Head of the RHIC project, has been named the CFN Project Director.

Performance Metric

Rating	Criteria
Outstanding	Awardable at or less than Baseline cost or within + 1%
Excellent	Awardable contract within + 3% of Baseline cost
Good	Awardable contract within + 6% of Baseline cost
Marginal	Awardable contract within + 8% of Baseline cost
Unsatisfactory	Awardable contract within + 10% of Baseline cost

Management Focus in FY2006

- The 19 month construction schedule is tight and will require close attention to detail.
- Continued focus on construction/subcontractor safety.

TABLE OF CONTENTS

1.0 EXCELLENCE IN SCIENCE & TECHNOLOGY.....	1
A. Summary Discussion.....	1
A.1 Scientific Staff.....	2
A.2 Planning (Long- and Short-term).....	3
A.2.1 Laboratory Strategic Initiatives.....	3
A.2.2 Other Initiatives:	6
A.3 Collaborations	7
A.4 Proposals	9
A.5 Laboratory Directed Research and Development (LDRD).....	10
B. DOE Office of Science Research Programs.....	12
B.1 Nuclear Physics (NP)	12
B.2 Basic Energy Sciences (BES)	19
B.3 High Energy Physics (HEP).....	30
B.4 Biological and Environmental Research (BER).....	37
B.5 Advanced Scientific Computing Research (ASCR) Program.....	51
B.6 Workforce Development (WD).....	53
C. DOE Non-SC and Work for Others	56
C.1 Energy Efficiency and Renewable Energy (EE)	56
C.2 Nuclear Energy Science and Technology (NE)	57
C.3 National Nuclear Security Administration (NNSA, NA).....	58
C.4 Other National Laboratories.....	61
C.5 Work for Others (WFO) and Technology Transfer	61
C.5.1 WFO – Other Federal Agencies	62
C.5.1.1 National Institutes of Health	62
C.5.1.2 National Aeronautics and Space Agency (NASA)	64
C.5.1.3 Environmental Protection Agency (EPA).....	65
C.5.1.4 Department of Defense (DOD)	66
C.5.1.5 Department of State (DOS).....	66
C.5.1.6 Naval Research Laboratory (NRL)	66
C.5.1.7 National Science Foundation (NSF)	67
C.5.2 WFO – Non-Federal Agencies.....	67
C.5.2.1 Private Firms	67
C.5.2.2 Non-Profit Organizations/Institutions.....	67

1.0 EXCELLENCE IN SCIENCE & TECHNOLOGY

A. Summary Discussion

Brookhaven Science Associates (BSA) rated its overall Science and Technology (S&T) performance for Fiscal Year (FY) 2005 as *Outstanding* with a corresponding score of 3.63. The Laboratory achieved noteworthy accomplishments under each of the four Office of Science S&T Objectives and the Nanoscience Initiative Objective as well as demonstrating progress in addressing comments raised by the Department of Energy (DOE) in previews, reviews and evaluations.

The table below shows individual scores for the Office of Science Objectives.

Objective	Weight	Rating	Score
Quality	30%	Outstanding	3.81
Relevance to DOE Mission	10%	Outstanding	3.88
Success in Constructing and Operating Research Facilities	25%	Outstanding	3.68
Research Program Management	30%	Outstanding	3.65
New Science and Technology Initiatives	5%	Good	1.74
Overall	100%	Outstanding	3.63

The Deputy Director for Science and Technology assigned these scores based on input from the Associate Laboratory Directors (ALD's) of the five BNL Science Directorates. In determining the evaluation scores, many factors were considered including benchmarks from experience and DOE evaluations; major successes; peer review input and research program deficiencies; success in addressing issues to improve research program management within science and technology organizations, and in the management of institutional-level initiatives.

In support of the science mission of the Laboratory, senior management has focused on two highly visible areas: safety and a new energy contract.

Regarding safety, the Laboratory has aggressively initiated a campaign promoting safety at all levels to help staff understand how BNL's Environment, Safety and Health policy commitments apply to all employees. This resulted in a milestone never before achieved at BNL: during the summer of 2005, the Laboratory worked more than 1.5 million person hours without a lost workday case. Laboratory management has also been aggressively pursuing the lowest possible electrical power rates to limit the impact any increases would have on our science mission. The result of the negotiation involving New York State, NYPA and LIPA led to an arrangement that the State will subsidize BNL's power cost by \$ 4.5M per year to mitigate the impact of a higher power rate. However, since the subsidy is fixed, the recent steep hike in energy costs will impact the science mission, perhaps severely.

Highlights of Science & Technology performance are discussed in the following sections.

A.1 Scientific Staff

During FY2005, a few changes in key scientific management positions occurred. Dr. Doon Gibbs, who had been serving as the interim Associate Laboratory Director (ALD), was appointed as the ALD for Basic Energy Sciences. Dr. Samuel Aronson replaced Dr. Thomas Kirk as the ALD for High Energy and Nuclear Physics, and Dr. Peter Bond took over as the interim ALD for Life Sciences. A permanent ALD for Life Sciences was recruited and recently accepted the position. A Directorate of Policy and Strategic Planning was created within the Director's Office, and Dr. J. Patrick Looney, formerly with the Office of Science and Technology Policy (OSTP), was named Assistant Laboratory Director. Dr. Sally Dawson was appointed Chair of the Physics Department and Dr. Gene-Jack Wang was appointed Interim Chair of The Medical Department.

BSA continues its effort to retain and recruit top-notch staff at all levels in order to maintain its core scientific strength. With a proactive and focused hiring effort, the Science and Technology sector appointed the following key staff:

- Frithjof Karsch, Sr. Physicist in the Physics Department to promote QCD Lattice Gauge research
- J. Patrick Looney, Assistant Laboratory Director for Policy and Strategic Planning
- Pavlos Kollias, Associate Atmospheric Scientist to strengthen Climate Science program with his radar expertise
- Jorg Schwender and Chang-Jun Liu in the Biology Department to renew BNL's plant program and develop a bio-energy team

With the departure of George Hendrey, the leader of the FACE project, its future status is uncertain and likely tied to the BERAC Subcommittee Review of BER's Terrestrial Carbon Processes program.

During FY2005, five Goldhaber Fellows ended their terms of appointment. Two of them left for university positions and three of them have been promoted to staff scientists at the Laboratory. Goldhaber Fellows who came on board in FY2005 are:

- Adrian Gozar, Materials Science Department
- Devicharan Chidambaram, Environmental Science Department
- Kuo-Wei Huang, Chemistry Department
- Alexander Milov, Physics Department
- Kyle Cranmer, Physics Department
- Mathew M. Maye, Nanomaterials Department

The Laboratory's postdoctoral Research Associate subsidy, the distinguished Goldhaber Fellowship Program established by BSA, and other opportunities have contributed significantly to the increase in the number of young scientists, which increased to 130 during FY2004 and remained at that level for 2005. The total number of scientific staff at the end of the fiscal year, including postdoctoral fellows, increased from 578 to 580,

while the total number of employees at the Laboratory decreased from 2,795 to 2,638 (including voluntary and involuntary terminations).

A.2 Planning (Long- and Short-term)

As BNL plans for the future, internal and external integration and collaboration activities are essential. BNL engages in planning at several levels: strategic planning that leads to the development of the Business Plan, facility initiatives planning, scientific program planning and integration, staff planning, and planning to meet user needs. The Project, Planning, Programming and Budgeting Process (3PBP) process for prioritizing short-term infrastructure/ESH projects, major facility and site master planning, and strategic planning by the Director and ALDs continue to be performed well. The Lab has established the Integrated Planning Office to provide ongoing improvement and coordination of this planning process. This effort will be further strengthened by the recently created Directorate of Policy and Strategic Planning. In addition, this was validated by a Third Party Review of the Management System Assessment Program for the Integrated Planning Management System when it concluded that BNL had implemented improvements in its planning processes. Below are examples of institutional planning and execution of that plan.

A.2.1 Laboratory Strategic Initiatives

The Laboratory has developed its Business Plan based on four major strategic initiatives that will ensure its long-term health and service to DOE and the national and international communities. Distilled from a roadmap of ten leadership themes and facilities in support of them that were developed by the Laboratory's Senior Science and Technology Managers, they are:

- **NSLS-II**
- **RHIC→QCD Lab**
- **Nanoscience**
- **Translational Neuroimaging**
- **Aerosol and climate change science (continuing leadership area)**

The Business Plan, prepared in response to a request from Congress to the Office of Science, defines the Laboratory's major business lines, core competencies, and major initiatives and discusses operational and managerial concerns. An important element in conceptualizing the Plan was assessing the relative technical, market, management and financial risks of each initiative vs. the potential benefit afforded. The Draft was well received by the Office of Science and will be finalized as Business Plan Highlights. A synopsis of each initiative in terms of scope, costs, expectations, benefits, and risks follows:

NSLS-II

- **Scope:** Construct world's best synchrotron together with advanced insertion devices, optics, detectors, and a suite of scientific instruments
- **Costs:** \$600 – 800 M; schedule ~FY2007-2013

- **Expectations:** The unique characteristics of NSLS-II will open up new realms of scientific discovery and investigation, and enable exploration of:
 - The correlation between nanoscale structure and function
 - The mechanisms of molecular self-assembly
 - The science of emergent behavior, especially for correlated electron systems

This is BNL's highest priority initiative that will provide the synchrotron user community with a world-leading research facility. With strong support from the Office of Science and its Office of Basic Energy Sciences, BESAC, and the regional academic and industrial communities, the determination of the mission need (CD-0) for this third-generation storage ring was approved by the ESAAB. Such a machine will benefit DOE and the taxpayer by advancing nanoscale science that will lead to improved energy technologies and systems and provide U.S. industry a competitive advantage for new materials and technologies beyond silicon. DOE lists NSLS-II as one of its priorities in "Facilities for the Future of Science: A Twenty-Year Outlook."

RHIC→QCD Lab

- **Scope:** Evolve the RHIC complex to further the study of QCD experimentally and theoretically
- **Costs:** ~\$500-680M; schedule ~FY 2009-2015
- **Expectations:** 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
 - The role of the color glass condensate in the structure and interaction of high energy hadrons

In Nuclear Physics, RHIC→QCD Lab will entail evolution of QCD physics, unraveling the nature of the quark-gluon plasma, spin of the nucleon, and testing the predictions of QCD theory are the top science priorities. RHIC is the BNL facility that will ensure the experimental priorities are met. The Electron Beam Ion Source (EBIS), which just received CD-1 approval, will replace the aging Tandem van de Graaff accelerators that serve as pre-injectors to RHIC. This is the first of several planned improvements to RHIC. Planning for the next twenty years of research at RHIC will also entail luminosity and detector upgrades and adding an energetic electron beam for collisions with RHIC ion beams (eRHIC) and a detector to measure them. To support the computational needs, BNL already commissioned two 10 Tflop QCDOC (QCD on a Chip) supercomputers, one at the RIKEN BNL Research Center (funded by RIKEN, Japan), and one funded by DOE for the U.S. Lattice Gauge Consortium. These resources and plans will continue to provide world-leading capabilities in Nuclear Physics well into the future. eRHIC is included among SC's priorities in "Facilities for the Future of Science: A Twenty-Year Outlook."

Nanoscience

- **Scope:** Understand and use the unprecedented functionality of nanomaterials to promote U.S. energy security
- **Costs:** \$81M for Center for Functional Nanomaterials (CFN) construction; schedule FY2004-2008 (with equipment installation)
- **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
 - Non-noble metal fuel cell catalysts

BNL's Nanoscience program will lead to revolutionary technologies in energy conversion, storage, and utilization that will impact the hydrogen economy, solar energy, and environmental protection. With the other Nanoscience Research Centers, it will maintain U.S. competitiveness in Nanoscience. This will be strengthened with its coupling to the current NSLS and the proposed NSLS-II.

Translational Neuroimaging

- **Scope:** To develop new scientific tools (radiotracers and multi-dimensional imaging technologies) to image the function of the brain (and other organs) and to rapidly translate discoveries to new knowledge that impacts human health
- **Costs:** Double the program in the next five years with support from other institutions (from \$10M/yr)
- **Expectations:** 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 span
 - How drug addiction, obesity, and other disorders affect the brain
 - How genetic variations affect brain structure, biochemistry, and behavior
 - How drugs taken during pregnancy affect the brain of the fetus and adult offspring.

In the Life Sciences, we are recognized as the world leader in studying the impact of addiction on the brain leading to drug and psychological disorders, as well as obesity. With DOE's continuing support of medical imaging being at the center of a future National Academy of Sciences study, Stony Brook as our partner and BNL are in the process of developing a plan for imaging, with the possible outcome of establishing a multi-institution collaboration.

Aerosol and climate change science

Atmospheric chemistry, particularly aerosols, is a field in which BNL is unquestionably the U.S. leader. The Chief Scientists for DOE's Atmospheric Science and Atmospheric Radiation Measurement (ARM) Programs are BNL researchers, as is the ARM Mobile Facility Site Scientist. We envision retaining our leadership role by creating an Aerosol Laboratory that will investigate radiative forcing that results from increases in atmospheric greenhouse gases and aerosols. We have already established a group of experts in regional climate models with an emphasis on aerosols whose goal is to improve climate models and increase our ability to distinguish between natural and human-caused climate change.

A.2.2 Other Initiatives:

- In addition to the Laboratory initiatives in Nanoscience and NSLS-II, the other major themes in the BES directorate are correlated systems/materials synthesis, catalysis, interface of life and physical sciences, and chemical dynamics. They have been called out in the DOE Office of Science Strategic Plan as part of its road map. To be successful, they will rely on integrating research programs with our present NSLS and future facilities, the CFN and NSLS-II. Because BES scientists have historically operated as independent investigators, planning for the Directorate reorganization to facilitate such an interdisciplinary approach, especially for nanoscience, occurred in FY2005. The changes became effective on 10/1/05.
- In response to DOE's initiative to develop a national energy strategy, BNL has established the internal "energy working group" to assure that the CFN will be unique in fostering energy independence and to help integrate some of the applied energy-related research in EENS with core BES programs, the CFN, and the NSLS. In addition, BNL participates in the national effort as a member of the Lab Working Group, which addresses national energy issues.
- For High Energy Physics (HEP), the Laboratory supported a proposal to the NSF from the AGS user groups for the construction of Rare Symmetry Violating Processes (RSVP) that would look for physics beyond the standard model. It is unfortunate that, in spite of a very favorable recommendation from the HEPAP subcommittee on the important physics the experiment would provide, the NSF has decided not to support the proposal. To put BNL's HEP program back on track after RSVP, we will likely pursue new initiatives in neutrinos, the International Linear Collider (ILC), and dark energy, while growing ATLAS.
- Following the successful completion of the US ATLAS construction to the 97% level and initiation of the LHC Tier 1 Computing Facility at BNL, the Laboratory plans to continue its effort in making ATLAS BNL's top priority in HEP. We will continue to make outstanding contributions that include hosting the Tier I Physics Analysis Center and Computing Facility, and managing M&O activities. BNL also continues to provide support for accelerator studies for future upgrades of the LHC machine.
- BNL is developing a strategic plan for neutrino physics with OHEP's concurrence. A dialogue on neutrinos with Fermi Lab has been initiated. BNL's leadership role is becoming evident as a major contributor to the Homestake Mine proposal for

DUSEL, and as coordinator for the neutrino working group, a multi-institution collaboration.

- The ILC, the expected future of the DOE mission in HEP, will enable physicists to zero in on a whole new class of fundamental particles and give theorists the ability to extend the Standard Model to an all-inclusive theory of matter. Our role will be in the design of the beam delivery and final focus systems for which BNL's direct-wind superconducting coils are the only known workable concepts at this time.
- The Large Synoptic Survey Telescope, a HEP project to determine the nature of Dark Energy, was endorsed by three National Academy of Sciences (NAS) studies; it surfaced as a high priority in OSTP's 2004 report "The Physics of the Universe." For BNL, a possible initiative is starting a research group that would work on the proposed DOE-funded component of the project, specifically the camera, with the focal plane assembly as its specific responsibility. If funded, this would provide fresh vitality to HEP at BNL and pave the way for a new line of fundamental research in astrophysics and cosmology that would take advantage of current core competencies.
- Over the past few years, Biology has been redirecting its programs to align with the goals of Genomics: GTL, using departmental and discretionary funds. However, DOE's GTL program is also the focus of an NAS review panel that convened recently. In light of this, BNL is waiting to develop a plan for GTL until the national picture becomes clearer.
- Site Master Planning continues to focus on providing space appropriate for science in the 21st century. Working with DOE, BNL continues to engage in short and long range plans to maintain and improve the site, including those for our new facilities, such as the Research Support Building and the CFN whose construction started in 2005. ALD input and approval was required for 3PBP projects to ensure that potential infrastructure improvements in support of their leadership themes are correctly prioritized.
- A final indication that our planning processes are maturing became evident in preparing the documentation for the institutional-level strategy corporate assurance risk committee. It incorporated the initiatives and their risk elements from the Business Plan for science program development, a list of reviews from the assessment scheduler, the metrics from this self-assessment for operations of RHIC and the NSLS, and a high level roll-up of this self-assessment for evaluating science program execution for major Office of Science programs.

All of these plans need continual attention as budgets and priorities of funding agencies change.

A.3 Collaborations

BNL has an extensive history of collaboration at its facilities, as well as at other laboratories. The following items touch upon the collaborative aspects of major scientific initiatives and leadership themes that occurred during the past year and are not intended to be comprehensive.

- BNL participates in all four RHIC experimental collaborations (BRAHMS, PHENIX, PHOBOS, and STAR) and our personnel take a prominent role in all of them, both in technical and scientific leadership and management of the collaborations.
- BNL in collaboration with the RIKEN Laboratory of Japan established the RIKEN-BNL Research Center (RBRC) located in the Physics Department in 1997, mostly funded by RIKEN under the Government-to-Government Agreement. It plays many important roles in promoting physics with RHIC. Some 30 young researchers supported by the RBRC engage in theoretical and experimental research in relativistic heavy ion collision and spin physics program. In addition, RBRC's 0.6 T-Flop QCDSF super computer and the 10 T-Flop QCDOC machine at the Center provide high power lattice gauge computation.
- The collaboration with the High Energy Accelerator Research Organization (KEK) of Japan in the PHENIX Detector program at RHIC, under another Government-to-Government agreement, continues at a significant level and supported the detector upgrade as well as data taking and analysis operations.
- BNL intends to play a key role in the new Large Synoptic Survey Telescope Collaboration, based upon Instrumentation's preeminence in the field of large-scale, low-noise electronic data system capabilities and our recruitment of scientists for the foundations of an experimental astrophysics/cosmology group.
- NSLS has continued to maintain a strong history of meeting user needs, building strong scientific programs, and fostering collaboration and integration for effective operations. It is anticipated that this history will continue in the NSLS-II era.
- The CFN arose as a result of internal and external collaborations and the integration of several BNL internal department staff and external university staff. It will become a focal point for collaboration with nearby universities, the other U.S. nanocenters, and industry.
- Internal collaborations continue to grow at BNL. Our success in obtaining funding for three (of six) proposals submitted to the Hydrogen Economy RFP with investigators paired across FWPs should be noted. Another important breakthrough is the internal "energy working group" that has been established for assuring that the CFN will be unique in fostering energy independence and for helping to integrate some of the applied energy-related research in EENS with core BES programs, the CFN, and the NSLS.
- BNL plays a national role in aerosols and climate change programs, as well as a facilitating role in other areas. BNL operates the FACE facility in the Duke Forest and the ARM External Data Center, and coordinated and participated in several ARM (and Atmospheric Science Program) field studies. With international collaborators, BNL is a vital contributor to advancement of reliable advanced nuclear power generation designs. The National Nuclear Data Center that resides in the EENS Directorate is a world class operation, disseminating data for basic nuclear research and applied nuclear technologies far exceeding that of any other nuclear data center with ~700,000 data retrievals in FY2005.
- BNL's medical imaging programs interact with research hospitals and clinics; and the biomedical engineering laboratory is an exemplary team with participants from five departments/divisions, LBNL and universities.

- In addition, BNL continues to carry a number of research collaborations with domestic and international institutions as follows:
 - HE and NP participate in numerous international collaborations under formal Government-to-Government agreements. Among them are:
 - 1) BNL-IHEP (the Institute for High Energy Physics, Beijing) Accelerator Collaboration
 - 2) BNL-JPARC Superconducting Magnet Collaboration
 - 3) BNL-GSI Superconducting Magnet Collaboration
 - 4) US-CERN LHC accelerator Collaboration and ATLAS Detector Collaboration, and Accelerator R&D project
 - In the area of experimental research programs, there are:
 - 1) LEGS Research Collaboration at NSLS
 - 2) SNO Collaboration at Sudbury; and
 - 3) The D0 Detector Collaboration at the Tevatron
 - The BES and EENS directorates are also involved in extensive collaborations. Among them are:
 - 1) US-Japan Collaboration on Neutron Scattering
 - 2) ISIS Postdoctoral fellow program with Rutherford Appleton Laboratory
 - 3) Scientific Collaboration on Neutron Scattering
 - 4) Complex Materials Consortium
 - 5) Global Climate Change and Carbon Management
 - 6) International Nuclear Safety Program
 - 7) Initiatives for Proliferation Prevention

Other partnerships:

- There are many partnerships that were fostered by the BSA partners.
- Finally, in evaluating our collaborative posture for the Business Plan, we determined that we have critical relationships with other DOE Laboratories, primarily in the areas of NSLS-II, RHIC, nanoscience, TEAM, U.S. ATLAS, aerosols and clouds, and the National Nuclear Data Center. The Business Plan contains the specifics.

A.4 Proposals

There are three main categories of proposals: the standard Field Work Proposal (FWP), new proposals for DOE, and proposals for Work for Others.

- DOE sets the FWP process. In FY2005, BNL submitted all scientific FWPs into the electronic R&D Portfolio Management Environment (ePME).
- Our proposal response to DOE initiatives depends on the DOE program and expectations. The grant renewal to BES for “Modification of Plant Lipids” was well-received by the three external reviewers who recommended an increase in support for the program. This stimulated Biology’s two recent hires in plant systems science.
- Internal collaborations continue to grow at BNL. Our success in obtaining funding for three (of six) proposals submitted to the Hydrogen Economy RFP with investigators paired across FWPs should be noted.

- BNL receives significant funding from BER in “environmental sciences” and continues to contribute to developing new programs. BNL proposed the Cloud and Land Surface Interaction Experiment (CLASIC), which has attracted multi-agency interest and will be considered for funding as an ARM Intensive Observation Period in 2007.
- In FY2005, BNL biologists submitted six grant proposals to BER, four of which were funded; two are GTL-related, and two are low-dose radiation-related.
- GTL and Computation represent two areas in which there are emerging opportunities for the Laboratory. Regarding GTL, when the call for proposals for Facility I is finally issued, BNL will submit a joint proposal with Argonne, although BNL is not the lead. In computational science, BNL is home to the two QCDOC machines, the RHIC computing facility and the ATLAS Tier I Computing Facility. BNL’s future computational needs will also be in biology and nanoscience. The path forward will most likely involve a proposal to New York State for subsidy to purchase BlueGene/L. There are infrastructure, partnership, and staffing concerns that need to be addressed.
- In our Work for Others (WFO) proposals, we received comparable funding from NIH, NRC, and NASA (~\$11M, ~\$10M, ~\$9M, respectively). Our track record with the Department of Homeland Security (DHS)/Department of Defense (DoD) is improving; DHS/DoD funds have increased to ~\$8M in FY2005. The Business Plan contains a breakdown of WFO by sponsor.
- One of BNL’s strategic goals is to increase our funding and capabilities by establishing strategic partnerships, especially in the Life Sciences. The following are two examples of success. The Center for Scientific Computing with a Shared University Research (SUR) grant to Stony Brook from IBM obtained a server that will support bioinformatics research relevant to GTL. Similarly, a partnership with Stony Brook’s Center for Structural Biology will enable the acquisition of a unique atomic force microscope through the NIH Shared Instrumentation Program that will be available to researchers at both institutions.

A.5 Laboratory Directed Research and Development (LDRD)

In FY2005, BNL spent \$8.34M in LDRD funds, which is approximately two percent of BNL operating funds. There continue to be many success stories resulting from the LDRD Program with projects receiving direct funding from DOE, NIH, and CRADA agreements. In addition, several patents were submitted based on LDRD research.

As in past years, we emphasized that funding would be limited to two years. This restriction limits the out-year commitments and permits us to fund a larger fraction of new projects in subsequent years. A mid-year review of all on-going LDRD projects was conducted. This was a factor in determining whether a project would continue into the next fiscal year. In addition, the LDRD Program Director continued the monthly meetings with the DOE Brookhaven Site Office to update the progress of the program and verify that the BNL LDRD Program is meeting the overall LDRD requirements.

During FY2005, the process for selection of new FY2006 LDRD projects was also undertaken. The LDRD selection committee consisted of the LDRD Program Director, the new ALD for Policy and Strategic Planning, the five Associate Laboratory Directors, and five senior scientific staff members. Each member reviewed all proposals and participated in the selection of the projects to be funded.

BNL does not restrict the source of any LDRD proposal within the Laboratory. For FY2006, LDRD proposals for projects in support of major laboratory initiatives are being emphasized. These major initiatives are set forth in the Business Plan: RHIC, the National Synchrotron Light Source, nanoscience, and medical imaging. Of the projects recommended for funding in FY2006, approximately half are aligned with these initiatives while half are distributed across the remainder of the Laboratory

After the selection process was completed, a self-assessment was conducted, which indicates that the program continues to function efficiently and effectively, and minor changes could further improve the process.

The LDRD Program continues under the leadership of the LDRD Program Director. The Program Director now reports to the new Assistant Laboratory Director for Policy and Strategic Planning (PSP).

B. DOE Office of Science Research Programs

B.1 Nuclear Physics (NP)

Objective 1.1 Quality of Research

[KB0101] Medium Energy: RHIC Spin & LEGS

- The RHIC Spin program completed an extensive run at 200GeV center of mass energy and about 45% beam polarization. STAR and PHENIX took data for longitudinal double spin asymmetry measurements, which are expected to yield significant measurements of the contribution of the gluon to the proton's spin.
- LEGS successfully completed pi-zero measurements with frozen spin targets. The observed target polarization of ~40% exceeded expectations by about a factor of two.

[KB0201] RHIC Research

- Peer-reviewed "White Paper" retrospectives from all 4 RHIC experiments on the results from runs 1-3 have transformed the understanding of High Energy Density Matter.
- BNL identified the new state of matter found in RHIC collisions as a nearly perfect liquid.
- A new Lattice Gauge Theory group was established in the Physics Department under one of the world's leading researchers in finite temperature lattice QCD, who was recruited from U. Bielefeld in Germany. This group is using the newly constructed QCDOC supercomputers at BNL.
- BNL theory group has the central role in identifying and understanding the sQGP and Color Glass Condensate found in RHIC collisions.

[KB0202011] RHIC Accelerator Operations

- RHIC operations availability reached 85%. Two species runs took place at 4 energies. This exceeded the performance goal of 80%. Multiple energy beams were delivered for experiments (100, 31.2 and 11 GeV / n). Ramp-up time was reduced to 2.5 weeks; the setup time for a new energy was reduced to 2 days.
- RHIC ion operations exceeded the peak and integrated luminosity (15 nb⁻¹) goals for FY2005 by a factor of 2. Calendar time at store reached 53% for ion operations.
- Proton beam polarization was improved by a factor of 2 to an average 50%. Integrated p-p luminosity was improved to a factor of 2 above design specification at 100 GeV. Calendar time at store was 56% for polarized protons. BNL commissioned

higher energy operations (3 days and 205 GeV beam energy) with significant polarization, 30%. AGS cold Siberian snake commissioning began.

- AGS cold Siberian snake construction was completed, delivered and tested on time and within budget. Performance specifications and objectives have been met or exceeded.

[KB0202012] RHIC Experimental Operations

- All 4 experiments successfully recorded data in Cu-Cu collisions at 3 beam energies. First analysis of the high-statistics Au-Au data sample taken in FY2004 was completed and these results dominated the international Quark Matter meeting in Budapest, August 2005.
- STAR and PHENIX successfully collected polarized proton data in both longitudinal and transverse spin configurations.
- The RHIC Computing Facility increased its computing and storage capacity to keep pace with increased data volume, accommodating all 4 experiments.

[KB0301] Nuclear Theory

- There was close interaction with experiments to identify and explore new states of the matter in RHIC collisions-- sQGP and CGC.
- BNL established leadership in Lattice Gauge Theory to provide realistic calculations for comparing QCD theory with experiment for finite temperature matter.

[KB0301] National Nuclear Data Center

- The program performed well. The National Nuclear Data Center portfolio of databases was maintained and updated using the best physics; databases were archived and distributed to US users regularly. Use of data increased considerably, with about 50% increase compared to FY2004.
- Nuclear reaction model code EMPIRE was improved considerably. A new version 2.19 includes multi-modal fission, pre-equilibrium emission of clusters, new gamma-ray strength functions, extended suit of utility codes and enhanced GUI. EMPIRE-2.19 is used widely in US national laboratories and universities as a tool for theoretical analysis of low-energy nuclear reactions.

[KB0401] Low Energy Nuclear Physics

- BNL completed production and testing of 12 HTS coils for RIA Magnet with stainless steel tape insulation. Complete coil package successfully tested at several different operating temperatures.

- BNL completed RIA R&D magnet design.
- BNL worked on development of metal-loaded liquid scintillators for double beta decay and neutrino oscillation proposals.

Objective 1.2 Relevance to DOE Mission

[KB0101] Medium Energy: RHIC Spin & LEGS

- The Medium Energy program at BNL is focused on high priority areas in nuclear physics, as identified in the NSAC 2002 Long Range Plan and in the goals identified in the 2003 NSAC report on Performance Measures: understanding the structure of protons and neutrons in terms of the fundamental theory of strong interactions, QCD.

[KB0201] RHIC Research

- The RHIC research program is the centerpiece of the DOE Nuclear Physics mission to create and explore high temperature and high density hadronic matter.

[KB0202011] RHIC Accelerator Operations

- RHIC is the nuclear facility with the greatest scientific impact in the US Nuclear Physics program. The RHIC Accelerator Operations effort is the single largest budget item of the Office of Nuclear Physics..

[KB0202012] RHIC Experimental Operations

- The successful operation of the RHIC experiments is key to the success of the US Nuclear Physics program.

[KB0301] Nuclear Theory

- The theory of QCD at finite temperatures and at very low x are fundamental aspects of the US Nuclear Theory program.

[KB0301] National Nuclear Data Center

- The National Nuclear Data Center followed the DOE mission closely by providing infrastructure for nuclear science, in particular by maintaining nuclear databases and distribution of variety of data to the U.S. nuclear science community.

[KB0401] Low Energy Nuclear Physics

- Work on RIA Magnet R&D is relevant to what may be the next large facility construction project in the U.S. Nuclear Physics Program.

- Liquid scintillator R&D is relevant to the near and mid-term goals of the national neutrino science program. The BNL (Chemistry Department) expertise in this area is rare in the U.S. and highly sought after by several U.S. collaborations in neutrino science.

Objective 1.3 Success in Constructing and Operating Research Facilities

[KB0101] Medium Energy: RHIC Spin & LEGS

- LEGS TPC successfully demonstrated micropattern readout with GEM technology for charged particle tracking.
- The gas jet target was used to measure the absolute polarization of the RHIC proton beams.

[KB0202011] RHIC Accelerator Operations

Proposed EBIS Project received CD-0 and CD-1 approval.

[KB0202012] RHIC Experimental Operations

- Collider-Accelerator Operations per the FY2005 Schedule and the accelerator performance met the operational goals as specified in the Field Work Proposal. RHIC Run-5 (FY2005) consisted of 32 weeks of cryo-operation with a Cu-Cu run and a polarized proton-proton run both at 100 GeV beam energy. The delivered integrated luminosities for the Cu-Cu run (PHENIX 15.2, STAR 15.0, BRAHMS 6.2, PHOBOS 5.7 nb⁻¹) and the p-p run (PHENIX 13.3, STAR 13.4, BRAHMS 4.4 pb⁻¹) all exceeded the projected minimum values substantially.
- STAR and PHENIX continued planning and development of upgrades, with prototypes of Time-of-Flight and Hadron Blind Detectors.
- STAR Barrel and Endcap Calorimeters played key roles as rare event triggers in the 2005 Cu-Cu and Spin runs.
- PHENIX AEROGEL detector significantly extended the momentum range for identified particles.
- BNL continued extensive support of core infrastructure for RHIC experiments. Radiation shielding design and construction for the PHENIX detector systems greatly reduced the accidental background rates. HVAC improvements for the experiments continued to eliminate downtime due to infrastructure failures.

[KB0301] Nuclear Theory

- The New Lattice Gauge Theory group will exploit world-leading computing capacity of QCDOC machines at BNL.

[KB0301] National Nuclear Data Center

- The National Nuclear Data Center improved its operations by developing new and better products to serve nuclear reaction and nuclear structure data. Standard performance metric (number of actual data retrievals from the NNDC web server) shows remarkable increase by about 50% compared to FY2004.
- New version of NuDat 2.1 was produced— by far the most popular NNDC product with web retrievals increasing by factor of 3 compared to FY2004. A new version of Nuclear Wallet Cards was produced with 10,000 copies published and distributed to users throughout the United States.

Objective 1.4 Effectiveness and Efficiency of Research Program Management

[KB0101] Medium Energy: RHIC Spin & LEGS

- A rigorous schedule to complete the LEGS experiment in FY2005 was followed, with milestones tracked and quarterly reporting to DOE and BNL management.
- BNL provided resources and management to successfully complete the LEGS TPC, and to repair and commission the LEGS superconducting magnet.
- BNL guided the RHIC Spin community to complete a Research Plan for the RHIC Spin Program, submitted to DOE in January 2005.

[KB0201] RHIC Research

- Long-term planning for RHIC II and eRHIC upgrades was carried out through a series of community-wide workshops, organized by BNL.

[KB0202012] RHIC Experimental Operations

- The RHIC experimental program for FY2005 was optimized to match physics priorities and facility development needs within the given operations budget. Both the heavy ion (Cu-Cu) and Spin runs achieved their experimental goals. First results from the Cu-Cu run were presented at the international Quark Matter meeting in August 2005.
- RCF and the four experimental groups collaborated successfully to acquire Run 5 data while analyzing the Run 4 data set. Results from the Run 4 data dominated the Quark Matter meeting in August.

- PHOBOS has completed its experimental program. Members of the BNL PHOBOS group will take advantage of extensive Si detector expertise by joining the PHENIX Si Vertex upgrade effort. Other members of the group will take a leadership role in the US-ATLAS Heavy Ion effort.

[KB0301] Nuclear Theory

- New Lattice Gauge Theory Group was initiated in February. Headed by an internationally recognized leader in the field, the Group is already established as a major center for this research.

[KB0301] National Nuclear Data Center

- The National Nuclear Data Center continued to manage its program in an effective and efficient way with careful planning and strong emphasis on national and international collaboration.
- The negative impact of budgetary constraints was partly offset by a considerable increase in the number of visiting scientists making substantial contributions to the nuclear reaction model code EMPIRE and to mass-chain evaluations for nuclear structure database ENSDF.

Response to DOE FY2004 Evaluation and FY2005 Program Reviews

The DOE report states, “The 2004 S&T review judged the 200 GeV polarized spin program to have well defined near-term goals whose attainment depends upon further significant improvement of the proton beam intensity and polarization. The longer term 500 GeV spin program requires a research plan.” BNL has prepared a research plan for the 500 GeV spin program.

The DOE report states, “With regard to the LEGS effort the continued slippage of the schedule has become a serious concern and the lack of adequate project management support by the laboratory has jeopardized the success of this effort.” With support from BNL management, and the Instrumentation and Magnet Divisions, this has been rectified. LEGS is now firmly on schedule to complete the full scope of the experiment on schedule and within the agreed-upon funding in FY2006.

The DOE report states, “Of concern, however, are the escalating RHIC operating costs: power, medical and space charge, which are projected to significantly reduce the number of running weeks.” Some contributing factors, such as electric power costs, rising health care costs and higher space charges due to mandated infrastructure work are outside the control of the Laboratory. The Laboratory and the RHIC facility continue to work on controlling costs and securing funding to maintain the current level of RHIC operations.

Nuclear Physics Annual S&T Review – July 2005

The report from the DOE Office of NP was recently received, two months after the review. It is strongly positive and contains the following recommendations:

- “BNL expects to choose between magnetized and non-magnetized beam cooling around the end of the 2005 calendar year. Following this decision, a detailed technical review of a documented R&D plan should be conducted to examine the adopted solution, costing estimates, and the further milestones required to demonstrate electron cooling feasibility.”
- “Update the RCF five-year plan to consistently reflect the needs of a five-year run plan in the context of projected detector upgrades and accelerator performance. This plan should be complete and submitted to DOE by January 2006. This report may be combined with the mid-term strategic plan provided the RCF plan is a prominent component.”
- “BNL should review the overall utilization of the RCF computing resources, and develop and implement a plan that will result in demonstrated improvements in utilization during the next running period.”
- “Develop a mid-term strategic plan which includes the implementation of necessary detector upgrades in the context of scientific priorities, expected machine performance, and the expected turn-on of the Large Hadron Collider (LHC). This plan should be cognizant of the DOE needs for formulating federal budgets and requirements for project management. The plan should be submitted to DOE by January 2006.”

In response to the first bullet, the choice for non-magnetic cooling has been made and plans are in the works to perform a technical review of the decision early in calendar year 2006.

In response to the second and fourth bullets, a planning process is in place to develop a mid term strategy for RHIC including RCF. This planning is being done by a group involving the users and the accelerator teams, coordinated by the Physics Department. The planning will be reviewed in November by the RHIC Program Advisory Committee and in December by the BSA S&T Steering Committee.

The third bullet is not reportable to DOE, but a recommendation for us to be mindful of the process whereby RHIC provided for optimum utilization of its resources. We plan to review internally the workings of RCF – both resource utilization and infrastructure planning and management.

National Laboratories' Nuclear Theory Review – July 2005

To date no formal review report has been received. In spite of informal comments from some of the reviewers that it was the strongest presentation made by any of the National Labs' theory programs, we expect to see in this report a negative evaluation of a particular aspect of the BNL Nuclear Theory program. The negative aspect is the apparent lack of BNL's sense of ownership of the DOE Performance Milestones for Nuclear Theory; in particular, the following milestone for relativistic heavy ion physics theory:

Year 2009	Perform realistic three-dimensional numerical simulations to describe the medium and the conditions required by the collective flow measured at RHIC
--------------	------------------------------------------------------------------------------------------------------------------------------------------------------

To meet the DOE Performance Milestones for Nuclear Theory, BNL theorists are collaborating with their Stony Brook and Columbia colleagues to propose a Topical Center (as defined in the 2003 NSAC review of nuclear theory) to address this and other theory performance measures formulated and recognized by DOE's Office of Nuclear Physics (ONP). This initiative has already been discussed with ONP and will be submitted soon. Other responses to the review are pending the receipt of DOE's report.

B.2 Basic Energy Sciences (BES)

Objective 1.1 Quality of Research

[KC0201010, KC0201030, KC0201050] Nanoscience

- Electron microscopy techniques have been used to understand the interfacial superconductivity of Ca doped $\text{YBa}_2\text{Cu}_3\text{O}_7$ (YBCO) grain boundaries. For example, atomic resolution Z-contrast imaging, electron energy-loss spectroscopy (EELS), and density-functional calculations have been used to demonstrate that in poly-crystalline YBCO, highly strained grain-boundary regions contain excess O vacancies, which reduce the local hole concentration. These results lead to a better understanding of how Ca doping increases superconducting critical current density.
- Carbon nanotubes are a fascinating class of materials where the smallest transistors and electrically-controlled light sources have been demonstrated. However, there is a large number of species of carbon nanotubes and progress has been hampered by ensemble averaging or, when single nanotubes were characterized electrically or optically, the exact structure of that particular nanotube was not known. For the first time, researchers have determined the optical spectrum of a single carbon nanotube and also determined the structure of the same nanotube by electron diffraction. This work allows theoretical models of the electronic structure of specific nanotubes to be compared so that refinements to tight binding models and many body effects in this important class of materials can be unraveled.

- Scientists have grown ultra thin films of organic chain molecules on the surface of liquid mercury and discovered that the molecules form ordered structures. The research interest is in films that have controllable properties at a thickness of just a few nanometers. This should lead to developing reproducible and controlled ways of making molecular junctions.

[KC0201030, KC0202010, KC0202020] Correlated Systems/Materials Synthesis

- The Giant Proximity Effect (GPE), a novel physical phenomenon observed in copper-oxide materials, may lead to new advances in electronic circuitry and new clues to the causes of high-temperature superconductivity. When placed between two thicker superconductor slices, a very thin layer of ‘normal’ metal behaves like a superconductor. In the newly discovered GPE, the normal metal barrier layer is as much as 100 times thicker than in the regular PE case – a result that stands outside current theories.
- Thin films made of thermoelectric materials can be used to convert heat directly into electrical energy, or vice versa, in a variety of applications such as integrated high precision temperature controls for microelectronics and semiconductor lasers used in information processing and fiber-optic communication. The discovery that thin cobaltate films with superior thermoelectric properties may be grown on ordinary silicon wafers offers the promise that existing silicon fabrication technology may be used to create energy renewable sources. Thermoelectric materials also hold great promise for clean-energy generation because they transform heat into electrical energy without producing carbon dioxide or other emissions.
- Recent neutron scattering experiments on the compound piperazinium hexachlorodicuprate have revealed the failure point of the quasiparticle construct, the standard model of condensed matter physics. Quasiparticles are the elementary excitations that carry energy in condensed matter much like the photons and various particles carry energy in the real world. Understanding when and how these energy carriers fail opens doors to another level of understanding, and can lead the way to new and important discoveries. Experiments studied excitations in magnetic crystals with non-magnetic ground states that can be identified as quantum spin liquids. The elementary excitations in such systems are massive quasiparticles, called magnons, which obey Bose statistics. However, such a description fails at sufficiently high energy where quasiparticle break-up into two excitations becomes allowed. This is observed as an appearance of the entire band of energies that can be excited in a system at each value of the system’s (quasi)momentum.

[KC0202020, KC0302010, KC0302040] Catalysis

- A new class of electrocatalysts for the O₂ reduction reaction, consisting of a mixed monolayer of Pt and another late transition metal (Ir, Ru, Rh, Re or Os) deposited on a Pd(111) single crystal or on carbon-supported Pd nanoparticles, has been

synthesized. Several of these mixed monolayer electrocatalysts exhibited very high activity and increased stability of Pt against oxidation, as well as a 20-fold increase in a Pt mass-specific activity, compared with state-of-the-art all-Pt electrocatalysts. This new class of electrocatalysts promises to alleviate some major problems of existing fuel cell technology by simultaneously decreasing materials cost and enhancing performance.

- Complex metal hydrides are perhaps the most promising hydrogen storage materials for a gradual transformation to a hydrogen-based economy. Scientists have used a computational approach to aid the ongoing experimental effort to understand the reversible hydrogen storage in Ti-doped NaAlH₄ and propose a plausible first step in the rehydrogenation mechanism. The study provides insights into the catalytic role played by the Ti atoms on an Al surface in the chemisorption of molecular hydrogen and identifies the local arrangement of the Ti atoms responsible for the process. These results can potentially lead to ways of making other similar metal hydrides reversible.
- High-resolution photoemission was used to study the adsorption and chemistry of SO₂ on Au/CeO₂(111) and AuO_x/CeO₂ surfaces. Although the heat of adsorption of the molecule on Au nanoparticles supported on stoichiometric CeO₂(111) was larger than on Au(111), there was negligible dissociation of SO₂. The full decomposition of SO₂ was observed only after introducing O vacancies in the ceria support. AuO_x/CO₂ surfaces were found to be much less chemically active than Au/CeO₂(111) or Au/CeO_{2-x}(111) surfaces. Furthermore, recent measurements of *in situ* x-ray absorption spectroscopy under water-gas shift reaction conditions show that the active sites in {Au+AuO_x}/ceria catalysts involve exclusively pure gold nanoparticles in contact with O vacancies.

[KC0203010] Interface of Life and Physical Sciences

- Chemically patterned surfaces on the nanolength scale provide a unique opportunity to direct assembly, orientation, structure and growth of many nano-sized objects. A new versatile chemical, nano-writing method called Electro Pen Nanolithography, delivers ink to the surface from an ultra-sharp, voltage-biased conducting tip to a surface. Line widths of 50 nm, more than a thousand times smaller than a human hair, have been achieved as well as quantized, multilayer patterns whose chemical properties can be precisely controlled. Nanoscale, chemically patterned interfaces are relevant to many emerging nanotechnology applications including biological sensors, micro-fluidic devices, self-assembled lithographic masks, and molecular electronics.

[KC0204011] National Synchrotron Light Source (NSLS)

- Several novel instruments, including a sub-micron spatial resolution x-ray diffraction endstation, a fast-scan x-ray monochromator, and a high energy focusing monochromator, as well as a new linear array detector, were developed to provide

new capabilities for nanoscience, catalysis, and high-pressure materials science research.

- A new monochromator and data-collection scheme were developed to allow fast measurement of x-ray absorption spectra. This new method reduces the collection time of a typical extended x-ray absorption fine structure spectrum to less than one second, a three orders of magnitude improvement over current methods. It will be particularly important for the study of kinetics in catalytic reactions.
- A new side-diffracting double-focusing high-energy x-ray monochromator was developed to provide 30-100 keV monochromatic x-rays to a new endstation in the X17B2 beamline, which includes a new high-pressure press and a MAR345 image-plate detector. It will enable high-resolution angle-resolved diffraction and pair-distribution function measurements to allow structure refinement for materials under high pressure.
- A state-of-the-art cryogenic Vertical Test Facility (VTF) was designed and constructed for precise magnetic field mapping and calorimetric measurement of superconducting undulator prototypes at cryogenic temperatures. Two interchangeable field mappers, a cryogenic motorized Hall probe and a pulsed-wire insert have been successfully commissioned for use with the VTF.

[KC0301010] Chemical Dynamics

- Mechanistic elucidation of electron transfer (ET) dynamics is a central goal in research directed towards improved schemes for solar energy conversion, electronic conduction at the nanoscale, and many other physical, chemical, and biological processes of fundamental and technological interest. The role of nuclear motion in control of electronic coupling between donor and acceptor sites involved in charge transfer remains a major theoretical challenge. A new theory of electron transfer has been developed for torsionally-induced non-Condon effects and their influence on ET kinetics. The new method provides valuable perspective regarding the limitations of currently popular approximate models, and extensions to accommodate multiple coupled torsional modes are being explored.

[KC030410] Energy Biosciences

- Two papers published in FY2005 describe changes resulting from substrate binding to desaturase enzymes. The first showed that the desaturase enzyme is “redox gated”; i.e., substrate binding causes a positive shift in its reduction potential favoring reduction when substrate is bound. The second demonstrated structural changes in the amino acid ligation to the active site diiron center upon substrate binding.
- The long sought after desaturase gene in Arabidopsis (*fad5*) was identified, 16 years after the isolation of the *fad 5* mutant.

- An improved technology for the phytoremediation of volatile organic solvents has been developed. Horizontal gene transfer was demonstrated in Poplar trees inoculated with an endophytic strain *Burkholderia cepacia* that is capable of degrading toluene. Transfer of the pTOM plasmid, which enables BTEX and TCE degradation, resulted in decreased toluene phytotoxicity and a reduced release of toluene via the leaves into the atmosphere. This concept presently is being extended to the phytoremediation of TCE.

Objective 1.2 Relevance to DOE Mission

- The BNL/BES research themes concerned with nanoscience, correlated and complex systems, catalysis, interface of life and physical sciences, and chemical dynamics are called out in the DOE Office of Science Strategic Plan as part of the DOE BES road map toward the broad goal of energy security.
- The overarching scientific theme of the Center for Functional Nanomaterials (CFN) is nanoscience for energy security, contributing to the broad DOE theme of energy security.
- The CFN and NSLS are aligned with the Office of Science Goal 7.1, “To provide the discovery class tools required by the U.S. scientific community to answer the most challenging research questions of our era.”
- The NSLS hosts over 2300 users each year, many conducting research that is strongly coupled to DOE missions in particular, on problems critical to the energy and environmental missions of BES and BER within the Office of Science.

Objective 1.3 Success in Constructing and Operating Research Facilities

General BES

- The Laser-Electron Accelerator Facility’s (LEAF) Pulse-Probe transient absorption facility has been upgraded to operate in the near infrared. While many improvements remain, the new capability has been used to observe spectral shifts due to solvation process for electrons in ionic liquids. Replacement of a principle pump laser has resulted in much more reliable operation in serving BNL staff and users. LEAF has been used in experiments to establish redox potentials of “molecular wires” that are not measurable electrochemically.
- BNL continues to be an active member of the Transmission Electron Aberration-corrected Microscope (TEAM) project, whose objective is to build the next generation electron microscope with aberration correction. Towards this goal, BNL will soon be experimenting with a spherical aberration coefficient (Cs) correction electron microscope.

[KC0204011] National Synchrotron Light Source (NSLS)

- The NSLS storage rings continue to operate near their theoretical limits of performance and with high reliability and availability. Both the vacuum ultraviolet/infrared (VUV/IR) ring and the X-ray ring operated well above their scheduled hours with high reliability. The VUV/IR ring provided 5808 hours of operation out of the scheduled 5856 hours, for a reliability of 99.1%. The X-ray ring provided 4849 hours of operation out of the scheduled 5103 for a reliability of 95.0%. The performance of both rings meets or exceeds the NSLS's own target for reliability of 95% and the DOE's performance objective of 90% availability.
- An improved, more symmetric, accelerator lattice was implemented for the X-ray ring after extensive modeling of the lattice and machine studies. Significant improvement of performance was observed at the X29 undulator and X25 wiggler beamlines for macromolecular crystallography.

Objective 1.4 Effectiveness and Efficiency of Research Program Management

General BES

- BNL appointed an Associate Laboratory Director (ALD) for Basic Energy Sciences.
- BNL established plans for, and is proceeding with implementation of, the reorganization of the BNL BES Directorate. The reorganization will consolidate the previous four Departments into three, all reporting directly to the ALD for BES. A centralized business/operations office is being established to serve all three Departments. BNL appointed a Chair to lead the new Department formed by merging Condensed Matter Physics and Materials Science.
- BNL submitted 6 multi-disciplinary preproposals in response to the DOE BES call for the Hydrogen Fuel Initiative, and had all 6 accepted. Subsequently 6 full proposals were submitted and three were funded in the broad areas of: catalyzed solar water splitting, reversibility in complex metal hydrides, and Pt-monolayer electrocatalysts on novel substrates.
- The Chemistry and Nanoscience Departments are working in close cooperation toward developing a Catalysis initiative at BNL. There is a planned evolution in leadership of the Catalysis programs.
- Successful external reviews were completed for the Condensed Matter Physics, Materials Sciences, and Catalysis and Chemical Transformations programs.
- The following new programs were established and funded: Molecular Beam Epitaxy and Nano-Structuring of Petrovskite Oxide Materials toward an Understanding of Strongly Correlated Systems, Reactivity of Strained Interfaces, Synthesis and Characterization of Individual Carbon and Petrovskite Oxide Nanotubes, Biology-

inspired Programmable Assembly of Functional Nanostructures, and Exploratory Synthesis of Novel Materials. The management of the Superconducting Materials program has transitioned. The following programs are being phased out: Synthesis and Structure of Conducting Polymers, Structure-Function of Photo-Synthesis and Catalytic Porphorins, and Mechanisms of Metal-Environment Interactions.

- Significant Laboratory-Directed Research and Development (LDRD) investments continue to be made in the broad areas of nanoscience, catalysis, hydrogen economy, solar energy, materials synthesis and at the interface of life and physical sciences. Related investments are being made in corresponding infrastructure, e.g., through laboratory upgrades.
- The Center for Neutron Science is being folded into the Neutron Scattering Group.

[KC0204011] National Synchrotron Light Source (NSLS)

- A suite of facility beamlines was established to cover the complete wavelength range generated by the NSLS storage rings and all major synchrotron experimental techniques. It allows improved efficiency in beamline operation and support due to standardization of hardware and software, as well as economy of scale.
- A user equipment pool was established to make available to NSLS users unique instrumentation as well as frequently used experimental equipment and material. A formalized user equipment loan process was established to enable the Department to better manage the inventory, usage scheduling, and maintenance of the equipment in the pool.

[KC030410] Energy Biosciences

- To renew the plant program at BNL and develop a bioenergy team, two outstanding young plant scientists were recruited and joined BNL in the last quarter of FY2005. One will apply recently developed methods of metabolic flux analysis to characterize plant metabolic pathways using *Arabidopsis thaliana* as a model system. The other will characterize isoflavonoid biosynthetic enzymes and pathways which provide resistance to plant diseases.
- A program in the molecular characterization of cotton fibers was terminated after external review concluded that productivity was suboptimal.
- Reviews of the renewal grant to BES for the Modification of Plant Lipids program were received. The three reviewers were “uniformly impressed with creativity, broad research approach, and high level of scientific productivity” of this program. An increase in support for this program was recommended.

Objective 1.5 New Science and Technology Initiatives

BSA will identify and develop world-class, cutting edge science and technology initiatives, provide effective management, and establish systems, processes, and staffing to bring the initiatives to maturity.

1.5.1 Center for Functional Nanomaterials (CFN)

BSA will develop and implement the Nanoscience initiative at BNL. This will include the development of an organizational structure at the Scientific Department level, the implementation of the “Jumpstart” program, and initiation of the Center for Functional Nanomaterials (CFN) project.

1.5.1.1 Preliminary Organizational Activities

- A. Continue with the Scientific Advisory Committee (SAC) to advise Laboratory management on CFN activities*
 - B. Bring Proposal Review Panel to maturity to review CFN jumpstart proposals from independent investigators*
 - C. Initiate staff hiring in support of Users and the Science program*
- The SAC met last May for the first time in conjunction with the first annual user's meeting. They reviewed current status and future plans, and provided constructive comments. The next SAC meeting is scheduled for late spring - early summer of 2006.
 - The proposal review panel (PRP) consists of experts in nanoscience who cover the spectrum of specialties offered by the CFN. A new PRP was constituted for FY2005 and the size has been increased from seven to ten to better handle the expected proposal load.
 - The CFN continued to build its operating staff: two scientists were hired to support the proximal probe and electron microscopy facilities; one scientist was hired to lead the soft matter/biomaterials theme area; a User Administrator, Business Manager, and a technician were also hired. The lack of sufficient funding could inhibit hiring staff at the appropriate rate.

1.5.1.2 CFN Scientific Activities

A. *Identify the CFN science theme areas and develop a growth plan for each area.*

B. *Refine the user science program.*

1. *Establish a User Executive Committee for the CFN.*

2. *Host Scientific Advisory Committee review*

C. *Host 2nd Annual User meeting at BNL*

- Three CFN science theme areas and theme leaders have been established: Nanocatalysis, Electronic Nanomaterials, and Soft Matter/Biomaterials. Working groups in each theme area have been identified and are developing plans for the science portfolio for each. More broadly, these will be coupled to the core programs at BNL, and outside BNL as appropriate.
- A User Executive Committee has been established for the CFN. A representative from the University of South Carolina is the Chair.
- In order to more fully develop the CFN's scientific themes, a series of thematic workshops will be planned. These workshops will develop the user base along scientific theme lines. The subject of the first workshop, which will be held on October 19-21, is Nanocatalysis. This workshop will be held in lieu of the Annual User's meeting.

1.5.1.3 CFN Construction

The objective of this measure is to award the building construction contract within the cost Baseline to ensure sufficient contingency in a changing construction climate.

- The CFN construction package was issued for bid. Three bids were received which were all ~30% above the baseline of \$33M.
- An extensive and thorough value engineering activity took place that maintained building functionality, TEC, TPC and reduced equipment scope by ~\$4.8M. The revised building estimate was \$38.5M.
- The CFN construction package was re-bid and the successful bid was ~ \$470K below the revised estimate.
- A recovery plan was developed and implemented that maintains the baseline CD-4a and CD-4b dates with two months and four months of float, respectively.
- CD-3 was awarded by DOE on 8/5/05 and the building construction contract was placed 8/8/05. The existing building occupying the site was demolished. Site clearing was largely completed in FY2005. Groundbreaking took place in early October. The 19-month construction schedule is tight, and will require close attention to detail.

Response to DOE FY2004 Evaluation and FY2005 NSLS Review

The DOE report stated, “An increased emphasis on fundamental themes, and further efforts toward more coherence among the subprojects [of the Molecular Processes program] was recommended for management attention.” The efforts in the BNL Programs in nanocatalysis and heterogeneous catalysis have refocused in more strongly coordinated research in energy-motivated catalysis. Planning is underway for the BNL Catalysis initiative, including key roles by the CFN and NSLS, active searches for new experimental and theoretical staff (through CFN), and new leadership. The Catalysis initiative will include strong coupling to existing photocatalysis and electrochemistry groups and movement toward Hydrogen Economy and solar energy themes.

The DOE report stated, “The review of research on the molecular genetics of cotton fiber development was marginal. Reviewers found the program to have disappointing productivity over the past three years.” This assessment is correct. The major paper describing recent findings using a model system was not accepted by reviewers who demanded results from transgenic cotton plants. Genetically transforming cotton is technically difficult, and efforts to obtain transgenic cotton plants were unsuccessful. This program is being phased out with the retirement of the PI.

The DOE report stated, “The development and execution of [a focused strategic plan for BES programs] is critical to the future vitality of the institution.” BNL concurs that the development and implementation of a focused strategic plan is critical to the future of the institution. The Laboratory has identified four strategic initiatives for the next 5-10 years including NSLS II, Nanoscience/CFN, RHIC, and Neuroimaging. The BES Science themes: nanoscience, correlated systems/materials synthesis, catalysis, interface of life and physical sciences and chemical dynamics are well aligned to the first and second of these initiatives, and are coupled to the fourth. Strategic plans based on these initiatives/themes are being developed and implemented as part of an ongoing process. Those themes concerned with Materials Sciences and Engineering programs were recently reviewed with DOE.

The DOE report stated, “If [the Materials-Environment Interactions program] is a high priority for BNL, then continuity of leadership is a critical issue. A similar concern exists with the Superconducting Materials program at BNL.” The PI for the Materials-Environment Interactions program is retiring in October 2005 and the program funds are being redirected to a new program in Exploratory Synthesis. The PIs for the Superconducting Materials program have retired and the program has new leadership. These latter changes were discussed with DOE as part of a recent program review.

The DOE report stated, “Recruitment for new personnel in the plant science area continues to be a challenge for BNL.” To renew the plant program and develop a bioenergy team at BNL, two outstanding young plant scientists were recruited. As noted previously, one will apply recently developed methods of metabolic flux analysis to

characterize plant metabolic pathways using *Arabidopsis thaliana* as a model system, and the other will characterize isoflavonoid biosynthetic enzymes and pathways which provide resistance to plant diseases.

The DOE report stated, “The National Synchrotron Light Source (NSLS) continues as a highly productive operating facility with a large number of users. However, the facility is more than twenty years old and has started to show the effects of ageing, in areas of beamline performance and overall facility reliability. In addition, other light sources now have approximately the same numbers of users as NSLS, and their user populations are growing at a more rapid rate than that of NSLS.” Indeed we have encountered some equipment failures over the last several years, but have managed to keep reliability and availability high in a world context. In this regard, our VUV-IR source is without peer, typically providing 99% reliability. The X-ray ring, which operates significantly beyond its original design specification, experienced a dip in reliability last year to about 92%, primarily due to the cycle (age) related failure of the injection ceramic (We did have a spare on hand to replace it, but it was a complicated replacement process and in a difficult to access location.). It is worth noting that this reduced reliability is still above the commitment to DOE of 90% reliability for major user facilities. This year the X-ray ring reliability is back up to our target of 95%.

2005 DOE Review of the NSLS

A peer review of the National Synchrotron Light Source (NSLS) was conducted by DOE-BES on April 25-27, 2005. Topics covered included: facility performance (schedules, user participation, etc.); selected presentations of the most outstanding research performed at NSLS during the past three years; R&D plans and future scientific directions; and BNL plans that may affect NSLS.

The reviewers were impressed with the continued productivity of the NSLS, which has performed well in remaining vital as the new third generation light sources, the ALS and APS, have built out their beamlines and developed their user communities. The developments of small gap insertion device beamlines; promotion of IR research; outreach efforts to biologists and environmental scientists, local universities and to new northeast-region users have been an important part of this effort. Reviewers also cited the x-ray detector development efforts. NSLS has done an admirable job in responding to the DOE-BES 2001 NSLS review recommendations. The enhancement of beamline scientific support staff, optimization of beamline utilization by decommissioning obsolete beamlines, and development of beamlines to serve vital user groups (e.g., high pressure research, biology, environmental and applied science) are notable. The development of the NSLS-II proposal, while not part of this review, is also very commendable.

DOE-BES identified three issues for NSLS and BNL management to address:

- “Develop within one year a 5-year NSLS Strategic Plan endorsed by SAC and the user community. The plan should have clearly prioritized phases and recognize the eventual phase out of NSLS following completion of NSLS-II.” BNL responded by

agreeing to develop a 5-year strategic plan in FY2006, incorporating ample user input and review by both the NSLS SAC and the NSLS User Executive Committee (UEC).

- “Implement regular Science Advisory Committee (SAC) meetings immediately.” The NSLS SAC was reconstituted in 2004. The full SAC has met three times since then and subcommittees of the SAC have met seven times. It will continue to meet twice per year.
- “Review and develop within one year new criteria for retention and promotion of NSLS staff that oversees beamlines. Ensure beamline scientists, in their normal course of their duties, have the same potential for "tenure" or promotions as do all scientists at BNL. Consideration should be given to the abolishment of this term, which appears to disadvantage beamline scientists and create a two-tier system.” BNL recognizes the importance of creative and dedicated scientific staff in the successful operation of large-scale user facilities and a significant number of NSLS scientific staff who oversee beamlines have been awarded tenure. BNL is reviewing its system of scientific staff appointments, including usage of the term tenure; we will participate fully in this Laboratory-wide discussion.

B.3 High Energy Physics (HEP)

Objective 1.1 Quality of Research

[KA1101] Proton Accelerator Research

- BNL was the convener of the tau ID group for the D0 experiment. A BNL scientist served as chairman of the top mass editorial board. BNL was the principal author of “Measurement of $Z \rightarrow \tau \tau$ production” BNL scientists developed tau analysis tools for new common analysis format for studies of WZ production with tau’s in the final state.
- E949: BNL identified new upper limits on 2 rare charged K decay modes and 1 rare neutral pion decay mode; BNL identified a new result on a measurement of another charged K rare decay mode. KOPIO: CDR and successful baseline reviews produced.
- MINOS: BNL made major contributions to: the NuMI beam commissioning efforts, including most of the online secondary-beam monitoring software; MINOS software for logging, databases, reconstruction; first measurement of the near-detector event rate; co-leadership of the electron-neutrino analysis.
- Very Long Baseline Neutrino Oscillations: BNL developed a new experimental technique for oscillation parameters; BNL produced a conceptual design report for a megawatt-class neutrino beam and new realistic detector simulations. BNL was a major contributor to the Homestake Mines proposal for DUSEL.

- BNL pursued development of large area avalanche photodiodes with a commercial company via a DOE SBIR for use in large water Cherenkov neutrino detectors.
- LSST: BNL established leadership of the sensor development team; BNL was a major contributor to the Data Management effort, including providing computing cluster; BNL published two papers on cosmology with weak lensing.

[KA1102043] LHC ATLAS Detector Construction

- BNL performed system integration for Liquid Argon; Liquid Nitrogen Refrigerator delivered, commissioned and accepted.
- BNL completed installation of System Crates, Pedestals, Power Supplies and Front End Boards in ATLAS Cavern.
- Cathode Strip Chambers were integrated with electronics.

[KA1102051] LHC Computing

- US ATLAS Tier 1 at BNL was one of the top contributing sites to ATLAS Data Challenge 2; BNL successfully achieved the throughput goals of LHC Computing Grid Service Challenge 2; BNL was one of the top contributing sites to ATLAS Rome Workshop data production.
- US ATLAS Tier 1 at BNL not only met the goals but was among the top 4 Tier 1 Centers in performance and reliability for both the disk to disk and disk to tape phases of LHC Computing Grid Service Challenge 3.
- 150 TB disk system using dCache on a Linux farm was successfully put into production in support of the service and data challenges as well as local users of the ATLAS Tier 1 at BNL. US ATLAS Tier 1 at BNL grew in capacity in both CPU and disk storage by more than a factor of 3.

[KA1102052] LHC M&O

- BNL completed commissioning of Liquid Argon Electronics.
- BNL completed preparation for Detector Maintenance Mode.

[KA1102053] Accelerator R&D

- The Mercury-jet target experiment was approved at CERN.
- BNL developed a new costing algorithm for FFAG accelerators.
- BNL initiated work on the International Scoping Study for neutrino factories.

[KA1401] Theoretical Physics

- BNL efforts in collider physics included: detection of neutralino dark matter; Higgs boson production in association with bottom quarks; next-to-next-to leading order calculation of single particle inclusive cross section.
- BNL results included: generation of small neutrino masses in Randall-Sundrum models; hints of new physics in B decays to pion+kaon; improved signals of new sources of CP violation at Super-B Factories.
- BNL also obtained: first results from dynamical simulation of domain wall quarks; new angular momentum sum rule; clarification of ambiguities in the up-quark mass.

[KA1501] Accelerator Science - ATF, SC materials

- Upgrade of the CO₂ laser system is completed and Terawatt level beam is achieved.
- Angular distribution of nonlinear Thomson back scattering was visualized in the first experiment with Terawatt CO₂ laser.
- Four 4 PhDs were completed this year on the material collected from the experiments at ATF.

[KA1502] SC Materials/Magnets

- BNL successfully produced a quadrupole test coil of a design potentially suitable for the final focus magnet system using 6-around-1 cable and featuring three double layers on a one-inch diameter tube. BNL successfully cold tested the coil in a 7-Tesla field.
- BNL developed a new heat treatment that resulted in a more stable Nb₃Sn cable.
- BNL started a systematic program of research into vibration effects in SC magnets.
- Demonstrated a quadrupole based on High Temperature Superconductor technology.
- BNL demonstrated a very high ramp rate ($> 2\text{T/s}$), low loss magnet.
- BNL delivered the final three LHC D2 dipole magnets. BNL completed testing on all three D3 dipole units and delivered one of the three. BNL completed testing on the last of three D4 dipole magnets and delivered one of the three.
- BNL started a systematic program of research into vibration effects in SC magnets.

[KA1503] Detector Development

- BNL started development of silicon detectors for a high luminosity upgrade of the ATLAS detector.

Objective 1.2 Relevance to DOE Mission

[KA1101] Proton Accelerator Research

- Rare kaon physics (including RSVP), neutrino physics, and the D0 experiment have been well-aligned with the national program. The recent termination of RSVP is leading to a redirection-of-effort discussion with the DOE Office of HEP. The guiding principle of BNL's redirection plan is relevance to the DOE mission. The emphasis will be on ATLAS, neutrinos and International Linear Collider (ILC).
- ATLAS is one of the flagship research efforts of the DOE HEP program. BNL's stewardship of US-ATLAS is a critical element of the DOE Mission.
- ILC is the expected future of the DOE Mission in HEP. BNL's ILC effort involves the Instrumentation Division and the Superconducting Magnet Division, and the research effort in the Physics Department will redirect generic detector development efforts toward the ILC.

[KA1102043] LHC ATLAS Detector Construction

- The success of US-ATLAS Construction effort is a critical element of the DOE's HEP mission. The construction is managed (and contributed to in a major way) by BNL.

[KA1102051] LHC Computing

- The US-ATLAS computing effort is another mission critical element and is centered at BNL.

[KA1102052] LHC M&O

- The US-ATLAS M&O activity is also mission critical and centered at BNL.

[KA1102053] Accelerator R&D

- Accelerator R&D activities at BNL in the Muon Collider/Neutrino Factory comprise the single largest piece of this national program.

[KA1401] Theoretical Physics

- Theoretical HEP research at BNL strongly supports DOE's and BNL's program in LHC research.

- Lattice gauge-based research at BNL is part of the national program. Computational lattice gauge physics originated at BNL, and BNL is a major contributor to this research area.

[KA1501] Accelerator Science - ATF, SC materials

- The ATF is the premier facility for developing and testing advanced accelerator concepts in the DOE program.

[KA1502] SC Materials/Magnets

- Work by the Superconducting Magnet Division in high temperature superconducting magnets and in direct-wind superconducting magnets is relevant to multiple DOE missions, most especially to the ILC, where BNL concepts are the only presently viable concepts for the ILC Final Focus system.

[KA1503] Detector Development

- BNL detector development efforts (Physics Department and Instrumentation Division) have been relevant to DOE HEP mission elements at Fermilab, LHC and will be similarly relevant to the ILC.

Objective 1.3 Success in Constructing and Operating Research Facilities

[KA1101] Proton Accelerator Research

- BNL effectively maintained the forward pre-shower detector for D0 built by BNL.

[KA1102041, KA1102043] LHC Program

- Construction was completed on time and within budget. Performance specifications and objectives have been met or exceeded.
- BNL delivered the final three D2 dipole magnets. BNL completed testing on all three D3 dipole units and delivered one of the three. BNL also completed testing on the last of three D4 dipole magnets and delivered one of the three.

[KA1102043] LHC ATLAS Detector Construction

- The construction of components of the ATLAS experiment is proceeding according to the baseline schedule and budget.
- Overall, BNL manages the entire U.S. ATLAS construction project.

- At a review in August, 2005, 98% completion was reported meeting the goal of 97% for CD-4A.

Objective 1.4 Effectiveness and Efficiency of Research Program Management

[KA1101] Proton Accelerator Research

- BNL is in discussion with the Office of High Energy Physics about the redirection of significant effort devoted to RSVP.
- Following cancellation of RSVP, BNL management of HEP was changed.
- BNL performed a reduction in force to deal with the FY2005 funding cuts and is in the midst of another reduction in force to deal with the FY2006 guidance from the Office of HEP.

[KA1102043] LHC ATLAS Detector Construction

- US ATLAS construction has been expertly and efficiently managed by BNL, leading to on time/on budget performance.

[KA1102051] LHC Computing

- The BNL Tier I center management has been highly effective, as evidenced by BNL performance in recent software and service challenges.

[KA1102052] LHC M&O

- Management of the M&O program has been very effective.

[KA1102053] Accelerator R&D

- The accelerator R&D management has made effective use of BNL resources in the face of declining budgets for muon collider/neutrino factory development.

[KA1401] Theoretical Physics

- Management of theoretical research has remained effective through changes in leadership in 2005.

[KA1501] Accelerator Science - ATF, SC materials

- Management of the ATF facility and program has remained effective through changes in leadership in 2005.

- Management of the Superconducting Magnet division has been outstanding in the face of severe budgetary reverses in FY2005, especially the termination of BTeV.

Response to DOE FY2004 Evaluation and FY2005 Program Reviews

The DOE report stated, “Lab management continues to deal effectively with a transitioning HEP program but there are still many questions including overall staffing issues, the age distribution of staffing, and the transition path of the D-Zero group. Lab management needs to develop a solid research plan based on realistic budgets and personnel needs, with various decision points or options based on the outcome of the outstanding questions such as final funding profile of the NSF support for RSVP, LHC schedule, AGS role in HEP in future years, and future developments in neutrino physics. Maintaining this diversity in the face of budget constraints is a continuing challenge for lab management. Expanding the diversity without ramping down other on-going lower priority activities will be unrealistic.” BNL agrees with this statement and has met with DOE several times to discuss reducing the number of higher priority items. BNL is developing a plan to proceed.

High Energy Physics Annual Review – April 2005

The report from the DOE Office of HEP was received recently, about five months after the review. The report summary states, “BNL’s current program of research is outstanding and is closely aligned with the national program. Also, BNL has a large number of potential activities that could be central research activities in the next 5-10 years—namely, RSVP, LSST, g-2 upgrades, AGS-based neutrino superbeam, and neutrino factory/muon collider R&D. However, while all these projects are worthy of pursuit, it is clear that not all of these activities can be supported within current budget projections, and that difficult decisions will need to be made soon. Most of the HEP programs at BNL are understaffed and the situation may be to some extent worse than last year while the Lab awaits external decisions on its programs. The DOE/NSF external review process will be completed in the coming months and will weigh in on these decisions. Setting priority and balance will be the major management challenges, especially in this stressed budgetary environment. The laboratory management will have to plan and act promptly in order to focus on limited areas so that those can be adequately supported and resulted in fruitful outcome.”

A BNL response is in preparation. The main activity of BNL HEP management is the preparation of a plan to redirect the effort devoted to the recently terminated RSVP experiments. This plan is being presented to and iterated with the Office of HEP at present.

B.4 Biological and Environmental Research (BER)

Objective 1.1 Quality of Research

[KP11] Life Sciences

Genomes to Life (GTL)

- A robotic pipeline has been developed for the high throughput characterization of proteins using synchrotron-based methods. The pipeline will be useful for characterizing proteins from Genomics: GTL facility I and for predicting new protein folds.
- Brookhaven scientists in collaboration with Emory School of Medicine and Oregon Health and Science University described the human-genome binding sites of a regulator protein, CREB, using a newly developed technique for tracking gene regulators. The technique can be applied to any protein that binds to specific sequences in DNA including proteins from plants, fungi and microbial communities.
- Advancements were made in the development of gold labeling of genetic pull-down tags that, when fully developed, will not only aid in understanding molecular machines, the DNA repair complex, and the Chromatin Remodeling Complex, but will aid in understanding many other cellular complexes.
- DNA-PKcs, one of the largest proteins known and a critical component of NHEJ DNA double-strand break repair complex that repairs damage from ionizing radiation, was expressed and purified.
- As part of the GTL effort, advances were made in genome signature tag technology. A molecular toolbox was developed for creating sequence tags from conserved DNA regions. Subsequent sequencing of the concatenated tags can be used to discriminate between closely related bacterial species, such as *Bacillus anthracis* and *Bacillus cereus*, or to quantitatively interrogate and deconvolute the composition of complex microbial communities, without the need for a priori knowledge of their composition.
- A description of auto-induction media was published in the June issue of *Protein Expression and Purification*. The newly developed media simplifies producing proteins from bacterial cells with the widely used T7 gene expression system. This development won an R&D 100 Award in October 2004.
- Selective metal binding to a membrane embedded aspartate in the *Escherichia coli* metal transporter YiiP (FieF) was characterized and published in *J. Biol. Chem.* The work contributes to our current understanding of how metal transporters are built and how they work.

Low-Dose

- Funding was awarded in April 2005 for a new project, “Whole Genome Analysis of Transcription Factor Binding in Response to Low Doses of Radiation”, and the method that greatly simplifies the original technique was presented at the Low Dose Contractors workshop.
- Deficiency of the p53-induced phosphatase Wip1 was shown to protect mice from oncogene-induced breast cancer and B-cell lymphomas. Surprisingly, protection from breast cancer required the Arf tumor suppressor but not p53, while protection from B-cell lymphomas required ATM and p53 but not Arf. These studies identify targets for new anti-cancer drugs and countermeasures for space radiation.
- It was shown that endogenous clustered DNA damages accumulate in cultured human skin cells and in 3D skin models but not in human skin tissue.
- Oxidized base endogenous clusters but not abasic clusters were shown to accumulate in primary human hematopoietic stem and progenitor cells, as well as in cultured human hematopoietic cells. However, abasic clusters—in addition to oxidized base clusters—are produced by radiation in irradiated cells.
- It was shown that the nature of the radiation (particle vs. photon), not its linear energy transfer (LET) properties, is the primary determinant of the spectrum of complex DNA damages. Charged particles, even high-energy protons of low LET, produced high levels of double-strand breaks relative to clusters; however, ionizing photons, both X-rays and gamma rays, produced more clusters relative to double-strand breaks.

[KP1201] Atmospheric Radiation Measurement (ARM)

- BNL successfully completed the ARM Mobile Facility and Atmospheric Sciences Program field experiment at Point Reyes, California. BNL scientists have played a leadership role in designing this experiment.
- BNL completed development on the Southern Great Plains (SGP) Merged Sounding ARM Value-Added Product, which defines the continuous thermodynamic and wind structure over the SGP site.
- BNL completed a one year calculation of the Radiative Heating Rate Profile over the SGP Site as part of the ARM Broadband Heating Rate Profile Project
- BNL proposed, authored the science plan for, and successfully conducted, the Marine Stratus Radiation, Aerosol, and Drizzle (MASRAD) Experiment, which was designed to study Aerosol Indirect Effects in Coastal Marine Stratus Clouds. Data for MASRAD were collected by the ARM Mobile Facility over the past six months and

constitute the most comprehensive measurements in this climate-sensitive-cloud-type to date.

- BNL contributed to and co-authored recently published studies that used ARM data to directly evaluate Cloud System Resolving and Single Column models.

[KP1202010] Atmospheric Science

- BNL designed and conducted a study of the climate-related properties of marine stratus clouds over the Northern Pacific in July 2005 jointly with the DOE Atmospheric Radiation Measurements (ARM) and Atmospheric Science Programs (ASP). This program, featuring both surface and aircraft measurements, was one of the largest and most sophisticated of such studies ever conducted.
- BNL showed that power plants in the Ohio River valley had reduced emissions of nitrogen oxides by nearly an order of magnitude greatly reducing the amount of ozone on the East Coast of the U.S. that could be attributed to these sources.
- BNL developed a new theory for the formation of raindrops in warm clouds that greatly improves the representation of precipitation formation and persistence in the General Circulation Models that are used to predict climate change.
- BNL developed and successfully tested a prototype instrument that improves the rate of measurement of aerosol particle size distributions (diameters 10 - 1000 nm) in the atmosphere by a factor of ten over existing instruments.
- BNL published a monograph entitled “Sea Salt Aerosol Production: Mechanisms, Methods, Measurements, and Models” that critically examines the basis for representing sea-salt aerosols in models, including those used for climate change predictions.

[KP1202020] Terrestrial Carbon Processes

- BNL completed studies of C and N metabolism at SoyFACE that demonstrates that increased carbon availability at elevated [CO₂] improves N assimilation in legumes and that in the absence of water stress there is no effect of elevated [CO₂] on C₄ plants.
- BNL completed construction of the Soil Analysis Facility where novel soil carbon measurements are made using neutrons.
- BNL successfully operated the free-air carbon-dioxide enrichment (FACE) Facility in North Carolina.

[KP1203] Ecosystem Function and Response and Vegetation

- BNL established the capability to analyze key physiological markers, metabolites and enzyme activities associated with central carbon and nitrogen metabolism using a high-throughput platform (HERMES).

[KP13] Environmental Remediation

- Based on the protein that regulates lead-resistance in *Ralstonia metallidurans* CH34 (PbrR), a sensitive biosensor for lead was developed that is 1000-fold more sensitive to Pb(II) than to any other bivalent heavy metal. The PbrR protein is the most specific detector for Pb(II) known to man.
- Uranium reduction at the Oak Ridge Field Research Center is inhibited by the presence of high levels of nitrate in the groundwater. In addition, the presence of increased levels of heavy metals, including nickel, hinders the activity of nitrate reducing bacteria. To overcome this problem, nickel resistance was successfully introduced into different members of the nitrate reducing bacterial community present at the site. The efficient removal of nitrate by the nickel-resistant, nitrate-reducing bacteria currently is being evaluated in soil columns prior to evaluating the effect of this pre-treatment on uranium reduction.
- Medical imaging techniques were successfully used to track the distribution of nutrients in poplar trees in response to a simulated insect attack. The research provides insights on how plants respond to environmental stress and shows how radiotracer imaging can be applied to plant biochemistry.

[KP1301] Bioremediation and Clean Up Research

- BNL scientists developed a simple, safe method of removing uranium from contaminated metallic surfaces using citric acid formulations so that the materials can be recycled or disposed of as low-level radioactive or nonradioactive waste. The research is published in the July 1, 2005, issue of Environmental Science and Technology.
- Environmental molecular science research has been expanded at the BNL National Synchrotron Light Source (NSLS) as a result of new support from DOE BER. A new microprobe beam line (X27A) was opened for users with three BER-supported users scheduled for the Fall 2005 experimental cycle. The X11A beam line received and began installation of a new detector system.
- Biotransformation of the polymeric form of $^{242}\text{Pu}(\text{OH})_4$ by the anaerobic bacterium *Clostridium* sp. showed that the Pu was solubilized due to its reduction to Pu(III). XANES analysis of the culture confirmed the Pu³⁺ oxidation state. An increase in α - and β -activity was observed in solution phase from Nevada Test Site (NTS) soil and Pu from Rocky Flats soil due to enhanced anaerobic microbial activity.

[KP1401] Medical Applications

- The synthesis and evaluation of several new radiotracers for the norepinephrine transporter (NET, a drug target in depression and ADHD) has revealed that one of these has properties suitable for imaging the NET. With recent FDA approval and a new kinetic modeling method for quantification, human studies will be initiated to use this new NET tracer as a tool to study new antidepressant drugs and stimulant abuse.
- We have successfully labeled the drug Gleevec (STI571) the most well known example small molecules that inhibit abnormal cellular processes including cancer. This allows us to measure with PET the biodistribution, pharmacokinetics and metabolite profile of STI571 in non-human primates.
- Using a novel radio-iodinated cannabinoid (marijuana) receptor ligand, the *in vivo* receptor occupancy of the brain CB1 cannabinoid receptor producing observable behavioral effects of cannabinoid drugs in mice has been determined.
- The behavioral response to alcohol is highly variable among individuals. We have measured brain function with PET and FDG at baseline and during alcohol intoxication with the surprising result that brain glucose metabolism is profoundly reduced even when behavior is minimally affected. This seemingly paradoxical finding raises the possibility that the large brain metabolic decrements during alcohol intoxication could reflect a shift in the substrate for energy utilization.
- Recent studies have linked polymorphisms in the MAO A gene (high and low MAO A genotype) and certain clinical phenotypes including impulsivity and aggression. We have initiated a study of gene-brain-behavior relationships combining PET/MAO A imaging, fMRI and neuropsychological measures to determine whether high and low brain MAO A genotypes correspond to high and low MAO A protein levels and to measures of inhibitory control.
- The responses of normal healthy individuals to violent videos and movies are highly variable and the neurobiological factors involved in this variability are not understood. We used PET and FDG scans to reveal changes in brain activity in response to emotional stimuli in the two groups.
- A novel combination of fMRI, PET and event-related potentials (ERP: recording brain electrical activity at a msec temporal resolution) (including simultaneous fMRI-ERP) and novel neuropsychological paradigms has been used to uncover core deficits in the ability of drug-addicted subjects to respond to normally salient events such as monetary reward. This combination of methods may be valuable in clinical application in addiction therapy.

- Intracranial hypertension (increased intracranial pressure) is a life-threatening complication of pathologies involving the brain. A novel non-invasive method for measuring intracranial pressure in humans was optimized and adapted to high field clinical MRI thus potentially replacing invasive monitoring which is in current use.
- A neuroinformatics infrastructure was created by BNL ITD to facilitate the dissemination of new 3D C57BL/6J mouse brain atlas created by high resolution MR imaging. The digital atlas will be used for high throughput anatomical phenotyping of genetically engineered mice by the neuroscience community.
- Several new peptide nucleic acid probes have been developed that have been chemically modified at their N-terminus to improve their ability to penetrate into cells. The probes have been labeled with iodine-125 to enable them to be tracked in biodistribution studies.
- The first high resolution MR images of a live mouse brain injected with nano-particle containing stem-cells was obtained on the newly commissioned 9.4T microMRI. The 30-nm nanoparticles were fabricated by the BNL Center for Functional Nanomaterials.
- Nanoparticles were functionalized with positron-emitting isotopes, generating a novel imaging probe that can be used to characterize the complex behavior of nanoparticles in time and in space in a living rodent. This revealed its deposition in organs such as the lungs and kidneys and even the well-protected brain.
- We have previously developed a highly selective nicotine receptor *agonist* radiotracer for imaging the brain nicotine system (nAChR) which has been implicated in a number of brain disorders including Alzheimer's disease and smoking addiction. We have now labeled a potent and selective nAChR antagonist as an improved and safer radiotracer for PET imaging.
- The first clinical fMRI images of dichotic listening in children diagnosed with autism spectrum disorder were obtained in collaboration with the Long Island CODY Center for Autism.
- A RatCAP tomograph for awake rat brain imaging with PET has been developed. The key electronic components including an application specific integrated circuit (ASIC, which can be used in a wide variety of applications) and full system reconstruction matrix have been completed and tested. A prototype has been constructed and tested.
- Two open labeled clinical trials using gamma vinyl-GABA (GVG) for the treatment of cocaine and methamphetamine addiction were successfully completed. These clinical trials suggested efficacy and demonstrated visual safety. As a result, the US Food and Drug Administration accepted two Investigative New Drug Applications for large scale clinical trials with GVG for treating adult cocaine addiction.

- PET technology and behavioral models have been employed to understand the rewarding and damaging effects of inhaling solvent vapors (a widespread practice in children and adolescents) and to explore treatment strategies. It was demonstrated for the first time that GVG blocked methamphetamine-induced increases in brain dopamine as well as the expression of solvent (toluene)-induced conditioned place preference in adolescent animals.
- Using a multi-dimensional approach (microPET, behavioral analysis, autoradiography, microMRI, microCT and blood endocrine analysis) we have identified a basic abnormality in obese vs lean mice. This presents a new opportunity in studying obesity in rodent models and complements on-going PET and fMRI studies identifying the brain circuits involved in food stimulation and in satiety.
- Though fMRI is used increasingly in clinical research, there are few systematic studies of the impact of head motion and scanner noise both of which are variables in most studies. Quantitative measurements reveals that even very small head rotations ($\sim 2^\circ$) can mask real BOLD response signal in fMRI studies and that scanner noise significantly affects brain activation patterns. Thus future comparisons between studies need to consider these variables.
- Memory problems are one of the most common side effects of brain surgery, irradiation and chemotherapy. Using a newly developed radiopharmaceutical and microPET we have been able to image acute, dynamic changes in excitatory brain receptor function following brain injury in the living rat including a short lived (3-10 min) increase and a long term (>24 h) decrease. Applying this technology to human subjects may improve management and treatment of head trauma victims
- Previous studies have shown that smokers have reduced brain MAO, an enzyme which breaks down neurotransmitters involved in mood and in the regulation of blood pressure. Using PET and highly specific radiotracers for MAO, we have shown that smokers have reduced lung MAO A, which may limit the ability of the ability of the smoker's lung to detoxify circulating vasoactive substances.
- Wireless physiological monitoring for high field MRI studies: An instrument for wireless physiological monitoring of rats within a high magnetic field (9.4T) which was developed in collaboration with Instrumentation division.
- Using a newly developed protocol microMRI and microPET images were coregistered for rats and mice allowing the same animal to be followed longitudinally and improving quantitative capabilities. In addition we developed rat whole body coil for use in MRI for coregistration of whole body FDG PET and utilization for quantitative in vivo measurement of fat and muscle in rodent model of obesity.

- A Cadmium Zinc Telluride detector for PET has been developed. This is a new effort investigating solid state detectors for PET applications. Timing resolution of ~10 ns has already been achieved which is a > 10X improvement compared to standard timing methods.

Objective 1.2 Relevance to DOE Mission

[KP11] Life Sciences

- Received 2004 R&D 100 Award from R&D Magazine for the development of auto-induction media for protein production in the T7 expression system. Work was supported both by DOE-GTL and National Institute of General Medical Sciences Protein Structure Initiative (NIGMS-PSI).
- Development of new whole genome analysis methods is relevant to BER Genomics: GTL and BES energy bioscience programs; this work also supports the BER Low Dose program mission to determine the mechanistic basis for the interaction of low doses of radiation with biological systems, including mechanistic studies focused on DNA damage and repair, endogenous vs. radiation-induced oxidative damage, adaptive responses, bystander effects, genomic instability and genetic susceptibility.
- Development of new protein tags for electron microscopy supports DOE's Genomics: GTL mission to characterize molecular machines.
- A laboratory-funded program to express, purify and characterize bacterial membrane proteins, including heavy-metal transporters, supports the Genomics: GTL mission to develop techniques for its large-scale protein production facility.

[KP1201] Atmospheric Radiation Measurement (ARM)

- BNL scientists supported by the ARM program have addressed high priority science issues, and special data sets developed by them have been used by modeling centers to improve climate models.
- BNL operated the ARM External Data Center and provided value added data to ARM scientists.

[KP1202010] Atmospheric Science

- BNL support of the Atmospheric Science Program is relevant to DOE and national priorities in climate change research.

[KP1203] Ecosystem Function and Response and Vegetation

- The DOE/BER FACE Facility is an Office of Science user facility. Brookhaven contributes to the operation of this Facility.

- Understanding the response of plant C and N metabolism to rising CO₂ concentration is key to advancing mechanistic understanding of how plants and ecosystems will adapt to global change. This is directly relevant to the goals and mission of BER's Program for Ecosystem Research and the programs for Terrestrial Carbon Processes and Carbon Sequestration.

[KP1301] Bioremediation and Clean Up Research

- The Center for Environmental Molecular Science is developing a molecular-level understanding of the processes underlying contaminant sequestration in natural and engineered systems that is important to DOE cleanup issues.
- State-of-the-art synchrotron-based molecular environmental science (MES) research supports DOE's mission of protecting the environment by helping to provide the fundamental understanding required to develop and deploy cost-effective remediation strategies for the nation's most pressing contamination issues.

[KP1401] Medical Applications

- Imaging programs have direct relevance to outstanding DOE missions of development of radiotracers, development of new techniques and technology.

Objective 1.3 Success in Constructing and Operating Research Facilities

[KP11] Life Sciences

Macromolecular Crystallography

- A crystal-mounting robot (automounter) that was built and installed at X12B last year was piloted in the general user population. The robot enables groups to screen large numbers of samples. It performed as expected and will be released to more users. There is a large interest from proprietary users because extensive crystal screening is a common need in the pharmaceutical industry.
- User publications included a report in Nature on the structure of a self-splicing group I intron from the ciliate, Tetrahymena. It was the first RNA shown to have enzymatic activity and overturned the dogma that only proteins serve as enzymes.
- The New York Structural Genomics Research Consortium efforts at BNL using NSLS crystallography facilities reported that 25 structures were determined and submitted to the Protein Data Bank during FY2005.
- BNL organized and ran a practical crystallography course, RapiData 2005 (Rapid Data Collection and Structure Solving at the NSLS: A Practical Course in Macromolecular X-Ray Diffraction Measurement).

Scanning Transmission Electron Microscope (STEM) Facility

- Mass analysis continues to be the major component of the user/collaborator program. With about 50 different projects, it has been essential to disseminate our analysis program to users so they can analyze their own data. A new version, PCMass27, was completed that provides numerous new features, and eliminates some problems users encountered with newer versions of the Windows operating system.
- Significant contributions have been made both in the fields of retrovirus assembly and in the structure of prion filaments. These fields continue to be active areas for STEM research.
- Upgrading the control, data acquisition and display computers of STEM is our major instrumentation project. New computers for STEM1, STEM3 and backup have been delivered, along with a commercial digitizer card that will be used in place of the current custom hardware.

[KP1201] Atmospheric Radiation Measurement (ARM)

- The ARM Mobile Facility Site Scientist at BNL provided outstanding scientific guidance for the first deployment of the mobile facility at Point Reyes, California, and has provided a plan for the second deployment in Niger.

[KP1203] Ecosystem Function and Response and Vegetation

- BNL has established and maintains the Forest-Atmosphere Carbon Transfer and Storage (FACTS-1) Facility in the Duke University Research Forest in Chapel Hill, North Carolina. The FACTS-I Facility serves as an integrated research platform for multi-disciplinary, multi-institutional studies on processes regulating forest carbon balance under both contemporary conditions and with elevated atmospheric CO₂ concentrations expected in the future.
- By the end of FY2005, the North Carolina Facility will have 4 elevated treatment plots, 3 fully instrumented control plots, and 5 additional ambient companion plots with a more limited instrumentation set. The operational reliability of the facility is very good, with CO₂ enrichment consistently operating more than 99% of all scheduled hours. Annual average CO₂ enrichment in the plant canopy has consistently been within 5% of the 200 $\mu\text{mol/mol}$ target.
- An operational goal of the DOE/BER FACE Facility is to operate the user facility (i.e., control CO₂ concentration at superambient values in the elevated-CO₂ treatment “rings”) for more than 90% of the scheduled operating hours each fiscal year. The North Carolina Facility will meet this goal; monthly progress is tabulated at <http://www.sc.doe.gov/ober/CCRD/face.html>.

[KP1401] Medical Applications

- The radiotracer laboratory operated successfully over the course of the year. Syntheses were accomplished in support of the clinical and pre-clinical research programs. However, updating for some of the automation devices used in radiotracer synthesis is needed.
- The PET Imaging laboratory operated successfully over the last year with increasing use and demand for the microPET to the point where it would increase productivity and efficiency to purchase a second microPET instrument.
- The 4 T human MRI continues to operate successfully though it is an old instrument and requires high level personnel for operation. It also incurs substantial operating costs for liquid helium which is lost through leakage. One of the needs for growth and stabilization of MRI research here at BNL is the purchase of a new 3 T instrument which will not lose helium and will not require high level personnel for operation and maintenance.
- Some operational problems were experienced with the cyclotron which resulted in the need to purchase radioisotopes on occasion. Efforts have been initiated to resolve long standing issues to improve machine reliability. This may necessitate purchasing a new cyclotron to back up the current machine and renovating space in order to locate a new machine closer to the radiotracer laboratory for efficient delivery of the short-lived isotopes over shorter distances.

Objective 1.4 Effectiveness and Efficiency of Research Program Management

[KP11] Life Sciences

- Members of the DOE Low Dose funded programs participate in weekly internal seminars, interact with members of other research teams, host visitors, and participate in national and international research conferences.
- BNL participates in an NIH-sponsored monthly videoconference on DNA repair that involves more than 14 institutes, universities and other National Laboratories.
- BNL formed the Computational Science Center to expand computing capabilities in several areas of computational biology including protein molecular dynamics and protein-protein interactions. This capability also will enable biologists to analyze large biological databases, conduct computer modeling of protein folding, better determine protein structure, and understand interactions of proteins with each other and with drugs.
- The New York Structural GenomiX Research Consortium, in which BNL Biology participates, was selected to be one of four large-scale centers for the next five-year phase of the Protein Structure Initiative of NIGMS. Development of methods and

vectors for high-throughput protein production is partially supported through this center and will be relevant to the DOE Genomics: GTL initiative to understand molecular machines.

- A highly successful new course to introduce scientist to synchrotron-based circular dichroism (CD) for protein characterization was held. The course will help scientists take advantage of the soon-to-be refurbished CD and fluorescence spectroscopy facilities that BER supports at the NSLS.
- With support from DOE BER and NIGMS, BNL co-organized a meeting on Methods in Protein Structure Analysis (MPSA2004). From the meeting presentations, two series of minireviews on protein networks were developed that will be published this fall in FEBS Journal. The development of computational and experimental tools for the characterization of protein networks is relevant to the goals of BER's Genomics: GTL program.
- BNL participated in a successful application with the Center for Scientific Computing and the Stony Brook University (SBU) to obtain a new server from IBM that will support bioinformatics efforts relevant to Genomics: GTL.
- Participated in a successful application with the Center for Structural Biology at the State University of New York (SUNY) to obtain a unique atomic force microscope through the NIH Shared Instrumentation Program that will be available to researchers at both BNL and SBU.
- In FY2005 the Biology Department submitted 45 grants to various agencies including 6 to DOE. To date, 12 have been funded, 4 of which are DOE grants (2 GTL, 2 Low-Dose). The WFO funding ties closely to our GTL and Low-Dose programs and will be used to create a base for growth in those areas.

[KP1201] Atmospheric Radiation Measurement (ARM)

- BNL scientists/managers contribute to developing new programs. BNL proposed the Cloud and Land Surface Interaction Experiment (CLASIC), which has attracted multi-agency interest and will be considered for funding as an ARM Intensive Observational Period in 2007.
- A BNL scientist served as the temporary Chief Scientist of ARM for a period of three months.
- BNL successfully located and secured a world class scientist to serve as the ARM Chief Scientist position, successfully operated the ARM External Data Center, and expanded BNL's cloud radar group by adding a new scientist. The Site Scientist of the ARM Mobile Facility successfully managed first deployment at Point Reyes, California, and planned for second deployment in Niger.

[KP1202010] Atmospheric Science

- A BNL scientist served as Chief Scientist for the Atmospheric Science Program.
- BNL organized the FY2005 Atmospheric Science Program Meeting.

[KP1202020] Terrestrial Carbon Processes

- BNL managed an effective collaboration between BER and DOE Office of Fossil Energy (FE) to support the soil carbon analysis research.

[KP1203] Ecosystem Function and Response and Vegetation

- BNL management responded to the departure of the FACE project Principal Investigator (PI) by consulting with the PI for nine months and then transferring his responsibilities to other scientists and engineers. The engineer who designed the North Carolina FACE Facility is now responsible for its operation. A scientist who has conducted research at FACE sites for almost a decade accepted responsibility for BNL's FACE science.

[KP1301] Bioremediation and Clean Up Research

- BNL management encouraged growing the relationship between BNL's Environmental Sciences Division and the NSLS.

The Synchrotron Environmental Science III meeting was held at BNL September 19-21, 2005. The meeting brought together the diverse community of scientists who apply synchrotron-based radiation techniques to study the biological and geochemical aspects of both local and global environmental issues along with applications in bioavailability and remediation science.

[KP1401] Medical Applications

- While the projects reside in both the Chemistry and Medical Departments, the imaging group researchers work in close harmony. Administrative improvements to reduce costs are being pursued.

Response to DOE FY2004 Evaluation

[KP11] Life Sciences

The DOE report states, "Aside from their significant contribution to the BER structural biology user station program, BNL makes a very minimal contribution to the BER Life Sciences program with a total of only 3 independent projects and one collaborative project." The Biology Department continues efforts to align its research with the BER Life Sciences programs. Six new proposals were submitted to DOE in FY2005; five

proposals submitted in FY2004 or FY2005 were funded or approved for FY2006 funding (one is from BES); an additional proposal (see below) for an upgrade to the synchrotron CD (UV user) station has received a favorable review. Biology Department scientists continue to develop projects with scientists in other National Laboratories that support Genomics: GTL initiatives.

The DOE report states, “Funding was provided for the development of a new ultraviolet user station with potential relevance to the Genomics: GTL program. A peer-reviewable renewal proposal and progress report was expected but not received in FY2004.” Progress reports were submitted at the normal FWP cycle in FY2004 and FY2005. The upgrade proposal was submitted in January, 2005; three favorable reviews have been received. BER is waiting for information on the FY2006 budget to determine if additional funds will be available.

In addition to BER funded projects, using Department and Laboratory resources, Biology is investing in several areas in support of Genomics: GTL: 1) new genomics methods for microbial communities; 2) alternate systems for protein production; 3) methods for producing, purifying and characterizing membrane proteins including heavy metal transport proteins; 4) metal biosensors.

As funding to BER has not increased significantly in years, Biology continues to seek Work for Others (WFO) that complements BER- and BES-funded efforts. In FY2005, Biology scientists submitted 28 WFO proposals to NIH, DOE, NASA, Industry and other potential WFO sponsors.

[KP1202020] Terrestrial Carbon Processes

The DOE report states, “With the departure from BNL of the FACE Project PI, the future of FACE science direction and management of the FACE infrastructure activities at BNL will be evaluated by the DOE/BER Program Office.” BNL management responded to the departure of the FACE project PI by consulting with the PI for nine months of FY2005 and then transferring his responsibilities to others. The engineer who designed the North Carolina FACE Facility is now responsible for its operation. A BNL scientist who has conducted research at FACE sites for almost a decade accepted responsibility for BNL's FACE science. BNL management is waiting for BER guidance that might follow the BERAC Subcommittee Review of BER's Terrestrial Carbon Processes program that includes the FACE program before making scientific hires in this area.

The DOE report states, “The BNL FACE research continues to make progress on key scientific questions related to CO₂ effects on ecosystems and on terrestrial carbon cycle processes, although they are not recognized as a leader of carbon cycle or CO₂ effects research. Publication performance in this area is satisfactory, but not outstanding.” BNL agrees with this statement. BNL is awaiting documented recommendations from DOE prior to developing and implementing improvements.

B.5 Advanced Scientific Computing Research (ASCR) Program

Objective 1.1 Quality of Research

[KJ0101] Applied Mathematics Research and the SciDAC Program

- For the Applied Mathematics program BNL, along with its Stony Brook and Columbia University partners, has developed exciting new algorithms and simulations in magnetohydrodynamics, diesel fuel injection, accelerator and electromagnetic field modeling, and the quantum mechanics of nanoscale particles. Further growth is needed but current results are outstanding.
- Magnetohydrodynamics – BNL developed new code for free surface flows at low magnetic Reynolds number based on the method of front tracking coupled to the embedded boundary method. This was applied to studies of processes associated with the refueling of tokamak fusion devices through the injection of frozen deuterium pellets, cavitation of liquid hydrogen and helium jets, and liquid mercury targets. The code agrees well with analytical results in simple test cases. Experiments in realistic cases have not yet been performed.
- Scientific Discovery through Advanced Computing (SciDAC) - Diesel jet atomization studies produced the first simulation of atomization and breakup of a high speed jet in the fuel injection regime. The simulation required modeling of a mixed phase (cavitation) flow regime through finite sized vapor bubbles with mass transfer (evaporation) across a tracked boundary. Comparison to ANL experiments was performed. The results are in semi-quantitative agreement with experiments. Longer computational runs and experimental averaging are being pursued to improve the comparison.

[KJ0102] National Collaboratory - Grid Based Research and Development

- Activities in this area are critical to functioning of DOE's major facilities and are also leading the way in new grid-based science opportunities.
- Particle Physics Data Grid – A Grid user management system capable of importing to a Grid site the user information from multiple Virtual Organizations has been developed, tested and deployed as part of the initial implementation of the Open Science Grid (OSG). It enables the appropriate authentication, authorization, and accounting of the use of resources at such a site.
- Terapaths – The use of a combination of local area network Quality of Service and wide area network Multi Protocol Label Switching has been demonstrated to effectively partition end-to-end bandwidth resources connecting BNL with Fermilab. This enables the allocation of bandwidth by user and function.

Objective 1.2 Relevance to DOE Mission

[KJ0101] Applied Mathematics Research and the SciDAC Program

- Work on magnetohydrodynamics is critical to the fundamental understanding of processes in weakly ionized plasmas and liquid metals interacting with intense particle beams, and the design of refueling and plasma disruption mitigation devices for tokamaks such as the International Thermonuclear Experimental Reactor (ITER) as well as for target materials for future particle accelerators.
- Improved design of fuel injectors for a diesel engine will result in increased efficiency and decreased pollution. Simulation studies contribute to this goal, initially by elucidation of basic mechanisms governing atomization, and later as part of a simulation-optimization design cycle.

[KJ0102] National Collaboratory – Grid-Based Research and Development

- A Grid user management system allows the use of DOE computing resources, including those at BNL, connected to the Open Science Grid to be appropriately and effectively managed to the benefit of the Relativistic Heavy Ion Collider (RHIC) and Large Hadron Collider (LHC) programs such that their scientific results are produced in a timely manner.
- Terapaths is specifically targeted at Wide Area Network connectivity, including that of BNL, which is commonly an oversubscribed resource, the use of which needs to be prioritized and allocated by program and function in order to optimize the use of major DOE computing resources, such as those located at BNL, in support of the RHIC and LHC programs.

Objective 1.3 Success in Constructing and Operating Research Facilities

Not Applicable

Objective 1.4 Effectiveness and Efficiency of Research Program Management

[KJ0101] Applied Mathematics Research and the SciDAC Program

Management reorganized Brookhaven's Advanced Computing activities forming a new Computational Science Center to replace the Center for Data Intensive Computing and increasing the number of computer professionals.

Response to DOE FY2004 Evaluation

The DOE report states, “It would be in BNL’s interest to enlarge their programs in applied mathematics and computer science with individuals of similar quality to those

presently employed.” BNL has been attempting to enlarge its programs in applied mathematics and computer science.

B.6 Workforce Development (WD)

Objective 1.1 Quality of Research

[KL01] Undergraduate internship programs

- Performance in this area has been outstanding in FY2005. The research conducted by interns has been complex, challenging, integrated across disciplines and has advanced the scientific initiatives at Brookhaven.
- Feedback provided by mentors has consistently noted the high quality contributions of students to their research activities. Several noted that the students work was key to successful programmatic implementation. Two specific examples include neuroimaging and urban dispersion program data collection.

[KL02] Professional development for faculty and teachers

- Both of the primary programs supported in the area, the Faculty and Student Teams (FaST) and the Laboratory Science Teacher Professional Development (LSTPD) programs, have had exceptional results at BNL. These results are consistent with the expectations of the Office of Science and have been frequently cited as model results.
- Follow up in FY2005 by the Office of Educational Programs (OEP) with faculty and BNL mentors from the five FY2004 FaST teams has been conducted. All five of these teams have secured research support funding at varying levels. They have also submitted over \$6.1M in collaborative grant proposals. Ten teams were hosted in FY2005, five from HBCUs, two from MSIs and two from HSIs. Similar results are anticipated.
- OEP supported a second cohort in the LSTPD program as planned with DOE. The first cohort of LSTPD teachers have progressed in terms of research capability and are all engaged in hands-on research based classroom activities directly resulting from their BNL experience. These teachers are now preparing for the leadership phase and will conduct peer workshops in the coming year.

Objective 1.2 Relevance to DOE Mission

[KL01] Undergraduate internship programs

- The undergraduate internship programs have been directly supportive of the DOE workforce development mission by introducing students to research at a DOE national laboratory.

- BNL efforts provided extraordinary results in terms of workforce diversity. The DOE sponsored programs at BNL had a 34% representation by minority groups.
- Brookhaven National Laboratory has also supported the DOE workforce development mission through support of the DOE High School and Middle School Science Bowl Regional competitions, held at BNL. The national competition was supported by BNL staff. Although not part of funding in KL01, this is a DOE sponsored event.

[KL02] Professional development for faculty and teachers

- The faculty and student teams at BNL continue to provide exceptional opportunities for university faculty to expand their research capacity through meaningful collaborations with BNL researchers. The faculty members continue to provide development plans and seek collaborative proposal opportunities.
- BNL placed a first Faculty Sabbatical member from a minority serving institution in the fall semester of 2005. This faculty member is working collaboratively with a BNL researcher to improve materials used for hydrogen fuel cells to improve durability in transport such as that required for a vehicle.
- The faculty and student teams at BNL were strongly supportive of the DOE diversity initiatives. Of the ten teams hosted, five were from Historically Black Colleges and Universities, two were from Minority Serving Institutions and two were from Hispanic Serving Institutions.

Objective 1.3 Success in Constructing and Operating Research Facilities

N/A

Objective 1.4 Effectiveness and Efficiency of Research Program Management

[KL01] Undergraduate internship programs

- A mid-year DOE assessment of the BNL management practices within the Office of Educational Programs was conducted by the Office of Science, Office of Workforce Development. DOE noted that the BNL program was excellent and reflected such in a report back to BNL. A grade/rating will not be specifically assigned by DOE until mid October of 2005.
- The Office of Educational Programs provided exceptional utilization of the DOE/NSF memorandum of agreement, nearly matching DOE SC funds with supporting funds from NSF. The overall cost per student, significantly reduced in FY2004 was further reduced by 13% in 2005, even with significant increases in operating costs.

- BNL also did an excellent job in leveraging other programs to support DOE sponsored programs. Students partially supported by other NSF programs, local organizational programs and others, coupled with over \$80,000 in cost sharing by research departments significantly increased the effectiveness and efficiency of the DOE sponsored programs.

[KL02] Professional development for faculty and teachers

- With moderate funding from DOE, BNL was able to leverage funding sufficient to support two faculty and student teams into ten teams. This was done through exhaustive relationship building with universities and NSF supported schools to find the right match between faculty and researcher and then funding the team with NSF supplemental funds.
- BNL continues to focus on developing faculty and student teams that can eventually become self supporting with external or DOE funding. As an example, through a proposal submitted in the spring of 2005, one team will be funded by NIH for the summer of 2006.
- The LSTPD program was implemented as agreed to with DOE Office of Workforce Development. The program is providing both the building of research experiences and skills of the teachers involved, and the leadership component.

Response to DOE FY2004 Evaluation

BNL's evaluation in FY2004 by DOE Office of Workforce Development was very positive. The areas noted by BNL's OEP as needing improvement were agreed to by DOE. BNL has actively pursued improvement in these, including student abstract quality, recruitment of pre-service teachers and community college students. BNL has targeted recruitment of these students through visits to community colleges and schools of education.

Improvement of student abstracts was addressed by including writing workshops for student interns and offering a one-on-one editing service for the students. Additionally, the desire to improve abstract and paper quality was highlighted at the mentor orientation session before students arrived.

BNL, for a second year in a row, significantly increased utilization of the DOE/NSF memorandum of agreement (nearly matching DOE SC funds with supporting funds from NSF) resulting in a 13% reduction in the cost per student week following a 40% reduction in cost per student week in FY2004.

C. DOE Non-SC and Work for Others

C.1 Energy Efficiency and Renewable Energy (EE)

Building Technologies

- BNL demonstrated technical feasibility of full-scale production of an alternative HVAC duct concept which is inherently sealed and insulated. Energy losses in conventional systems are typically 25% and so this represents a significant savings potential.
- BNL completed field and laboratory R&D projects supporting use of biodiesel as an alternative, renewable heating fuel.
- BNL completed a study showing high-efficiency, condensing boilers can be used even with existing hydronic distribution systems, representing a significant energy efficiency opportunity. A peer-reviewed ASHRAE paper was accepted.

Geothermal Materials Program

- Cost-effective acid-resistant zeolite-based cement, which is lower cost than conventional Portland well cement was developed in geothermal drilling program.
- 300-degrees C-stable polyphenylenesulfide (PPS) coating was developed using nanocomposite technologies for wellhead and heat exchanger components in geothermal plants.
- New types of nanoscale rare earth metal oxide-doped organometallic polymer (OMP) coatings was developed using BNL-developed self-assembly nanocomposite technology for condensers. The patent application for this technology was made.

Hydrogen Production and Storage

- Three distinct phases of Aluminum Hydride were synthesized that exceeded the DOE's 2010 gravimetric and volumetric onboard storage goals.
- The thermal and structural properties of two new hexa-hydride alanates were synthesized and investigated using synchrotron x-ray diffraction. These measurements demonstrated that appropriate cation substitutions alter the stability of the alanate.
- X-ray absorption spectroscopy on Titanium doped alanates showed that the catalyst formed Ti-Al clusters on/near the surface and lowered the potential energy barrier to the formation of aluminum hydride.

C.2 Nuclear Energy Science and Technology (NE)

Generation IV Nuclear Systems

- In support of the gas-cooled fast reactor (GFR) system design and safety, BNL has performed modeling and transient calculations with regard to passive decay heat removal under accident conditions. The analysis is for the design of the large 2400MW GFR in collaboration with CEA under an I-NERI with France. The analytical model includes the reactor, the power conversion units, the emergency cooling loop, and the guard containment. Passive decay heat removal is by natural circulation cooling and radiative heat transfer.

Advanced Fuel Cycle Initiative

- BNL is working on options for transmuting spent nuclear fuel in commercial light-water reactors (LWRs) to improve repository performance (e.g., minimize long-term toxicity and increase loading), with a focus on safety and licensing issues. Researchers considered homogeneous and mixed core configurations with conventional uranium-oxide, transuranic-mixed-oxide, and inert matrix fuels with various matrix materials.
- BNL developed, validated and exercised a scoping methodology to perform an initial screening of the neutronic, thermal-hydraulic, and transient performance of candidate transmutation fuel options in LWRs.
- BNL, ANL and General Atomics are evaluating the performance of a variant of the MHR (Modular Helium Reactor) to perform a “deep-burn” of transuranics in spent commercial nuclear fuel.

Space Reactor Technology Program

- BNL carried out an integrated neutronic-fluid dynamics-thermal analysis of a NERVA based Nuclear Thermal Propulsion (NTP) system. In addition, a less detailed analysis was carried out on a GE-710 based NTP system. Researchers estimated the criticality consequences of a launch accident involving surrounding and eventual immersion of a NERVA or GE-710 reactor in light water or sand, and suggested a possible remedy for the implied criticality related consequences.
- BNL also participated in planning and design meetings related to the NTP system effort. BNL prepared a report outlining the results of the preliminary analysis, and made suggestions regarding future activities on NTP.

C.3 National Nuclear Security Administration (NNSA, NA)

[NA-22] Development and Evaluation of Advanced Radiation Detectors

- BNL is developing high pressure xenon radiation detector arrays.
- BNL is evaluating various neutron detection technologies.

[NA-25, Office of International Material Protection & Cooperation]

Technical Survey Team (TST)

- TST met its objective of providing objective focused advice to the Assistant Deputy Administrator to support effective, consistent and efficient implementation of upgrades to reduce the risk of theft of nuclear materials from Russian sites by reviewing and preparing reports on sixty-three upgrade projects.
- TST provided in depth reviews of each project's Project Work Plan and Annex 1 at the beginning of the fiscal year.
- TST participated in two briefings concerning Second Line of Defense, Mega Port Upgrades and progress in implementing MPC&A upgrades for the Serial Production Enterprises.
- TST prepared an issue paper for NA-25 concerning the effect of increasing the Design Basis Threat definition for Russian sites; the impact it would have on the vulnerability analyses that were prepared for each site and; potential strategies for mitigating the increased risk.

Nuclear Noncompliance Verification

- BNL developed an international safeguards approach for a natural uranium conversion plant.
- BNL also assisted in the development of a remote monitoring system for safeguards application.

Additional Protocol Implementation in the USA

- Personnel trained the BNL site in Additional Protocol implementation, and are in the process of preparing BNL's draft Additional Protocol declaration.

Material Consolidation and Conversion (MCC) Program

- BNL staff continues to support the MCC monitoring program (2 trips per year).

Program of Technical Support for IAEA Safeguards (POTAS)

- BNL advised the IAEA on down blending of high-enriched uranium at the Ulba Fuel fabrication facility in Ust Kamenogorsk, Kazakhstan.

[NA-24I] Nuclear Noncompliance Verification Team

- BNL developed an IAEA safeguards approach based on unattended process monitoring instrumentation for natural uranium conversion plants.
- BNL supported testing of the safeguards approach and the required instrumentation at uranium processing facilities at Oak Ridge and at the Springfields Conversion Plant in the UK.
- BNL prepared analyses of technologies for uranium enrichment that will enable an (IAEA) inspector to estimate the separative capacity of an isotope separation facility based on observables obtained in IAEA special or complementary-access inspections.

International Radiological Threat Reduction Program (IRTR)

- A Certificate of Recognition was awarded by NNSA in appreciation of service provided by BNL staff in ensuring the security of the 2004 Summer Olympic games by securing Greek high-risk radioactive materials.
- NNSA received a letter of thanks and congratulations from the International Criminal Police Organization, Interpol, highlighting the efforts of the IRTR Team, with two BNL members, in the successful execution of the pilot phase of the Cooperative Radiological Instrument Transfer Project, making it an effective tool in international law enforcement.

[NA-25] Megaports

- BNL prepared for the NA 25 Megaports Initiative, "Response Protocols and Emergency Response Procedures at the Freeport Container Port, Freeport, Grand Bahama".

[NA-21] Global Radiological Threat Reduction

- BNL organized a "Roundtable Discussion on Radiological Threat Reduction Efforts in Moscow and NYC." The meeting was attended by US representatives from NNSA, DHS, and State.
- BNL developed a four-year Action Plan for the International Atomic Energy Agency's Office of Nuclear Security.

- BNL supported the Office of International Radiological Threat Reduction (NA-211) in the development of a Path Forward for establishing global priorities for securing high risk radioactive sources.
- BNL developed a Priority Plan of Action for the Emerging Threat and Gap Material program in the Office of Global Nuclear Threat Reduction..

[NA-25] Office of Material Consolidation and Civilian Sites

- BNL continues to play a major role in the Nuclear Materials Consolidation and Conversion (MCC) project. A BNL staff person is the lead for this project. A goal of the project is to reduce the number of sites and buildings that contain weapons-usable nuclear material in Russia and reduce the attractiveness of existing highly enriched uranium by downblending it to low enriched uranium.
- A BNL staff member is the MC&A lead for the project team for the Institute of Physics and Power Engineering. Most of the work for this project is focused on long-term sustainability.

[NA-25] Office of National Infrastructure and Sustainability

- A BNL staff member leads the MPC&A Education and Awareness project. Under this project, the team works with Russian sites to promote awareness of the importance of MPC&A and encourages management to allocate resources to MPC&A with the goal to sustain MPC&A systems long-term and decrease MPC&A incidents caused by “human factors.”
- A BNL staff member leads the MPC&A Operations Monitoring Project. Under this activity a system was designed, constructed and installed at MEPhI to monitor the upgraded MPC&A systems to ensure that they continue to be operated and effective. This project has grown significantly and MOM systems are installed at four other sites in Russia and will be soon installed in three more sites.
- BNL made substantial contributions under the MPC&A Regulatory Project in assisting Russian oversight agencies in the development of a regulatory framework for implementing the improved and more comprehensive nuclear materials safeguards.

[NA-25] Office of Weapons Material Protection

- BNL continues to be responsible for managing all of the contracting activities associated with the MPC&A upgrades at the Siberian Group of Chemical Enterprises (Tomsk-7), one of the largest and most complex Russian Nuclear enterprises. One BNL staff member is the deputy project lead.

- BNL staff continue to support MPC&A upgrade activities at the Mining and Chemical Combine (K-26) site and the All Russian Institute of Technical Physics (C-70).

[NA-242] Global Initiatives for Proliferation Prevention in Former Soviet Union (FSU) Countries

- BNL is participating in 25 active projects which support approximately 700 WMD scientists in FSU, and involve 25 CRADAs with U.S. companies.
- BNL completed a project in fuel waste processing that led to active sustainable business in Kazakhstan.
- BNL completed a project in heavy metal removal from process waste water that led to sale in Russia, testing at business sites in US, and a patent.
- BNL's IPP Projects led to over 22 publications and presentations in 2004.

C.4 Other National Laboratories

Princeton Plasma Physics Laboratory (PPPL)

- The Instrumentation Division's Gas & Liquid Detector Group provided PPPL with a large two-dimensional X-ray detector for measurements of Doppler shifted X-ray lines from fusion plasma in PPPL's National Spherical Torus Experiment (NSTX) and at the Textor Tokamak in Juelich, Germany. These on-going measurements have been very productive, and will form a solid basis for PPPL's lead role in managing ITER, the International Thermonuclear Experimental Reactor.

C.5 Work for Others (WFO) and Technology Transfer

The WFO program enables investigators at BNL to expand their research activity to include efforts of scientific interest consistent with and complementary to our DOE mission work and which contribute to sustaining the Lab's core research capabilities.

BNL's technology transfer program enables BNL to enhance our research capabilities and be a resource to U.S. industry, thereby enhancing U.S. competitiveness. Key components of the program are collaborative research projects with industry (CRADAs) and patent licensing.

C.5.1 WFO – Other Federal Agencies

C.5.1.1 National Institutes of Health

- Several of our biomedical programs and facilities operate with joint funding from DOE and NIH. These programs/facilities include our Center for Translational Neuroimaging which encompasses the PET and MRI programs in the Medical and Chemistry Departments, the Scanning Transmission Electron Microscope in the Biology Department, and the Structural Biology beamlines at the NSLS.
- About 1/3 of the users at the NSLS, from Brookhaven, other national laboratories, universities, and pharmaceutical companies use ten of the NSLS experimental stations to study biological structures using x-ray crystallography. Six of these stations are part of a cooperative effort, funded roughly equally by DOE BER and the National Center for Research Resources (NCRR) of NIH.
- Several important innovations have been made possible by the NCRR/BER collaborative effort: providing an on-site technical specialist to support users, 20 hours per day, seven days per week; providing personnel and facilities for a mail-in data collection service; and providing web-based observation of the experiment and the possibility for remote control.
- At present, BNL has more than three dozen active grant awards from NIH. 31 new research grant proposals were submitted by BNL to NIH in FY2005, along with three new National Research Service Award proposals.
- NIH funds the Regional NIDA Neuroimaging Center at the BNL PET Facility and provides substantial support for medical imaging research through grants to individual BNL investigators. Such grants support radiotracer R&D for nuclear medicine, and animal and clinical research at the neuroimaging center.
- NIH supports biomedical research relating to DNA damage and repair, protein structure and folding, viral proteases and receptors, and high resolution labels for electron microscopy.

Genetic Variation in Human NHEJ DNA Repair Genes

- BNL analyzed the *ARTIMUS* gene, including its 14 exons and 5'- and 3'-UTRs for polymorphisms (SNPs) in four established cell lines and 96 normal individuals. No coding SNPs were identified although SNPs were present in the promoter region. BNL also analyzed 21 radiation sensitive individuals for SNPs in 20 exons of *PRKDC* and sequence-length polymorphism in the 5' region of *KU80*. Animals deficient in these genes are sensitive to ionizing radiation; SNPs may result in radiation sensitivity or increased susceptibility to cancer.

Cryo-Electron Microscopy

- Using cryo-electron microscopy, the two-dimensional structure of PapC was solved. PapC is a membrane protein involved in the process by which *E. coli* infects human cells. This protein structure is a first step to better understand how an *E. coli* infection begins and may lead to information on how to block it.
- In collaboration with researchers at Lawrence Berkeley National Laboratory, the mechanism by which Epothilone A binds to tubulin was elucidated. EpoA is a next generation cancer treatment that avoids many of the problems associated with current chemotherapeutic agents. Cryo-electron microscopy was used to obtain an electron density map that showed the drug inside the protein density. Follow up computer modeling was used to determine a drug structure that fit the map.
- Mycobacterial tuberculosis (Mtb) has the remarkable ability to resist killing by human macrophages. The cryo-EM group studied the structures of two critical resistance-related gene products, the Mtb 20S proteasome and the Mpa. The work revealed a closed substrate entrance for the wild type Mtb proteasome, suggesting the requirement for an ATPase for entrance opening. Indeed, the Mpa was shown to possess ATPase activity and has a hexameric structure closely resembling that of known proteasomal ATPases in other systems. This study supports the new concept that Mtb has an enhanced and regulated proteolysis pathway that increases the ability to clear out proteins damaged from exposure to reactive nitric oxide from the macrophage.

Virus Infection and Protein Regulation

- The first molecular-scale images of DNA binding to an adenovirus enzyme were produced using a footprint technique. This binding step is essential for the virus to cause infection. If this interaction can be blocked it will prevent the virus from replicating.
- The crystal structures of two viral proteins were solved in a program aimed at developing new antiviral agents, against human adenovirus and the virus that causes SARS.
- Carbon nanotubes were successfully coated with the CAR protein, a receptor for the adenovirus Knob protein. With fluorescent antibodies against CAR, it was shown that the protein kept the correct conformation. This was confirmed by the fact that fluorescently labelled Knob protein bound to the CAR protein on the carbon nanotubes. These nanospheres will be studied in mice to assess potential applications for imaging and drug delivery.

Structural Genomix

- The New York Structural GenomiX Research Consortium was selected to be one of four large-scale centers for the next five-year phase of the Protein Structure Initiative of NIGMS. Development of methods and vectors for high-throughput protein production is partially supported through this center.
- 25 protein structures were solved this year as part of the BNL effort. All have been submitted to the Protein Data Bank.
- Auto-induction paper was published in the June issue of *Protein Expression and Purification*: F. W. Studier, Protein production by auto-induction in high-density shaking cultures. *Protein Expr. Purif.* 41: 207-234 (2005). Work was supported by both DOE-GTL and NIGMS-PSI and won an R&D 100 Award from R&D Magazine.

Aquaporins

- A report entitled " Selective metal binding to a membrane embedded aspartate in the Escherichia coli metal transporter YiiP (FieF)" was published in the *J. Biol. Chem.* The work contributes to our current understanding of how the metal transporters are built and how they work.
- The structure of a bacterial water-conducting channel was solved at 3.2 angstroms.
- A conformational trapping mechanism in the bacterial metal efflux pump YiiP was discovered.

DNA Damage Clusters

- BNL determined that human cells repair clustered damages very slowly, with most clusters persisting until DNA synthesis; found that clustered damages are partially processed to intermediate clusters, and then these clusters are very slowly resolved. BNL discovered that in repair-proficient human cells, few if any clusters are converted to double strand breaks during cluster processing. This research addresses the basics of repair of complex DNA damages, formed even at low radiation doses, are import to DOE in understanding the effects of low radiation doses.

C.5.1.2 National Aeronautics and Space Agency (NASA)

- NASA funds the operation of the NASA Space Radiation Laboratory (NSRL) in the Collider-Accelerator Department, representing DOE's partnership with NASA to provide extraordinary facilities and capabilities for research on issues related to the NASA mission. The NSRL takes advantage of heavy-ion beams from the Booster for studies on radiation effects related to the space program.

- NASA provides support for space radiation health research through grants to individual BNL scientists. Investigations are directed to genetic effects of high energy ions on DNA and brain cell damage due to heavy ions.
- Eleven new research grant proposals have been submitted by BNL in response to NASA program announcements in the current fiscal year. In addition, NASA has issued several new contracts in FY2005 for advisory services or feasibility studies involving BNL's Instrumentation Division, EENS Directorate and EST Department.
- The NASA Space Radiation Laboratory facility supplied a host of beams from protons to Fe and Ti. The rapid context switching between proton and ion irradiations was successfully accomplished. The digital beam imaging system was successfully brought online. All approved experiments received their allocated integrated beam intensity with the requisite beam spatial distribution. The NSRL operation was reviewed by a NASA review team and was found to be outstanding. Beam was also successfully delivered by the AGS for a NASA supported physics experiment.
- Researchers found that charged particles from protons to Fe induce neoplastic transformation of human primary skin fibroblasts.
- Research showed that cells exposed to high energy protons then within a short time to a single Fe ion hit experience higher transformation rates than would be expected from the sum of the two radiations separately. This research also investigates the effects of low doses of radiation—in fact, single hits by the particles or low doses of photons—that are of concern to the DOE Low Dose program. As a standard of comparison, in companion studies to those of the effects of space radiation on human cells, the effects of gamma or X-rays are investigated. The biological impacts of this radiation at low doses are important to DOE.

C.5.1.3 Environmental Protection Agency (EPA)

- BNL has played a major role in a demonstration project in the NY/NJ harbors to identify sediment decontamination technology.
- BNL supports of the Arctic Military Environmental Cooperation Program (AMEC) in the Russian Arctic to address environmental concerns with toxic and hazardous waste generated by Russian military activities and especially wastes generated as a result of dismantlement of nuclear submarines from the Russian Navy under the START Agreement.
- BNL provides technical assistance on the organization of international symposia to advance the capacity and knowledge of the Taiwan government and other non-government stakeholders in Greenhouse Gas mitigation.

C.5.1.4 Department of Defense (DOD)

- DOD supports diversified R&D at BNL through Program 40 funding and through grants. In both instances, the projects are often in support of Homeland Security.
- Program 40 funds support investigations in six different research Departments directed to shipboard accurate Doppler profiles, raman lidar spectroscopy, and special nuclear materials signature studies.
- Program 40 funds also support the operation of the BNL Radiation Detector Testing and Evaluation Center (RADTEC).
- Grant funding supports biotechnology R&D related to structural and molecular biology studies of toxins.
- BNL contributed a chapter on the structures of botulinum toxin in a book titled 'Treatments from Toxins' by CRC publications.
- Researchers identified two ganglioside binding sites in tetanus toxin. While one is common to botulinum toxins, the other is unique for tetanus. The second unique site also binds a tri-peptide which suggests that this peptide could be used as an inhibitor for tetanus, at least.
- Researchers determined the structure of the C fragment of botulinum neurotoxin type B.
- BNL's Source Development Lab (SDL) has received \$1M in the current fiscal year (with an additional \$1M anticipated in FY2006) to execute cutting-edge experiments essential to realizing a high average power free electron laser for military applications.

C.5.1.5 Department of State (DOS)

- DOS supports the International Safeguards Project Office (ISPO) at BNL. ISPO is responsible for the day-to-day technical and administrative management of the U.S. Support Program to IAEA Safeguards (USSP) at the behest of the Subgroup on Safeguards Technical Support (SSTS). The ISPO Brookhaven Office is the primary point of contact with the SSTS and U.S. contractors.

C.5.1.6 Naval Research Laboratory (NRL)

Integrated Circuit Development for X-ray Source-Based Navigation for Autonomous Position Determination (XNAV)

- BNL was awarded a subcontract to develop front-end electronics and ASIC for an X-ray Autonomous Navigation system (XNAV) sponsored by DARPA.

C.5.1.7 National Science Foundation (NSF)

- The C-AD completed a conceptual design and cost and schedule estimate for the AGS aspects of RSVP. An external NSF appointed review team found the design, cost and schedule to be correct.

C.5.2 WFO – Non-Federal Agencies

C.5.2.1 Private Firms

- The utilities fund work at BNL in the energy sciences field related to pipeline leak detection, and new materials for insulating storage facilities.
- Biotechnology companies such as Structural Genomix support R&D at BNL related to structural biology and protein structure determination.
- Defense contractors, such as ITT, support work related to raman lidar spectroscopy.

C.5.2.2 Non-Profit Organizations/Institutions

- The National Space Biomedical Research Institute (NSBRI) is a non-profit institution funded by NASA that supports the majority of research conducted by BNL at the NSRL. Studies, conducted by three research departments, address effects of deep space radiation on human stem cells, CNS damage and countermeasures, and microbeam detectors.
- BNL found that melatonin has no effect on cell survival but strikingly protects against neoplastic transformation of primary human skin cells. This may provide a countermeasure to potentially-oncogenic space radiation damage.
- BNL showed that primary human hematopoietic stem and progenitor cells repair complex damages induced by space radiation more slowly than those damages induced by X-rays. This research deals with low doses of radiation, and the data obtained on DNA damage and cellular responses to that damage may also provide useful input to the DOE Low Dose program.
- Non-profit R&D institutions, such as the National Oilheat Research Alliance and the Energy Research Center, which support R&D in the energy sector, fund work at BNL related to fuel oil burner design, low-sulfur fuels, and maximizing fuel performance.
- The Electric Power Research Institute (EPRI) funds work relating to power reactor control room improvements.

- The largest segment of our work for non-profit organizations/institutions is for hospitals and biomedical research institutions. These studies, funded by sponsors such as the Multiple Sclerosis Society, NYU Medical Center, the University of Medicine and Dentistry of New Jersey, and St. Luke's Roosevelt Hospital, utilize BNL's capabilities in PET and MRI and molecular biology. Investigators are directed to MS lesion development, Alzheimer's disease, leukotoxin production and neutron activation.

C.5.2.3 Universities

- BNL's atmospheric chemistry group is involved in a research program with the University of Minnesota involving CO₂ studies at a FACE facility.
- The University of Rochester, with funding from NSF, supports a major U. S. Atlas program in the Physics Department.
- Stony Brook University supports research at BNL in energy modeling.
- The University of Delaware supports work relating to the precipitation and sequestration of metals in soil.

C.5.2.4 State Agencies

- The Laboratory's funding from state agencies comes from the New York State Energy Research and Development Authority (NYSERDA). Current work for NYSERDA is directed to improving electric efficiency in heating equipment, heating with low sulfur oil, and efficient oil burners.

C.5.2.5 Foreign Sponsors

- BNL's expertise in conducting risk-assessment studies and other work for the Nuclear Regulatory Commission has resulted in a significant amount of foreign sponsored research, for which we perform similar studies at foreign nuclear power plants. BNL conducts such work for NATO and for sponsors in Sweden, Spain and Austria.
- The Australian Nuclear Science and Technology Organization, recognizing the unique capabilities in BNL's Instrumentation Division, is funding BNL to design and construct an advanced neutron detector for their new research reactor. The Instrumentation Division's Gas & Liquid Detector group has continued construction of 120° thermal neutron detector for the Australian Nuclear Science and Technology Organization. Personnel from ANSTO have visited BNL twice during FY2005, and found the work progressing very well, both in quality and according to time schedule. ANSTO has adopted the Instrumentation-designed read-out card as a standard for several of their new ANSTO instruments.

- BNL completed construction and testing of both magnets for the Beijing Electron Positron Collider (BEPC II) IR Quadrupoles Program Construction on time and within budget. Performance specifications and objectives have been met or exceeded.
- BNL completed testing of a rapid cycling magnet - successfully ramped 8 cm aperture dipole at the rate of several Tesla per second while maintaining field quality for the Gesellschaft für Schwerionenforschung (GSI) (Institute for Heavy Ion Research, Darmstadt, Germany) Rapid Cycling Magnet Program.

C.5.3 Technology Transfer

C.5.3.1 Intellectual Property

- The Laboratory's intellectual property protection program continues to be effective. The Office of Intellectual Property and Sponsored Research (OIP) received 27 invention disclosures in FY2004 and 28 through July 2005; OIP filed 17 U.S. patent applications in FY2004 and 18 through July 2005, and BSA received 13 U.S. patents in FY2004 and 9 through July 2005.
- Inventions arising from BNL's biotechnology research programs continue to be of particular licensing interest to industry. Technologies related to medical imaging, radiopharmaceuticals, nuclear medicine, molecular genetics, genomics, structural biology, and protein engineering are licensed to industry.
- Technology based on the T7 gene expression system continues to evolve with new commercial licenses granted. In FY2004 over 44 new licenses were granted covering the T7 technology.
- Not counting the T7 technology the Laboratory entered into 10 new licenses in FY2004. There are over 160 technologies in BSA's Patent Licensing Portfolio; 59% of these technologies are licensed to industry; and 25 of the technologies licensed by the Laboratory are the basis for new products on the market.
- The net revenue generated by the licensing program available for re-investment in the Laboratory's research programs has risen from \$1.1M in FY2001 to \$1.6M in FY2004 and is expected to exceed \$2M in FY2005. The licensing program continues to be very cost effective, with the costs of patent prosecution, patent maintenance, and licensing being 23% of the gross revenue in FY2004.

C.5.3.2 CRADA Program

- BNL's participation in CRADAs is being funded from two sources: DOE's Initiative for Proliferation Prevention Program for the Newly Independent States of the former Soviet Union (IPP-NIS); and, industrial partners who fully fund BNL's CRADA research activities.
- The IPP-NIS program supports research partnerships which take advantage of the research capabilities of established scientific institutions in the NIS and the commercialization expertise of U.S. industry. DOE supports the research conducted by BNL and the NIS institute. BNL is currently a participant in twenty-three IPP-NIS CRADAs.
- The Laboratory receives funding from industry to support research collaborations. BNL is currently involved in 22 industry funded CRADA's; for example BNL is working with Dow to create environmentally beneficial agricultural plants with applications for human health and nutrition and with Johnson & Johnson on development of new radiotracers.
- BNL is working with eV Products on the development of a Peak Detector/Derandomizer ASIC for Multi-Sensor Signal Processing. BNL has developed a high-speed, 64-channel ASIC. This chip will be used in high-throughput industrial and security scanners based on CdZnTe detectors.
- BNL is also working with eV Products on the development of Signal Processing ASIC for Coplanar Grid CdZnTe detectors and demonstrated a novel feature: timing acquisition from grid signal without use of cathode information.
- BNL is working on development of a 32-channel CMOS low-noise ASIC readout chip for Nuclear Medicine for Digirad, Inc., for use in a compact gamma camera for nuclear medical imaging product.
- BNL participated in early discussions with B-K medical on a nuclear detector and readout ASIC for multimode probe for prostate cancer diagnosis.
- BNL installed a new Long Trace Profiler (LTP V) at the Swiss Light Source in collaboration with CRADA partner Ocean Optics, Inc. Preliminary test results indicate accuracy at the 100nrad level is achievable.

**BSA FY 2005 SELF-EVALUATION
CRITICAL OUTCOME 2 PERFORMANCE**

App. B #	TITLE	WEIGHTING	BSA RATING	BSA SCORE
2.0	Environmental Management	8%	<i>Outstanding</i>	3.9
2.1	Execution of Program Activities	100%	<i>Outstanding</i>	3.9
2.1.1	Project Completions and Other Key Milestones	100%	<i>Outstanding</i>	3.9

Summary Level Assessment
FY2005 Critical Outcome 2.0 Performance

Performance Summary

During FY2005, Brookhaven Science Associates (BSA) met the criteria set forth in Critical Outcome 2.0 to qualify for the recovery of 100% of the available fee. BSA's adjectival rating for its FY2005 Critical Outcome 2.0 performance is Outstanding (Numerical Rating: 3.9), as supported by the summary-level assessment of its performance provided herein.

EM Work Completion

During FY2005, all 16 Critical Outcome work packages were completed in accordance with the Environmental Management (EM) Performance Baseline completion criteria. BSA also planned and implemented a comprehensive and first-of-a-kind transition plan that guided Brookhaven cleanup from the construction phase into long-term surveillance and maintenance in a highly organized and controlled manner. In completing this work and as an additional noteworthy performance highlight, BSA emerged as a Department of Energy (DOE) complex leader having successfully let and managed two contracts with DOE ID/IQ contractors.

This high standard of performance satisfied all nine DOE Gold Chart completion milestones.

Additional Work and Out-year Project Accelerations

The scope of BSA's FY2005 work included the construction of a Strontium-90 ground water treatment system (started in FY2004) and the removal of the BGRR fuel canal. These projects were included in the Baseline, but only as a measure of contingency. Both were started on a fast track and successfully completed during FY2005.

BSA successfully completed the decontamination and dismantlement of the Building 650 hoppers. This additional work package was assigned to BSA by the DOE well after the start of FY2005. Even with this late start, BSA successfully completed the project by the end of the fiscal year and satisfied an additional FY2005 DOE Gold Chart milestone.

Two key out-year reactor decommissioning tasks were accelerated into FY2005 by BSA and are summarized as follows:

- BSA aggressively managed and coordinated Core Team work activities during FY2005. By the end of the fiscal year, the Core Team was close to reaching a consensus for the HFBR end state. BSA's efforts and results have the DOE well positioned to obtain a final CERCLA decision for the HFBR during the first half of calendar year 2006.

- BSA successfully launched preliminary BGRR planning activities. A waste characterization plan was developed and implemented during FY2005. This work has yielded valuable data that will be used to formulate a successful waste disposal strategy for the BGRR pile removal project. BSA developed a performance-based pile removal specification, and conducted an innovative workshop to stimulate market place interest in the BGRR pile removal project. BSA received excellent feedback from the ID/IQ contractors that participated in the event.

These task accelerations have the DOE well positioned to make meaningful FY2006 progress with both of the reactor decommissioning projects.

Project Safety

BSA completed a substantial campaign of high-risk work in the field during FY2005 without a single lost work injury. In fact, over the last four and one-half years, there have been only two lost work injuries in connection with BSA's EM work activities. Nonetheless, BSA agrees with BHSO's assertion that there is room for improvement in nuclear facility and rail transportation safety and BSA has proactively taken steps to ensure that future work is completed on an event-free basis. BSA actions include the following:

- BSA has assembled a team of subject matter experts from across the Laboratory to evaluate all of the past events associated with rail operations at BNL dating back to September 2002. The team is in the process of separately analyzing each event, re-determining root causes where applicable, identifying process improvements, and performing corrective actions. This is being accomplished pursuant to a Type R ORPS report that was initiated by BSA as a management concern.
- BSA has also identified the need for improved compliance with the administrative controls included in the former hazardous waste management facility and High Flux Beam Reactor Safety Evaluation Reports. BSA has performed in-depth critiques of the two events and has identified the causes and appropriate corrective actions. BSA has developed a comprehensive plan to insure that all future work is performed within the controls and limits of the approved safety documentation. Again, this work is also being performed pursuant to an ORPS report that was initiated by BSA as a management concern.

CERCLA Final Decisions

As a result of, and under BSA's coordination, the DOE and the Interagency Agreement (IAG) regulators approved the final remaining four CERCLA decisions during FY2005 in concert with the aggressive Brookhaven cleanup schedule. Final Records of Decision were signed for the BGRR and Peconic River, and cleanup decisions for Strontium-90 groundwater cleanup and the Magothy aquifer were effectuated by way of an IAG-approved Explanation of Significant Difference.

Cost Performance

BSA completed the FY2005 work within the DOE funding profile. It is noteworthy that BSA completed the FY2005 EM completion mission including what was known as the “Revision 6 Baseline” scope for \$22M less than what was initially included in earlier DOE funding profiles for this work.

Even under the aggressive Revision 6 Baseline cost plan, BSA’s raw Cost Performance Index (CPI) during FY2005 was 0.97. The raw CPI does not take into account significant conditions and changes that impacted ACWP for which Baseline Change Proposals were not initiated and processed. The most significant of these are summarized as follows:

- Over 4,000 yards of contaminated soil in excess of Baseline quantities were excavated and disposed of in connection with three work packages. This translates to approximately \$2M in additional ACWP. This was absorbed in the FY2005 performance metrics as a cost variance.
- An FY2003 Davis-Bacon determination made by DOE-Chicago for the Brookhaven cleanup projects was inconsistent with BSA’s wage rate assumptions made in several work packages. The consolidated FY2005 cost impact of this change is approximately \$1M for FY2005.

With these two impacts alone, the evaluated CPI for FY2005 was 1.05. There were numerous other changes that would have further increased the evaluated CPI for the fiscal year.

Schedule Performance

During FY2005, BSA completed all of the remaining 16 work packages included in the original EM scope at Brookhaven. This capped BSA’s successful two-year acceleration of the completion of this work that was launched during FY2001. BSA’s raw FY2005 Schedule Performance Index was 1.07.

**BSA FY 2005 SELF-EVALUATION
CRITICAL OUTCOME 3 PERFORMANCE**

App. B #	TITLE	WEIGHTING	BSA RATING	BSA SCORE
3.0	Laboratory Management and Operations	32%	<i>Excellent</i>	3.28
3.1	Corporate Leadership	25%	<i>Outstanding</i>	3.66
3.1.1	Strategic Partnerships	30%	<i>Excellent</i>	3.3
3.1.2	Laboratory Leadership	65%	<i>Outstanding</i>	3.8
3.1.3	Diversity	5%	<i>Outstanding</i>	4.0
3.2	Business Processes	17%	<i>Excellent</i>	3.06
3.2.1	Phase IV of Benchmarking Study	53%	<i>Outstanding</i>	4.0
3.2.2	Cyber Security	35%	<i>Good</i>	1.8
3.2.3	Procurement Operations	12%	<i>Excellent</i>	2.6
3.3	Management System Planning, Assessment and Improvement	20%	<i>Excellent</i>	3.04
3.3.1	Management System Maturity Determinations	20%	<i>Outstanding</i>	3.8
3.3.2	Third Party Assessment of Program	80%	<i>Excellent</i>	2.85
3.4	Improved ESH&Q – Operations Services	15%	<i>Good</i>	2.5
3.4.1	OSHA Reportable Injury Management	100%	<i>Good</i>	2.5
3.4.1.1	Days Away, Restricted, or Transferred Rate	50%	<i>Good</i>	2.5
3.4.1.2	Total Reportable Case Rate	50%	<i>Good</i>	2.5
3.5	Site Infrastructure, Facilities and Operations and Security	13%	<i>Outstanding</i>	3.51
3.5.1	Alternative Financing (AF)	14%	<i>Excellent</i>	3.0
3.5.1.1	BNL Housing Reconstruction Project (HRP)	100%	<i>Excellent</i>	3.0
3.5.2	Project Management	23%	<i>Excellent</i>	2.6
3.5.3	Maintenance Investment Index (MII)	23%	<i>Outstanding</i>	4.0
3.5.4	Energy Contract	34%	<i>Outstanding</i>	4.0
3.5.5	Infrastructure Reliability (RI)	6%	<i>Outstanding</i>	3.6
3.6	Communications and Trust	10%	<i>Outstanding</i>	4.0
3.6.1	Community, Education, Government and Public Affairs Management	100%	<i>Outstanding</i>	4.0
3.6.1.1	Promoting Scientific Initiatives, Accomplishments and Operations Priorities	40%	<i>Outstanding</i>	4.0
3.6.1.2	Measure 3.6.1.2 Expanding Partnership Opportunities	30%	<i>Outstanding</i>	4.0
3.6.1.3	Internal Communications and Involvement	30%	<i>Outstanding</i>	4.0

3.0 - Laboratory Management and Operations

Excellent: 3.28

Summary of Critical Outcome

BSA will manage and enhance operations and management processes to provide an effective and efficient work environment that enables the execution of the BNL Mission in a manner responsive to customer and stakeholder expectations.

Overall performance under this Critical Outcome was *Excellent (Score = 3.28)* for FY2005. BNL's performance is highlighted by *Outstanding* efforts in Communications and Trust, Corporate Leadership, and Site Infrastructure, Facilities and Operations. This section also reports *Excellent* performance in Business Processes, Management System Planning, Assessment and Improvement , and Improved ESH&Q – Operations Services.

Specific information regarding performance is provided on the following pages as both summaries of Performance Objectives and details of individual Performance Measures.

Summary of Performance Objective

The BSA partners will provide demonstrable value to ongoing Laboratory operations by providing leadership and management direction to resolve challenges, solve problems, and attract external resources that complement and build upon the BNL mission.

Strategic Partnerships

BSA has established partnerships or programs resulting in sponsorship or enhanced financing to support research programs. BSA and Stony Brook University (SBU) completed and implemented an MOU for use of SBU's Institutional Review Boards. BNL became a satellite facility of SBU's General Clinical Research Center and secured approval of 41 investigator-initiated human subject protocols. BSA also secured financial support from NSF for an upgrade of the PHENIX detector at RHIC. Battelle sponsored the development of the Battelle Nanotechnology Alliance and initiated two CRADAs with BNL. Battelle also developed a partnership with BNL and ORNL to focus on New York State energy partnerships. The proposed Long Island Energy Technology Center (a joint initiative among SBU, BNL, and Keyspan) would pursue the study of renewable energy sources, hydrogen and conventional fuels.

Corporate Leadership

BSA conducted a peer review of procurement at BNL and developed a plan of action preparing BNL for the PERT review. BSA also reviewed BNL's self-assessment process to address variances between BNL and DOE's annual evaluations. BNL also participated in the Battelle Laboratory Operations Council comparing approaches to performance improvement and to adopt elements of Battelle Safety Leadership program. BSA also provided financial and other incentives to assist BNL in identifying/hiring and retaining key managers. The BSA partners continue to commit 45% of all fees received to Laboratory initiatives to enhance Laboratory viability and performance. Initiatives include: Goldhaber Fellowships, BSA Distinguished Scientist Fund, conference support, community support for science education, and staff fitness and wellness plans.

Diversity

BNL Policy Council members agreed to adopt a Diversity Engagement Practices checklist as an accountability tool for diversity that will be linked to managers' performance appraisals. BNL developed a diversity strategy as defined in BNL's Annual Diversity Plan. The Diversity Office aligned BNL recruitment activity with HR to focus on S&T strategic goals and to maximize exposure to opportunities in science and operations. Managers provided the names and contact information for potential candidates to the Diversity Office who pursued these leads resulting in hiring of minority candidates. BNL initiated pilot training programs on diversity education awareness.

MEASURE 3.1.1 Strategic Partnerships

Excellent: 3.3

Summary of Performance Measure

BSA will endeavor to establish partnerships or programs that result in sponsorship or enhanced financing from non-DOE entities to support research programs.

Specific Status of Metric

General Clinical Research Center (GCRC)

- Completion of MOU and Workflow Plan between BSA and SBU for use of SBU's Institutional Review Boards (IRBs).
- Appointed 3 former BNL IRB members to the SBU IRBs; 3 additional were appointed in July.

- SBU's IRBs commenced review of human subject applications from BNL.
- Since the BNL clinical research center became a satellite facility of SBU general clinical center (GCRC), 41 investigator-initiated human protocols from BNL were approved by the general advisory council (GAC) of the GCRC. Most of these projects are funded by NIH and DOE.
- In the past year, 688 subjects participated in research protocols at BNL and 11 subjects from the west coast and local area were admitted to the SBU GCRC for overnight observation and care.

Performance Metric

Outstanding	Consistent with the strategic agenda for the Laboratory, identify and implement a select few top priority actions necessary to support critical elements of the strategic agenda and deliver new substantial partnerships or programs for enhanced non-DOE funding at BNL in accordance therewith.
Excellent	Consistent with the strategic agenda for the Laboratory, identify a select few top priority actions necessary to support critical elements of the agenda and deliver confirmation of emerging partnerships with non-DOE entities that have the potential to sponsor substantial research programs/activities at BNL.
Good	Consistent with the strategic agenda for the Laboratory, identify a select few top priority actions necessary to support critical elements of the agenda and take actions identifying further substantial partnerships or programs for enhanced non-DOE funding at BNL in accordance therewith.
Marginal	Failure to implement priority actions from strategic agenda and take actions at the Corporate level to initiate substantial partnerships or programs for enhanced non-DOE funding at BNL.
Unsatisfactory	Failure to prioritize and take actions at the corporate level to initiate substantial partnerships or programs for enhanced non-DOE funding at BNL.

Specific Status of Metric (cont.)

General Clinical Research Center (GCRC) (cont.)

- With this joint venture, two protocols (i.e. study of autism) from SBU investigators were approved to perform imaging studies at BNL in the past year.
- Projects were initiated to perform human studies using PET and functional MRI at BNL by the investigators of the departments of anesthesiology, medicine and pharmacology.

NSF Support for Upgrade of PHENIX at RHIC

- There are 2 proposals to NSF for detector upgrades for the PHENIX experiment.
- NSF MRI proposal headed by SBU, secured a promise of \$57K for infrastructure from the Office of the Vice President for Research at SBU and received notification from NSF of recommendation of full proposal funding for \$250K.
- SBU MRI proposal is for the acquisition of a Hadron Blind Detector (HBD) to be used in the PHENIX Experiment at the RHIC.
- The HBD will allow measurement of the temperature of the Quark Gluon Plasma produced in heavy ion collisions at RHIC by detecting electrons and positrons from virtual photons radiated by the plasma. The HBD will directly measure and reject the otherwise overwhelming background of electrons and positrons from unstable hadron decays. The HBD utilizes novel technology: CsI photocathodes evaporated onto GEM (Gas Electron Multiplier) detectors to detect Cherenkov photons radiated by electrons traversing the detector.
- The conceptual design of this detector was done at SBU, prototyping and detector design by our collaborators at the Weizmann Institute and at BNL.

Three institutions plus the University of Tokyo will build the detector. Weizmann Institute will build the mechanics and procure the GEM planes; evaporation of the CsI and assembly of the detector will be done at SBU; and integration, testing and monitoring will be done at BNL. The work at SBU and BNL will be done collaboratively by people from BNL and SBU, assisted by our collaborators from Israel and Japan.

IBM SUR Award

- SBU has received a \$750M Shared University Research (SUR) award from IBM
- The award consists of a pSeries supercomputer located at BNL, and a visualization engine, which will be used to support research in parallel computing, structural biology, nanomaterials, bioinformatics and studies.
- This machine will be used by BNL, SBU and CSHL researchers as well as the PIs behind the proposal, many of whom are from BNL.

Neuroimaging Program

- Two proposals, one to HHMI, the other to the Coulter Foundation, are to create a world-class Bioimaging Institute on Long Island by merging the unique research facilities and scientific expertise of BNL with the power of SBU in education and in basic and translational research.
- Bioimaging Institute synthesizes the full spectrum of physical resources and intellectual capital available at both institutions to meet challenges in imaging from the high-resolution structure of complex biomolecules to the intricate real-time function of the human brain.
- Bridging the BNL and SBU campuses, the Institute will forge the frontier of bioimaging science to discover, develop, translate, validate and commercialize technologies that will lead to new diagnostics, therapeutics and medical devices.

MEASURE 3.1.1 Strategic Partnerships (cont.)

Excellent: 3.3

Specific Status of Metric (cont.)

Neuroimaging Program (cont.)

- The initiative is intended to build on that tradition of excellence to define opportunities in biomedicine and lead the world in pioneering bioscience in the new millennium.
- Both BNL and SBU are recognized as world leaders in the formulation and application of bioimaging modalities, including Magnetic Resonance Imaging (MRI), Positron Emission Tomography (PET), Micro-Computed Tomography (mCT) and the imaging capacity of the National Synchrotron Light Source (NSLS).
- The two institutions have agreed to make key joint appointments in order to build the center activity to a point where it can hope to garner NIH center of excellence status. Since these carry tenure-track status at SBU, this is a significant long-term obligation and commitment.
- SBU submitted the proposal to the Coulter Foundation translational research partnerships program on 6/1. The proposal made it through the full proposal stage and a site visit took place on 7/21- 7/22.

MRSEC in Thermal Spray

- BNL participation in the SBU MRSEC on Thermal Spray includes collaboration of BNL/SBU scientists in the synthesis/characterization of novel magnetic materials, magnetic caloric oxides and MgB₂ superconductors; and the writing of several important publications as a result. Joint SBU/BNL activity ranges from collaborative research to a project to produce MgB₂ powders with the company Specialty Materials (now an SBIR phase II proposal to DOE) to the development of a unique capability in Induction Plasma Synthesis (an MRSEC Seed).
- After 10 years, funding for the MRSEC was not renewed despite persuasive science and large matching commitments from the contributing institutions. New collaborative ventures arising from this effort are planned.

Nanotechnology Alliance targeted on building external partnerships in nanomaterials:

- Battelle has sponsored the development of the Battelle Nanotechnology Alliance - a cross-DOE Laboratory effort to develop a portfolio of innovations/capabilities toward sustained industry/government partnerships in nanoscience and nanotechnology.
 - Battelle financially supported the participation of BNL staff in a mission to China, and in workshop discussions with Boeing Aerospace, the largest US manufacturer of commercial aircraft.
- As a result of these activities, the Battelle Nanotechnology Alliance initiated a Memorandum of Understanding with Boeing Aerospace to develop functional nano-composites for the next generation of Boeing commercial aircraft. The MOU is a multi-year agreement to work with Boeing and its suppliers to develop a new class of materials for the aircraft. The plan will put BNL in a position of partnership with Battelle's Laboratories and Boeing's Tier I suppliers in the development of a new class of composite materials.
- Examples of progress with BNL include: the start of 2 CRADAs with Battelle, one in fuel cells and the other in carbon nanotube synthesis; targeting areas of interest for the USAF (electronic coatings), Boeing (conductive nanomaterials/coatings) and the Bill Gates Foundation (advanced imaging technology for cancer studies). (Over \$200K in Battelle funding)
- Development of white papers with DARPA and commercial interests with a goal of \$5M in Business Volume in FY2006.

Specific Status of Metric (cont.)

State Energy Partnerships

- Building on the complementary skills in energy conservation programs at ORNL and BNL, Battelle has developed a partnership with these labs to pursue state energy partnerships in energy R&D.
 - Initial efforts are focused on the New York State Energy Research and Development Administration (NYSERDA) program, with the goal of developing both near term projects and a longer term R&D partnership to augment the application of the technology base developed for and by DOE.
 - The second phase will target the California Energy Commission, the other major state energy program.
- The effort to build BNL's energy research portfolio has been augmented by SBU's initiative to secure NY State funding for a LI energy center. Initial feedback from Albany has been positive.
- This joint initiative among SBU, BNL, LIPA, NYSERDA, Keyspan, other universities and numerous industrial partners will establish a Center to study renewable energy sources, hydrogen and conventional fuels.
 - Collaborations with the SUNY Albany nanofabrication facility and SBU Marine Sciences Research Center will explore the harnessing of power using regional natural resources.
 - Work between SBU and BNL focused on biomass generation of hydrogen processing, high power density miniaturized fuel cells, biomimetic fuel cells, self assembled nanostructures for ultra high capacity hydrogen storage, superconducting low power transmission lines and computer visualization programs to monitor the safety and ensure the reliability and efficiency of the energy transmission.

- Distribution systems will also be a key element of this Center.
- The design of smart materials, catalysts, and membranes that will allow more efficient harnessing of their energy with reduced pollutants will be of primary importance. Extensive research in these areas, in partnerships with international oil companies (Conoco, Exxon/Mobil), are already in progress at SBU and BNL.
- Long Island Energy Technology Center
These efforts will be further coordinated by the Center and integrated with other research in conservation, power transmission and environmental remediation.
- In addition to providing joint research opportunities for BNL scientists, this center will:
 - Nurture BNL's relationship with NY State government
 - Expand the outreach of BNL to business and industry; enhancing Tech Transfer opportunities.
 - Provide BNL the opportunity to develop a leadership role in addressing the energy needs of the local area.

Promoting New Collaborations In Research

- SBU/BNL Multi-Teraflap Conference: This collaborative conference among BNL, SBU and IBM held on 9/12/05 brought over 80 participants to SBU's campus to discuss how the advances in computing capability will impact computational biology, computational materials science at the nanoscale and modeling materials for advanced energy devices. In addition to speakers from the three organizing institutions, ORNL, RPI, HHMI; NYU, Columbia and Cornell delivered presentations.
- SBU-BSB/BNL Symposium: This symposium among SBU's Biochemistry and Structural Biology Department and scientists at BNL promoted research interactions between the institutions and allowed BNL scientists the opportunity to establish new collaborations with SBU faculty and students.

Management Focus in FY2006

- Develop NY State support for NSLS II
- Work with NY State executive and legislative branches, NYPA, ESDC, LIPA, and Keyspan to establish competitive and regularized energy rates for BNL.
- Nurture existing and newly formed partnerships to ensure success, including:
 - NSF support for PHENIX Upgrade at RHIC.
 - Continue efforts to build the Bioimaging Institute on LI.
- Nanotechnology Alliances:
 - BSA Partners are actively developing a concept for a nano-photonics center to be funded by NYS at BNL. As an augmentation to the CFN, this effort would be a major research facility to be developed for industry participation with seed NYS funding. This is a preliminary concept, but has been recognized by the DOE SC leadership as a key effort to build NYS support for a major focal point in BES research that would complement and augment BES funding at BNL.
- State Energy Partnerships:
 - Development of the LI Energy Technology Center

MEASURE 3.1.2 Laboratory Leadership

Outstanding: 3.8

Summary of Performance Measure

BSA will demonstrate active corporate involvement in seven defined activities.

Specific Status of Metric

1. Corporate management assessments

- BSA has conducted a peer review of the procurement systems at BNL and developed a critique of critical issues and a plan of action for correcting deficiencies in time for the PERT review of September 2005.
- BSA has conducted a review of BNL safety performance and critical actions required to improve overall safety performance.
- BSA has conducted an assessment of third party financing options for the user housing at the Laboratory and has developed a joint effort with ORNL and PNNL to achieve approval of the plan for 3rd party financing of the housing facilities at BNL.
- BSA has conducted an audit of the CD-0 documentation for the approval of the NSLS II mission requirement and corrected deficiencies in the requirements definition.
- BSA has completed an assessment of the self assessment process to determine the variance between Lab self assessment and BHSO's assessment.

2. Facilitate exchange of ideas and practices

- BNL has participated in three sessions of the Battelle Laboratory Operations Council, a joint effort with ORNL, PNNL, NREL and BCL to compare approaches to performance improvement. Two key topics transferred to BNL have been the Battelle corporate assurance process framework (from PNNL) and the Battelle Safety Leadership program framework. The latter has resulted in the adoption of the Dupont Safety Training Observation Program (STOP) and the Safety leadership training for the BNL Policy Council in the 3rd quarter.
- Through the efforts and contacts of SBU's Office of Governmental Relations and Provost/VP of Brookhaven Affairs, meetings were secured in the offices of Governor Pataki, Assemblywoman Patricia Acampora and Senator Kenneth LaValle to discuss the ending of the contract for low-cost New York Power Authority (NYPA) electrical energy to Brookhaven National Laboratory (BNL). LIPA and ESDC were also involved. These talks began prior to the end of the contract, alerting these officials to the importance of the science conducted at BNL and the economic impact the Lab has on the region and the State. The result was a renewal of the NYPA contract for a 3-year term. This contract preserved important transmission-related benefits estimated at \$3-5m per year, and included a direct subsidy from NY State of \$4.7M per year. The total economic benefit to BNL over the 3-year contract term is estimated at over \$27M relative to the market cost of power on LI. This was an outstanding achievement within the deregulated NY State electric market. It also served to remind the State officials of the importance of BNL to NY State and LI. Unfortunately, within weeks after approval of the new contract, major disruptions in the US energy market caused the target rate of \$0.065/KWH to escalate substantially. The BSA partners are now, once again working with State officials to develop a remedy to this unexpected situation and secure a lower cost and stable energy supply for the Lab.

Performance Metric

Outstanding	All 7 items determined acceptable
Excellent	6 of the 7 items determined acceptable
Good	5 of the 7 items determined acceptable
Marginal	4 of the 7 items determined acceptable
Unsatisfactory	3 or less of the 7 items determined acceptable

Specific Status of Metric (cont.)

2. Facilitate exchange of ideas and practices (cont.)

- Supercomputing Project: Joint efforts by the Director of BNL, SBU's VP for Brookhaven Affairs, VP of Economic Development, and Governmental Relations Office and additional members of the BSA Board have been undertaken to lobby state and local officials for \$25M to build a 400 teraflop Supercomputer at BNL. Initial feedback has been positive.
- Housing Partnerships: SBU has participated in meetings of BNL management with Suffolk County officers to discuss possible partnerships with the County for Third Party Housing at BNL.
- SBU/BNL Network Link: The CIO of SBU initiated work with Keyspan and the CIO of BNL to establish a fiber optic network link between the two institutions. Installation of the link will occur by January 15, 2006. The agreement obtained by SBU with Keyspan permits the institutions to use the link for a 4 month period at no cost.

3. Involvement in scientific programs to enhance BNL prestige

- Battelle's Nanotechnology Alliance sponsored a delegation to Tsingtau University and the Chinese Academy of Science in conjunction with the participation by the Alliance in a special session of the Beijing Nanotechnology Conference. BNL participated with a focused presentation on electronic and energy nano-materials. The Alliance papers were well received and discussions on collaborative research with the Chinese Nanomaterials Institute were initiated.
- Battelle has initiated a CRADA funding efforts in nano-catalysts for fuel cells activities and an additional effort in functionalized carbon nanotubes for functionalized nano-composites. This effort has led to the development of an alliance with Boeing to develop functionalized nano-composites.

4. Develop a strategic hiring plan

- BSA identified several key, strategic hiring actions for FY2005. The FY2005 priority was to secure Steve Dierker as the Director for NSLS II. This was the number one issue for the lab in FY2005 per agreement with BES. SBU committed to a tenured full professorship for Steve Dierker in order to provide him a connection with a research university. SBU also offered a tenured full professorship to Steve's spouse, Megan Aronson. BSA has committed \$400K to support the relocation and funding for these individuals.
- In recognition of the need to strengthen BNL's leadership team with qualified and strategically focused senior management, BSA and BNL leadership accomplished the following key strategic hiring actions:
 - The succession transition of Sam Aronson into the position of ALD HENP, along with the selection of Sally Dawson as the Physics Chair re-anchored the Physics organization.
 - The creation of the ALD for Policy and Strategic Planning, and selecting Pat Looney to fill this position. The Directorate includes the Office of Intellectual Property and Sponsored Research, the Integrated Planning Office, LDRD and Program Development.
 - Naming Doon Gibbs as the ALD for Basic Energy Sciences.
 - Hiring Fritz Henn as ALD Life Sciences.

MEASURE 3.1.2 Laboratory Leadership (cont.)

Outstanding: 3.8

Specific Status of Metric (cont.)

4. Develop a strategic hire plan (cont.)

- Translational Neuroimaging is one of the three business lines in the Business Plan presented to DOE SC in May 2005. In order to develop BNL's proficiency in this line of research, SBU Provost/VP of Brookhaven Affairs, SBU Deans, and the BNL Director committed to key joint appointments in this area of research. These positions will be faculty positions at SBU and scientific staff positions at BNL, with each institution paying half the costs. The objective is to strengthen the Neuroimaging work at BNL and SBU in order to compete for additional funding from NIH and elsewhere to offset possible losses in DOE support.
- Other key staff selections include:
 - Andy McNerney in to the ALD F&O position to bring a "science" perspective to operations.
 - John Hauser for the ALD Finance
 - Pat Williams as the Manager of Safety & Health Services Division

5. Provide proven management systems

- Battelle conducted a pilot effort at safety performance training for Laboratory leadership as part of the safety performance improvement plans. Following the pilot, the training was provided to the BNL Policy Council.
- An overall safety management plan was developed by Battelle for implementation at BNL, adopting best practices for safety management at BNL. The approach captures the best practices from industry benchmarking and lessons learned from safety improvement efforts at PNNL and ORNL. The plan has resulted in marked and measurable improvement in attitudes towards safety at BNL and the first improvements in safety performance in the last 4 years.

6. BSA Partners financial commitment to BNL

- The BSA partners continue to commit 45% of all fees received to Laboratory initiatives to enhance Laboratory viability and performance. Specific initiatives include:
 - BSA Goldhaber Fellowships
 - BSA Distinguished Scientist Fund to attract and retain leadership class scientists
 - Staff development and retention funding
 - Conference support
 - Community support for science education
 - Staff fitness and wellness plans
- The joint appointments offered by SBU represent a financial commitment of over \$300,000 annually in salaries for the course of each faculty member's career as well as start up costs for each appointee. The above mentioned grant and matching funds were provided by Stony Brook to BNL for joint proposals.
- The personnel time/costs of lobbying efforts in the state and federal legislation.
- In addition to the existing faculty joint appointments between SBU and BNL, SBU continued its long term financial commitment to BNL by offering tenured faculty positions in support of BNL's key research endeavors.
- Furthermore, SBU has collaborated with BNL personnel to establish the position of Brookhaven Professor at SBU, BNL scientists who hold this title will teach courses and serve on departmental committees but at a reduced level of effort than for university-paid faculty. In addition, they would have access comparable to other faculty for graduate research students and, depending on topic, this appointment could be the basis for competing for research support from agencies other than the DOE. Additionally, these professors will have a departmental office and departmental laboratory space at SBU.

Specific Status of Metric (cont.)

7. Demonstrate BSA partners' leadership in resolving challenges for the Laboratory

- The BSA partners initiated a BNL Performance Improvement Task Force comprised of experts from Battelle and Stony Brook as well as BNL senior management
- The Task Force has developed a Laboratory Performance Improvement Agenda mapping 14 key performance issues to corrective action plans for these issues.
- The Task Force is overseeing the development and implementation of the corrective action plan for the Laboratory, with a goal of recognizable performance improvement by the end of CY06.
- The SBU Provost/VP of Brookhaven Affairs led a campaign among the BSA universities to lobby the Senate for the restoration of federal funds to BNL. Columbia, Harvard and MIT have joined SBU's lobbying efforts by contacting their own representatives for the restoration of BNL funding.
- Dr. Shirley Strum Kenny used her contacts in NYC to set up a meeting with the Queensboro President Helen Marshall on very short notice to address the rail car shipment issue. The meeting took place on 7/13 in the office of President Marshall, where representatives from BSA (Dr. Shirley Strum Kenny, Dr. Robert McGrath), BNL (Dr. Praveen Chaudhari, Les Hill), NY&AR, LIRR, the NYC Legal Office, Queensboro environmental regulations, met with President Marshall. Because of the meeting, a timely resolution of the impasse was possible and rail car shipments were able to resume on 7/22
- Battelle and Stony Brook representatives joined representatives from ORNL and BNL in a task group to restore momentum of the approval process for the NSLS II. The effort resulted in the development of a revised CD-0 that was accepted and approved by the Deputy Secretary, re-establishing the momentum of the NSLS II program and providing a critical foundation for aggressive pursuit of a funding plan and siting plan for the new facility, a key requirement for the future of the Laboratory. Approval was achieved by the end of the fiscal year.

Management Focus in FY 2006

- Continue efforts to have NYS (Executive, Legislative and Agencies – NYPA, ESDC, etc.) become more knowledgeable and politically and financially supportive of BNL's mission and its contribution to NYS and the northeast.
- Continue efforts to ensure the success of NSLS II
- Work with state legislators, NYPA, ESDC, LIPA, Keyspan to establish competitive and regularized energy rates for BNL.
- Continue efforts to ensure the success of:
 - Supercomputing Project
 - Housing Partnerships
 - SBU/BNL Network Link
- Develop and implement plans as necessary to continue the improvement in safety performance at BNL.
- Implement the plans developed as a result of the peer review of the Procurement System conducted in May 2005 in order to ensure a successful PERT Review scheduled for May 2006.

MEASURE 3.1.3 Diversity

Outstanding: 4.0

Summary of Performance Measure

BSA will strive for Best Practices in managing diversity programs linked to recruitment and diversity educational awareness activities.

Specific Status of Metric

- Measure #1 – A Diversity Engagement Practices checklist was presented to the Policy Council at a meeting on 9/20/05. Their feedback resulted in four changes to the list. Policy Council members agreed to adopt the revised checklist as an accountability tool for diversity that will be linked to the FY2006 performance appraisal.
- Measure #2 – A timeline was established for completing six recommendations from the 2001 Hewitt Diversity Emphasis Study that were identified as pending or unfulfilled. Three of those items, scheduled to start in FY2005, were completed:
 - An OA Diversity strategy was defined and linked to business strategy in BNL’s Annual Diversity Plan.
 - A Level I Managers performance appraisal-based accountability tool was developed and approved.
 - An Affinity Group(s) stakeholder feedback process was used to identify valued activities and programs administered by Diversity Office.

The timeline calls for the remaining three to be developed and implemented in FY2006, with a completion date in FY2007.

- Measure #3 – The Diversity Office aligned BNL recruitment activity with HR to focus on S&T strategic goals and to maximize exposure to opportunities in science and operations.
- Measure #4 - Level I and II Managers provided the names and contact information for potential candidates to the Diversity Office, who together with HR, pursued these leads. The Associate Laboratory Director for EENS, assisted with hiring an African–American Research Associate. As a further step, EENS hired that individual’s spouse, also as a Research Associate. This was BNL’s first offer of dual-spouse employment to African-American scientists. The Department Chair also provided the name of a majority female, who was subsequently hired as an Assistant Scientist.

Performance Metric

Outstanding	5 of 5 performance elements being implemented
Excellent	# 1 and 3 of remaining performance elements being implemented
Good	#1 and 2 of remaining performance elements being implemented
Marginal	2 of 5 performance elements being implemented
Unsatisfactory	1 or less performance elements being implemented

Specific Status of Metric (cont.)

- Measure #5 – Initiate the pilot training programs on diversity education awareness and provide some diversity education Laboratory-wide by 2008. Completed Phase I in which four topics were presented to approximately 40 BES employees. In Phase II, three topics were presented to approximately 30 BES employees (Religious Awareness on 5/25/05, Sexual Harassment on 7/20/05 and Diversity Communication in the Workplace on 9/21/05). The fourth topic, Mentoring, in Phase II, will be given on 10/19/05. In addition, approximately 400 employees participated in at least one hour of such training.

Management focus in FY2006

- The focus on enhancing BNL's Diversity program will continue in FY2006. BNL has committed to four (4) new Diversity, performance measures with seven (7) new performance targets.

Summary of Performance Objective

BSA will develop and deploy business processes that are effective and efficient. The systems will contain elements that are found in world-class organizations that enhance the scientific effort of the Laboratory, are cost effective and promote a safe operating environment. The Laboratory's business systems will be ranked among the top Tier effective organizations as validated by a nationally recognized group. To be achieved by September 30, 2007.

Phase IV of Benchmarking Study

BNL completed several activities from the Hackett Study Implementation Plan, specifically those from the Procurement-to-Pay and Planning, Forecast and Analysis (Budget) areas. The eProcurement plan was approved, business rules for eProcurement were established, and the first eProcurement contract is being drafted. Utilizing a financial dashboard, the ALD for Finance continued to provide/improve monthly financial updates to the Policy, Management and Administrative Councils. At monthly meetings with Administrative Managers, the ALD for Finance highlighted the importance of the PeopleSoft Cost plans refining budgeting and forecast process and improving FY2005 projections. A Science Operation Matrix was developed and used at monthly Science Council meetings to facilitate ALDs and Chairs reporting the status and progress of their programs. BNL also completed successful eSettlement testing with one vendor.

Cyber Security

BNL developed a corrective action plan responding to DOE's Cyber Security Review and progressed towards meeting the milestones of the plan. BNL created the external wireless network to move wireless access points and greatly reduced the security risk wireless access points pose to the internal network. BNL evaluated and deployed automated blocking using Intrusion Prevention Systems for the residential area of the bnl.org network and the distribution layer network reducing response time to attacks and preventing attacks without requiring human intervention. BNL implemented NetFlow network capture at the perimeter router and network distribution layers so that network traffic within the BNL campus and between it and the Internet can be analyzed affording visibility into the traffic on the BNL internal network allowing internal threats to be monitored. BNL configured Departmental firewalls to allow Nessus scans to identify security holes for patch management as essential to prevent vulnerabilities on BNL's network. BNL also centralized the management of Departmental firewalls.

Procurement

BNL developed the Acquisition Management System Improvement Plan (AMIP) and submitted the Plan to DOE-BHSO. DOE-BHSO accepted the Plan on 9/30. The AMIP includes detailed milestones and completion of key milestones are included as a performance measure in the Procurement Balanced Scorecard Plan for FY2006.

MEASURE 3.2.1 Phase IV of Benchmarking Study

Outstanding: 4.0

Summary of Performance Measure

Implement FY2005 activities in accordance with the Implementation Plan (2004) resulting from Hackett Benchmarking study.

Specific Status of Metric

- Progress was made on the Procurement-to-Pay and Planning, Forecast and Analysis (Budget) areas (twelve activities in total) listed in the Implementation Plan. Several were completed.
- eProcurement - Plan approved; business rules for eProcurement were established and the first eProcurement contract is being drafted.
- Utilizing a dashboard - The ALD for Finance continues to provide/improve monthly financial updates to the Policy, Management and Administrative Councils.
- Refine budgeting and forecast process - At monthly meetings with Administrative Managers, the ALD for Finance highlights the importance of the PeopleSoft Cost plans. This has improved FY2005 projections.
- Science Operation Matrix - At the monthly Science Council meetings, the ALDs and Chairs report the status and progress of their programs.
- eSettlement - Completed successful eSettlement testing with one vendor.

Procurement-to-Pay Accomplishments

1. eProcurement

- An eProcurement module was purchased June 2005.
- An eProcurement plan was approved, business rules for eProcurement established and the first eProcurement contract is being drafted.
- The initial eProcurement contract with Government Scientific Source, Inc. was signed in August and preliminary work was initiated. Price verification is underway and the catalog is expected to be loaded in the PeopleSoft system during the first two weeks of October.
- A contract with Taconic Farms is in process and the catalog will be implemented in FY2006 first quarter.
- Objectives for Next Quarter – Complete the implementation of first two catalogs and initiate proceedings for the next five catalogs.

2. Automated Workflow

- New version of WebReq will be in place during October 2005.
- eProcurement and eSettlement will improve the workflow.

Performance Metric

(Percentage of recommendations being addressed)

Outstanding	100%
Excellent	>80%
Good	>70%
Marginal	>50%
Unsatisfactory	<50%

Procurement-to-Pay Accomplishments (cont.)

3. Electronic Payment

- eProcurement and eSettlement modules were installed and internal testing completed. The next steps involve pilot testing using real BNL vendors.
- Approximately 15% of vendors now receive payment electronically. The number is expected to grow gradually over time.
- eSettlement testing was successfully completed with the first vendor (S&A Scientific); processing continues. The Second vendor (KC Electric) is ready to go, but on hold pending BSD implementation/activation of additional eSettlement functionality.

4. Web-Based requests for quotation (RFQ) and requests for proposal (RFP)

- Electronic Certifications & Representations posted on Procurement and Property Management (PPM) Web Site
- PPM utilizes Dell e-quote
- PPM developed and implemented an electronic RFQ template that can be emailed to designated potential suppliers
- Consideration is being given to developing an electronic RFP template in FY2006.

5. Supplier Self-service

- A PeopleSoft Supply Chain Portal Pack was purchased June 2004. Internally operational, however, due to cyber-security concerns it is awaiting a new outward-facing server, which is due in FY2006.

Planning, Forecast & Analysis

Accomplishments

1. Measure Strategic Initiatives

- Integrated Planning Office established 1st quarter FY2004 (complete).
- ALD for Policy and Strategic Planning hired.
- Developed and deployed processes and tools to identify an integrated set of strategic S&T initiatives and allocate discretionary FY2005 investments (complete).
- Incorporated monitoring and measurement processes for key elements of strategic initiatives in the FY2006 planning cycle.
- Initiated performance review by Science and Operations ALDs at Feb/March 2005 Policy Council meetings.
- Determined successes resulting from LDRD projects.
- At the direction of the New ALD for Policy and Strategic Plan drafted an SBMS subject area to better manage Program Development projects.

2. Dashboard Utilization

- Completed an enhanced Dashboard - September 2005 and presented Dashboard at the Policy and Management Councils meetings in October 2005.
- The ALD for Finance continues to provide, improve and simplify monthly financial updates to the Policy and Administrative Councils.

Planning, Forecast and Analysis

Accomplishments (cont.)

- During FY2005, PeopleSoft functionality was used to create User Define type reports, to save time in setting-up and processing data that are regularly analyzed. Examples include:
 - a) Work for Others Quarterly Report - This report initially was run in Excel, but data were input manually monthly from various sources, i.e., PeopleSoft queries and month-end spreadsheets created by the Budget Office. This was a quarterly exercise the analysis of which required at least two to three days. BSD and Budget Office personnel collaborated on formatting a User Define Report, which mimics the Excel version. This new report simply queries the user for an "as of" date, then goes a step further by providing separate summaries/detailed reports for the Other Federal Agencies and the Non-Federal Agencies.
 - b) Month-End Pre-Trial Report - This report also was run in Excel and required the user to create 10 individual worksheets within a single file to segregate the BNL project types. The worksheets were then individually sorted and sub-totaled, depending upon the control levels within the project type. BSD and Budget Office personnel collaborated on a User Define Report designed to eliminate the many steps previously required. This report saves time during the month end/year end close when turnaround time is critical.
 - c) BJV Panel - This enhancement is not derived from a User Defined Report, but rather, adds a feature to the Budget System that allows the Budget Office to process month end/year end journal vouchers complete with all related overheads without having to rerun allocations. This functionality cut processing time at month end by a minimum of 4 to 6 hours. PeopleSoft functionality will continue to be applied where appropriate. This measure is complete.

3. Indirect Operational Matrix

- Completed the enhanced Dashboard - September 2005 and presented the Dashboard to the Policy and Management Councils - October 2005.
- The ALD for Finance continues to provide, improve and simplify monthly financial updates to the Policy and Administrative Councils.
- During FY2005 PeopleSoft functionality was used several times to create User Define type reports in order to save time in setting-up and processing of data that are regularly analyzed. Two areas that impacted indirect operations were the Month-End Pre-Trial Report and the BJV Panel.

4. Science Operational Matrix

- Completed the enhanced Dashboard - September 2004 and presented the Dashboard to the Policy and Management Councils - October 2004
At the monthly Science Council meetings the ALDs and Chairs report the status and progress of their programs.

5. Reporting on Operational

- The Dashboard reporting of key financial measures was simplified by ALD Finance (October 2004) and is being used for Administrative/ Management Councils and Policy Council meetings

Planning, Forecast and Analysis

Accomplishments (cont.)

6. Process Alignment

- The Budget Office and Departments/Division collaborated in developing accurate Cost Plans completed 12/31/04.
- The Organizational Cost Plan Graphical Tool in use and proven beneficial. Repeated communications of the importance of accurate, realistic cost plans has brought about this improvement. Efforts will continue to maintain improved cost plans will continue.

7. Integrated Information

- The functionality of the PeopleSoft Dashboard was compiled in June 2005. In addition, during FY2005, PeopleSoft functionality was also used several times to create User Define type reports which saves time related to set-up and processing data that are regularly analyzed. Three improved operations were the Work for Others Quarterly Report, Month-End Pre-Trial Report and the BJV Panel.

Management Focus in FY2006

- Complete the implementation of eProcurement first two catalogs and initiate proceedings for the next five catalogs.
- Implement additional eSettlement functionality by BSD.
- Support PeopleSoft Supply Chain Portal Pack with new outward-facing server.
- Create a monthly Lab-wide budget and expense report.

MEASURE 3.2.2 Cyber Security

Good: 1.8

Summary of Performance Measure

Track performance through the DOE's Cyber Security Review, Information Technology Division's (ITD's) development of a corrective action plan and ITD's progress towards meeting the milestones of the corrective action plan for FY2005 milestones.

Specific Status of Metric

- Created the external wireless network to move wireless access points from the internal network to the external network; this action greatly reduced the security risk wireless access points pose to the internal network.
- Evaluated and deployed automated blocking using Intrusion Prevention Systems for the residential area of the bnl.org network and the distribution layer network comprising approximately 90% of the BNL user population. This approach reduces response time to attacks and proactively prevents attacks 24/7 without requiring human intervention.

- Implemented NetFlow network capture at perimeter router and both network distribution layers so that network traffic within the BNL campus and between it and the Internet can be analyzed. This affords visibility into the traffic on the BNL internal network that was not previously available, allowing internal threats to be monitored.
- Configured departmental firewalls to allow Nessus scans to identify security holes for patch management; this was essential to prevent vulnerabilities on BNL's network.
- Centralized the management of departmental firewalls to ITD.

Accomplishments

- A corrective action plan was developed to address the findings from the DOE's OA inspection. BHSO and the DOE's OA approved it.
- The FY2005 cyber security budget was significantly redefined to resolve the cost of implementing FY2005 action items.
- Of the 32 action items (unclassified & classified), 28 were completed on time or before their due date.

Performance Metric

Outstanding	'Effective' rating; Corrective action plan developed, if required.
Excellent	'Needs Improvement' rating; 95% of FY2005 milestones completed.
Good	'Significant Weakness' rating; Corrective actions to address significant weakness completed in FY2005
Marginal	'Significant Weakness' rating; Corrective actions to address significant weakness not completed in FY2005.
Unsatisfactory	'Significant Weakness' rating; Corrective actions to address significant weaknesses not developed.

Management Focus in FY2006

- Continued focus in FY2006 will be on producing an approved Certification and Accreditation (C&A) package.
- Execution of the corrective action plan to the OA audit will also be a major focus in FY2006.

MEASURE 3.2.3 Procurement Operations

Excellent: 2.6

Summary of Performance Measure

This measure tracks the progress towards developing the Acquisition Management System Improvement Plan, Phase II, that will include performance measures for monitoring sustained improvement. The Plan is expected to be established immediately upon its completion and acceptance by the DOE.

Specific Status of Metric

- The Acquisition Management System Improvement Plan (AMIP) was accepted by the DOE-BHSO on 9/30 and key actions to implement it will begin in FY2006.

Accomplishments

- The AMIP was completed and accepted by BSA management and the DOE-BHSO.
- The AMIP includes detailed milestones for its implementation in FY2006.
- Developed path forward from Procurement Readiness Review performed in May 2005.
- Completion of the key milestones are included as a performance measure in the Procurement Balanced Scorecard Plan for FY2006.

Management Focus in 2006

- Preparation for the PERT Review in May.
- Determine optimum staffing levels for Procurement Operations and implement critical hires identified for 2006.
- Develop formal training programs for procurement staff.

Performance Metric

Outstanding	DOE accepts Plan by Sept. 30, 2005 and implementation of some key actions occurred in FY2005
Excellent	DOE accepts Plan by Sept. 30, 2005, implementation of key actions to begin in FY2006
Good	Plan accepted by BSA management by Sept 30, 2005
Marginal	Plan submitted to BSA management, approval not obtained by Sept 30,2005
Unsatisfactory	Plan not submitted to BSA management by Sept 30, 2005

Summary of Performance Objective

BSA will develop, deploy, and maintain management systems to reliably perform all work at BNL in an efficient and cost-effective manner, complete with a comprehensive self-assessment program sufficiently robust to detect and correct problems before they develop into vulnerabilities for BSA or DOE.

Management System Maturity Determinations

BNL completed Maturity Determination workshops for six management systems: Facility Operations; Hazardous Materials Transportation Safety; Information Resource Management; Occupational Medicine; Science and Technical Program Management; and Work Planning and Control. Reports were prepared documenting the consensus ratings, strengths and areas for improvement. Management System Stewards committed to improvements. Appropriate DOE-BHSD Management System Stewards and Points of Contact were invited to, and attended, workshops.

Third Party Assessment of Program

The Third-party Team reviewed the following management systems: Human Resources; Information Resource Management; Standards-Based Management System; Integrated Assessment Program; and Work Planning and Control. The Team noted the positive progress made towards responding to the recommendations from FY2003 and FY2004 and made seven new recommendations. The Team noted improvement in the overall approach to management system self-assessment and a clear management commitment. The Team also found that assessment activities are being deployed as planned and progress was made in using a variety of assessment techniques. The Maturity Determination workshop was identified as an effective tool that contributed significantly to system improvements. Management system self-assessment resulted in improvements in management systems and operations; although this area is still at an early level of maturity.

Summary of Performance Measure

Complete a formal consensus-based user/peer reviewer Maturity Determinations, or comprehensive Independent Assessments for six management systems (MS).

Specific Status of Metric

- Stewards and the POCs selected teams of users/customers for each MS and gave them documentation on the status of the definition, implementation, planning, assessment and improvement initiatives for the MSs.
- Completed Maturity Determinations workshops for the six management systems (MSs): Facility Operations; Hazardous Materials Transportation Safety; Information Resource Management; Occupational Medicine; S&T Program Management; and, Work Planning and Control.
- Reports for each MS were prepared documenting the consensus ratings, strengths and areas for improvement.

Accomplishments

- Development of MS plans.
- Identification of high-risk event barrier processes and selection of associated performance risk measures.
- Implementation of an MS-based Corporate Assurance process.
- Quarterly Performance Monitoring and Reporting by MS.

Management Focus in FY2006

- Introducing the BHSO Management System Stewards/POC program added value to the Maturity Evaluation process in FY2005, and communication aspects of the program will be significantly enhanced in FY2006 with BNL counterparts.

Performance Metric

Outstanding	6 of 6 completed by September 30, 2005
Excellent	5 of 6 completed by September 30, 2005
Good	4 of 6 completed by September 30, 2005
Marginal	3 of 6 completed by September 30, 2005
Unsatisfactory	Two or less completed by September 30, 2005

MEASURE 3.3.2 Third Party Assessment of Program

Excellent: 2.85

Summary of Performance Measure

Modify the evaluation protocol and, using a Third-party Team, evaluate the management system's planning and assessment activities.

Specific Status of Metric

- The following management systems were reviewed: Human Resources; Information Resource Management; SBMS; Integrated Assessment Program; and, Work Planning and Control.
- The Third-party Team noted the positive progress made towards responding to the recommendations from FY2003 and FY2004 and made seven new recommendations.

Accomplishments

- The overall approach to management system self-assessment and a clear management commitment improved.
- Assessment work is being deployed as planned and progress was made in using a variety of assessment techniques. The Maturity Evaluation was identified as an effective tool that contributed significantly to system improvements.
- MS self-assessment resulted in improvements in MS and operations; this area still is at an early level of maturity.

Performance Metric

As determined by the criteria and the Third-party evaluation.

Management Focus in FY2006

- BNL is preparing a Site Improvement Plan that addresses corrective actions from ISM and the Third Party Evaluation, and the improvements necessary to meet the requirements of DOE Order 226.1.
- BNL will share the development and execution of the Site Improvement Plan with BHSO.

OBJECTIVE 3.4 Improved ESH&Q - Operations Services

Good: 2.5

Summary of Performance Objective

BSA will exhibit a commitment to best-in-class Environment, Safety, Health and Quality (ESH&Q) performance in support of the operational mission and goals of the laboratory through strong, high-level leadership, effective management, and accountability throughout all levels of the organization. This commitment shall drive sustainable, demonstrable and measurable improvements. BSA will demonstrate continuous improvement toward industry-leading programs recognized for integrity in environmental stewardship, excellence in workplace safety and health, and value-added quality. These programs will be complemented and supported by robust management of facilities and infrastructure.

Measure 3.4.1 - OSHA Reportable Injury Management

During FY2005, BNL celebrated achieving 1.5 million hours without a DART case – the best record in the Laboratory's history. Although BNL did not reach DOE-SC's interim goals for FY2005, the number of injuries, as measured by DART cases, were half of the number in FY2004. BNL organizations included in the OHSAS 18001 Phase I were successfully reregistered and the Phase II organizations prepared for a registration audit in November of 2005. These BNL organizations integrated their annual Occupational Safety and Health and Environmental Management System management reviews. Included in these management reviews were improvement initiatives from Job Risk Analyses, Facility Risk Analyses and Worker Safety Committees. At the conclusion of each OSH/EMS Management Review, organizations identified internal objectives and goals for continually improving their ESH performance.

Summary of Performance Measure

Roll-up of 3.4.1.1 (50%) and 3.4.1.2 (50%)

Accomplishments

- BNL celebrated achieving 1.5 million hours without a DART case – the best record in the Laboratory's history.
 - The number of DART cases in FY2005 were reduced by half compared to FY2004 (35 vs. 18).
 - The number of TRC cases in FY2005 were reduced by one third compared to FY 2004 (56 vs. 37).
 - As a result, BNL's year-end self-evaluation has been estimated at the high end of the good range (2.5).
- BNL hosted the first Office of Science Laboratory Electrical Safety Training.
- Laser Safety Training was offered to users of lasers and ESH professionals.
- Approximately 100 Job Risk Assessments were completed by employees, supervisors and ESH professionals in the NSLS, Physics Department, Magnet Division, Chemistry Department, Instrumentation, Staff Services, Material Sciences Department and Environmental and Waste Management Services Division.
- The "Investigation of Incidents, Accidents and Injuries" Subject Area was updated on 7/11/05. The new version included the requirements for conducting critiques, causal analyses and corrective action plans; details on how to track, trend and analyze accident- and injury- statistics were added.
- Departments and Divisions in OHSAS 18001 Phase I and II registration process are tracking and trending their injury- and accident- statistics; this is discussed in their annual OSH management reviews. Also detailed are the improvement initiatives from Job Risk Analyses, Facility Risk Analyses and Worker Safety Committees. At the conclusion of each OSH Management Review, they identify internal goals for continually improving in their ESH performance.
- Employee's awareness of DART cases increased through the sign at the Main Gate, the ESH&Q monthly newsletter, Monday Morning Memo, BNL Web pages and "world class" initiated talks.
- SKM Power Systems (Arc Flash) course was conducted 5/2-5/6 for electrical engineers.
- NRTL and UL training was conducted 5/23-5/27 for electrical engineers.
- OSHA Electrical Safety course was conducted 6/27-6/30.
- Hazard ID for Engineers course was conducted 6/7-6/8 and 6/9-6/10 for engineers and safety professionals.
- Human Performance Training for ESH Coordinators, WCMs, WCCs and ECRs was conducted June 2005.
- Exceptional Customer Service training was provided to employees from ESH&Q Directorate on 6/1/05.
- Safety Leadership Training was provided in July 2005.
- Accident Prevention and Investigation Workshops were held 8/2-8/3 and 8/4-8/5.
- Phase I organizations successfully re-certified to OHSAS 18001 standard.
- Completed field verification of the OSHA findings.
- Held Safety Partnership Week 11/29-12/3/04.
- National Safety Month (June 2005) – "brown bag" lunchtime talks given on multiple safety topics, i.e. Ladder Safety, Swimming Pool Safety, etc.
- Defensive Driving courses were reinstated onsite. (Held on 3/12, 4/2, 4/30, 6/11, 8/20, 10/1 and upcoming class on 12/10. Approximately 450 people have taken the course to date.)
- Safety Solutions Program was created.
- 3 assessments completed with balanced reviews – Electrical Safety, Industrial Hygiene Exposure Monitoring and ISM Focused Assessment.

MEASURE 3.4.1.1 Days Away, Restricted, or Transferred Rate

Good: 2.5

Summary of Performance Measure

BSA will track progress through improvement in the Days Away, Restricted, or Transferred (DART) rate.

Specific Status of Metric

- BNL worked throughout June, July and August without a DART case, approximately 1.5 million hours.
- The end-of-fiscal-year DART rate is 0.74, in the Good range.
- The injury rate improved markedly in the second half of the year.

Management Focus in FY2006

- Accident prevention will continue to be a major focus in FY2006.
- Subcontractor safety is of paramount importance, especially with the increased construction activity on CFN and RSB.

Performance Metric

Outstanding	BNL Dart ≤ 0.45
Excellent	> 0.45 and ≤ 0.60
Good	> 0.60 and ≤ 0.80
Marginal	> 0.80 and ≤ 0.90
Unsatisfactory	> 0.90

MEASURE 3.4.1.2 Total Recordable Case Rate

Good: 2.5

Summary of Performance Measure

BSA will track progress through improvement in the Total Recordable Case (TRC) rate.

Specific Status of Metric

- BNL worked the month of June without a TRC.
- The end-of-fiscal-year TRC stands at 1.52, in the Good range.
- The injury rate improved markedly in the second half of the year.

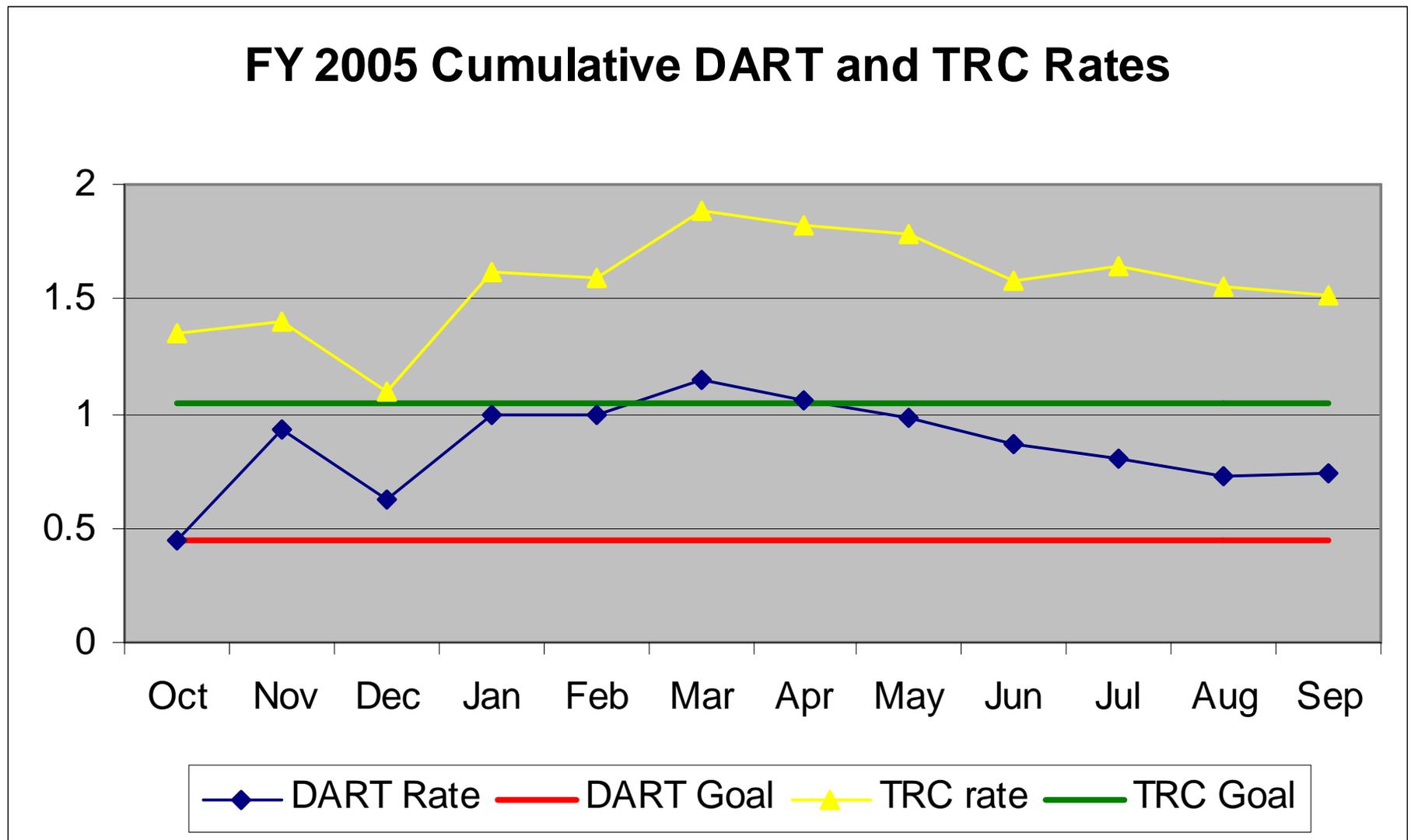
Management Focus in FY2006

- Accident prevention will continue to be a major focus in FY2006.
- Subcontractor safety is of paramount importance, especially with the increased construction activity on CFN and RSB.

Performance Metric

Outstanding	BNL TRC ≤ 1.05
Excellent	> 1.05 and ≤ 1.25
Good	> 1.25 and ≤ 1.55
Marginal	> 1.55 and ≤ 1.85
Unsatisfactory	> 1.85

Cumulative DART and TRC Rates and Goals



OBJECTIVE 3.5 Site Infrastructure, Facilities and Operations... *Outstanding: 3.51*

Summary of Performance Objective

BSA will upgrade and maintain efficient and cost effective site infrastructure, facilities, and operational functions to a standing that fully supports world-class research and implementing a best in class Real Property Asset Management Program. In addition, GSA will meet and/or exceed DOE security requirements applicable to the Laboratory.

BNL Housing Reconstruction Project (HRP)

BNL delivered the latest version of the Housing Acquisition Strategy Document on 09/27 to DOE-BHSO for final review and transmittal to DOE-HQ. BNL's Acquisition Strategy assumptions are very similar to those being adopted by other laboratories in their third-party projects. BNL continues to investigate other avenues for funding, including possible county and state assistance.

Project Management

The rating for this objective was significantly affected by the high bids initially received for the CFN Project. These high bids resulted in a missed Construction Start Milestone. A recovery plan was successfully executed and CFN now is on schedule.

The Research Support Building is progressing on budget and schedule. Several major GPP/Facilities projects were completed as planned; although the MBE Facility GPP project was completed two months late and over budget due to unforeseen requirements in its scope that were needed to support this one-of-a-kind instrument.

Maintenance Investment Index (MII)

Investment levels were monitored on a quarterly basis. The Laboratory achieved a final MII of 1.79% or 105% of target. Investments were carefully reviewed and prioritized to ensure maximum effectiveness.

Energy Contract

The final NYPA contract was approved on 09/30/05 and extends through 06/30/08. The contract provides for continuation of transmission rights valued at \$3-5M per year and a direct subsidy of \$4.5M per year from NY State. At the time of agreement, the effective annual rate was estimated at \$0.065/kWh. Subsequent significant increases in the cost of energy nationwide drove this rate upward toward the end of FY2005. The 3 year value of the benefits are estimated in excess of \$27M.

Infrastructure Reliability (RI)

The index exceeded 0.9998. The preventive maintenance program for critical equipment supports the reliable operation of systems and equipment. The increasing investment in capital renewal is possible by using Maintenance Investment Index funds.

MEASURE 3.5.1.1 Alternative Financing: BNL Housing...(HRP)

Excellent: 3.0

Summary of Performance Measure

Proceed with developing the alternatively financed Housing Reconstruction Project.

Specific Status of Metric

- BNL delivered the latest version of the "Housing Acquisition Strategy (AS) Document" on 09/27 to the DOE-BHSO for final review and transmittal to the DOE-HQ.
- Several changes to the AS assumptions were required during the last several months for various reasons, including similar projects at other DOE sites and feedback from several other agencies and areas of the DOE.
- BNL continues to investigate other avenues for funding, including possible County and State Assistance while still pursuing the DOE's approval for the AS.
- BNL and BHSO met with the County on 08/08/05 & 09/22/05 to discuss housing options, including a County-run Workforce Housing project and potential to use low-cost County bonds to finance a project at BNL.
- BNL and BHSO also met with and had conversations with the Empire State Development Corporation (ESDC) over the last fiscal year to discuss the State's potential involvement in BNL's infrastructure needs.
- BNL and BHSO continued to explore a potential hotel complex just south of BNL for possible housing options.

Accomplishments

- The Housing Acquisition Strategy document is very close to getting final approval from BHSO.
- BNL's Acquisition Strategy assumptions are very similar to those being adopted by other laboratories in their third-party projects.
- BNL is participating in the County's Employer Assisted Housing Program that provides financial assistance to new employees to help them afford housing on Long Island. This participation resulted from meetings with the County on the Housing Project.
- BNL and BHSO received a favorable response from the County/State about possibly using low-cost bonding authority from the Industrial Development Agency (IDA) for the housing project. This could lower costs.

Management Focus in FY2006

- Appropriate assumptions and criteria must be included in the Acquisition Strategy that are in line with the latest DOE, OMB and OGC criteria, which continue to change.
- Continue work with County/State and local officials to identify various avenues of support for housing development onsite.
- The Laboratory will continue to participate in and support Suffolk County's "Workforce Housing" development initiative at Yaphank.

Performance Metric

Outstanding	Successful in obtaining a funding commitment following either Path A or Path B as described below.
Excellent	Path B - Explore other avenues for funding such as NY State, County, or other Federal agencies etc. while still pursuing DOE approval through DOE authorized Alternative Financing channels.
Good	Path A - Pursue and obtain Acquisition Strategy approval (CD-1) by the Office of Science
Marginal	Submittal of Acquisition Strategy to DOE for approval
Unsatisfactory	No further progress after September 30, 2004

Summary of Performance Measure

Manage construction and construction-like projects to ensure scope, schedule and cost objectives are met.

Specific Status of Metric

- Performance for the year borders on Good to Excellent but was significantly affected by the high bids received on the CFN Construction Project.
- These high bids resulted in a missed Construction Start Milestone. A recovery plan was successfully executed and CFN now is on schedule.
- The high CFN bids were due, in part, to unique market conditions that saw record increases in the cost of construction material in FY2004 to FY2005.
- The Research Support Building is progressing on budget and schedule.

Accomplishments

- The following major GPP/Facilities projects were completed as planned: Genome to Life Laboratory B463; Rehab of Laboratory C-2 B 815; HiBay Upgrade B510; Excess Facility Disposal
- The B480 MBE Facility GPP project was completed two months late and over budget due to unforeseen requirements in its scope that were needed to support this \$5M one-of-a-kind instrument.
- The Laboratory formed a matrix “Project Management Organization” to identify, manage and ensure the continuing professional development of its staff having project management experience and expertise. The first seminar on SNS Lessons Learned was held on 11/18/05.

Management Focus in FY2006

- Continue to develop the “Project Management Organization”.
- Prepare for EVMS Certification.

Performance Metric

Outstanding	(PM) = 0.90 to 1.00
Excellent	= 0.80 to 0.89
Good	= 0.70 to 0.89
Marginal	= 0.60 to 0.69
Unsatisfactory	= Less than 0.60

MEASURE 3.5.3 Maintenance Investment Index (MII)

Outstanding: 4.0

Summary of Performance Measure

This measure tracks operating expense maintenance investment on active conventional facilities against the DOE's maintenance investment goals.

Specific Status of Metric

BNL achieved a final MII of 1.79% or 105% of target. The investments in maintenance projects were carefully monitored and prioritized to ensure that maximum effectiveness was achieved. Preventive maintenance was given a high priority to ensure safe, environmentally sound, and reliable operations of buildings, equipment, and building systems.

Performance Metric

Outstanding	$MII \geq 1.7$
Excellent	$1.6 \geq MII < 1.7$
Good	$1.5 \geq MII < 1.6$
Marginal	$1.4 \geq MII < 1.5$
Unsatisfactory	$MII < 1.4$

Accomplishments

- Successfully completed the FY2005 building demolition program and planning for FY2006.
- Consolidated staff and reduced space utilization.
- Monitored MII investment levels quarterly at the senior leadership level and adjusted as required.
- Exceeded MII investment target by 5%.

Management Focus in FY2006

- Work towards reducing deferred maintenance backlog while minimizing space charge rate increase.
- Continue to optimize how maintenance work processes are managed to drive further efficiencies in terms of "wrench time" percentages in craft areas.
- Continue to evaluate facility and space utilization to optimize the required operational "footprint" of the Lab and reduce overall costs.

Summary of Performance Measure

BSA will strive to obtain the lowest possible electric power rates for the Laboratory when it renews its electric power contract in FY2005.

Specific Status of Metric

- The NYPA contract was extended through 6/30/08 and approved on 9/30/05. The agreement preserves transmission rights worth \$3-5M per year and includes \$4.5M per year in direct NY State subsidies. The estimated unit cost for the new agreement was \$0.065/Kwh. The subsequent unexpected rise in the national energy market caused the rate to rise above this level for the first three months of the contract. However, the annual effective rate for FY2005 still remained below 6.0 cents/kwh.

Performance Metric

Rating	Unit Cost (\$/kWh)
Outstanding	< \$0.07
Excellent	≥ \$0.07 < \$0.085
Good	≥ \$0.085 < \$0.09
Marginal	≥ \$0.09 < \$0.10
Unsatisfactory	≥ \$0.10

Accomplishments

- The target for unit cost was achieved.
- A coalition was formed including NYPA, LIPA and ESDC to continue to work on the long term (beyond 2008) power supply issue.
- Economic benefits of > \$9M per year were achieved relative to local power prices.
- Relationships with key LI and NYS energy and economic development officials were developed and expanded.

Management Focus in FY2006

- The costs for FY2006 will exceed the targets due to the recent dramatic increases in fuel costs. A continued effort to seek alternate support for rate reduction will be a high priority.
- Onsite generation alternatives will be aggressively explored.
- Planning with the “BNL coalition” to develop the next power contract (2008) will continue with emphasis on securing capacity on the Neptune Cable project.

MEASURE 3.5.5 Infrastructure Reliability (RI)

Outstanding: 3.6

Summary of Performance Measure

The measure tracks the effectiveness of maintenance using the Infrastructure Reliability Index (RI) and Electrical System Reliability (ESR). The two inputs are blended in the following fashion: $RI = .6 ESR + .4 BFR$.

Specific Status of Metric

- The weighted average of the Infrastructure Reliability Index and the Building Reliability Index was over 0.9998. Continued management emphasis on preventive maintenance scheduling and accomplishment was the primary driver for this result.

Accomplishments

- Continued to make strategic investments in key utilities and building systems that drove up reliability.

Management Focus in FY2006

- The continued support and growth of MII will help to reduce maintenance backlog and maintain the reliability of utilities.

Performance Metric

Outstanding	ESR = Greater than 0.9998
Excellent	ESR = Greater than 0.9996 to 0.9998
Good	ESR = Greater than 0.9994 to 0.9996
Marginal	ESR = Greater than 0.9990 to 0.9994
Unsatisfactory	ESR = Less than 0.9990

Measure 3.6.1 - Community, Education, Government and Public Affairs Management

Under Brookhaven Science Associates, the Laboratory continues to develop and enhance communications, community relations, and educational programs to achieve its and the U.S. Department of Energy's strategic mission and goals. The Laboratory is committed to ensuring that its community relations, education, government and public affairs (CEGPA) programs are aligned with its and the DOE'S short and long-range science and operational priorities, and continue to meet best industry, government and academic practices and standards, so that:

- The Lab's world-class science is properly communicated to decision makers, policy leaders, and science attentives.*
- Scientific results from Brookhaven research are linked to the U. S. Department of Energy.*
- DOE is credited for its role in advancing science in the nation and the world.*

An independent third-party review team, the Communications and Trust Advisory Panel, evaluated the results of meeting Objective 3.6. The Panel rated the Lab's performance as Outstanding as measured against the nationally recognized Baldrige Criteria for Approach, Deployment and Results.

In FY2005, BNL successfully planned and executed strategic communications for DOE's and the Laboratory's scientific initiatives and accomplishments (e.g., RHIC, CFN, NSLS/NSLS-II, medical imaging, and the World Year of Physics) and operations priorities (e.g., groundbreaking for the Research Support Building, Biodiesel workshop, urban dispersion program, environmental management and low-cost power negotiations). BNL also effectively built partnerships with targeted research and educational institutions (e.g., local and New York City/State educational institutions, Historically Black Colleges and Universities, minority serving institutions, government agencies, and professional societies). BNL also promoted and supported DOE by conducting Middle School and High School Science Bowls and participating in DOE sanctioned events (e.g., Junior Academy of Scientists and the National Science Teachers Association Annual Conference). DOE's Office of Science recognized BNL's Office of Educational Programs as a "model for integrating the strategic goals of OEP, the guidelines of WDTS and the needs of the students." BNL developed an internal communications and involvement policy, plan and procedure with input from BNL stakeholders, identified top internal challenges/issues and worked with BNL managers to develop and implement communications and involvement plans for each, and supported the Lab Director's goal of increasing employee understanding of the Lab's priority initiatives and strategic planning process.

MEASURE 3.6.1.1 Promoting Scientific Initiatives...

Outstanding: 4.0

Summary of Performance Measure

Promoting the DOE's and the Laboratory's scientific initiatives and accomplishments and operations priorities.

Specific Status of Metric

- **Science:** Strategic communications were planned and executed for CFN, RHIC, medical imaging, NSLS/NSLS-II, Urban Dispersion Program, a biodiesel workshop and the World Year of Physics.
- **Operations:** Strategic communications were planned and executed for the ground breaking of the research support building, natural resources management, environmental management, low-cost power negotiations, railcar transportation and worker safety.
- **Promoting DOE and the Laboratory:** Media were managed to achieve exceptional news coverage on the discovery of the "perfect liquid," the Urban Dispersion Program and the "World Year of Physics." Special events, visits and tours were arranged for science and operations: Congressman Hobson's visit to the Laboratory for the dedication of the CFN site and the Matt Cohen (Schumer) and Sean O'Shey (Clinton) tours.
- **Issues anticipation:** Significant contributions were made to low-cost power negotiations, restoring funding for the RHIC and NSLS and the resolution of the delayed railcar issue.
- A communications and activity checklist was developed and implemented that was systematically used to plan events.

Performance Metric

An independent third-party review team, the Communications and Trust Advisory Panel, will evaluate the results of meeting objective 3.6. The individuals on the panel are recognized as experts in the fields of public affairs, community, communications and web design.

The program will be measured against the nationally recognized Baldrige Criteria for Approach, Deployment and Results.

Accomplishments

Scientific Initiatives and Accomplishments

- **RHIC:** In collaboration with the RHIC strategy team, CEGPA developed and executed a plan to announce the publication of four white papers at the April 2005 American Physical Society meeting. CEGPA's efforts resulted in national and international press coverage on the discovery of the "perfect" liquid – several hundred print and electronic clips – with the DOE named in several prominent publications, quoting the Office of Science's Director Ray Orbach.
- **CFN:** In collaboration with the CFN facility and theme leaders, CEGPA helped develop and carry out plans to mark the construction milestones for the Center for Functional Nanomaterials. These included a planned visit by Congressman David Hobson for the site dedication in April and a planned groundbreaking including a visit by Congressman Tim Bishop scheduled for early October. For the April dedication, which drew over 300 employees and dignitaries to the dedication, CEGPA arranged for Hobson to tour the RHIC, NSLS and PET, all key to the Laboratory's vitality as a world-class research institution.
- **NSLS/NSLS-II:** In collaboration with the scientific team, the CEGPA executed plans to promote both the NSLS and NSLS-II during high-level visits and helped identify and publicize research at the NSLS, including research done by users.
- **Medical Imaging:** The CEGPA managed to retain steady media interest in addition research and featured this facility during key high-level stakeholders' visits.

Accomplishments (cont.)

- **Urban Dispersion Program:** In collaboration with five national laboratories, multiple government agencies at the federal, state and city levels and several academic institutions, the CEGPA partnered with the scientific team to conduct two field studies in Manhattan (March and August). The collaborators deemed the studies a success, with special acknowledgment of Brookhaven as the on-location laboratory with responsibilities for helping to establish relationships with the community, city agencies, universities and local media. News coverage was thorough, serving to alert and reassure the public about the field study and its importance for Homeland Security.
 - The Office of Educational Programs arranged for 40 CUNY students to help with sampling during the March field study, thus saving the research program \$20K in labor costs. The success of the first study led to expanding school involvement for the August study, which included another 40 students over three weeks from ten Long Island, New York City and upstate New York schools.
- **World Year of Physics:** The CEGPA identified the World Year of Physics (WYoP) as a major opportunity to promote the DOE as the single largest supporter of basic research in the physical sciences in the United States. During the fiscal year, the CEGPA updated Brookhaven's physics timeline and narrative, posted the complete physics history package online and printed the timeline in the Bulletin. The CEGPA also focused on several community and student activities on WYoP, such as the essay contest and Summer Sundays linked all physics news releases and physics talks to the World Year of Physics website and arranged for the participation of Quantum Diaries, through the RHIC physicist Peter Steinberg.

Accomplishments (cont.)

- **Bio-diesel Workshop:** The CEGPA supported BNL's researchers in planning and hosting a biodiesel workshop, partnering with the Greater Long Island Clean Cities Coalition, the Town of Brookhaven and the Northeast Regional Biomass Program. The workshop drew 180 participants, including a keynote presentation by Congressman Bishop and a legislative roundtable session with interested Suffolk County legislators leading the discussion.

Operations Priorities

- **Low-cost Power Negotiations:** By offering political and communications counseling, the CEGPA supported the Laboratory's negotiations with New York State to provide a source of low-cost power to BNL. This negotiation involved the cooperation and agreement of three state agencies with the support of Senator Ken LaValle and Suffolk County Department of Economic Development.
- **Environmental Management:** The CEGPA supported the following milestones to ensure the maintenance of strategic stakeholder communications and involvement in the following projects:
 - Records of Decisions signed for the BGRR and Peconic River
 - Explanation of Significant Differences – changes made to the Record of Decision for groundwater cleanup of the Magothy aquifer and on-site plumes of Strontium-90
 - Long Term Response Action future plans for monitoring and surveillance of cleanup projects
 - HFBR decommissioning alternatives
 - Peconic River celebration - planned and held 9/22 .

Accomplishments (cont.)

- Celebration of Environmental Management cleanup set for 10/14.
- Five-year Review briefing to Community Advisory Council and Brookhaven Executive Roundtable
- Helped facilitate resolution issue of delays in rail shipments in July through government and media relations.
- **Safety:** In support of the Environment, Safety, Health and Quality Directorate, CEGPA did the following:
 - Developed a plan for safety community involvement and communications plan and submitted it to the ESH&Q Assistant Laboratory Director for review and implementation.
 - Assisted in developing, writing and editing safety communications materials for Monday Memo, Bulletin, ES&H Monthly Summary, Safety Partnership Week and Main Gate messages.
 - Coordinated campaigns for Safety Partnership Week, personal safety, bicycle safety, electrical safety, the Safety Solutions program and the Ice Cream Social celebration for the achievement of one million hours without a lost-time incident.
- **Research Support Building:** In collaboration with a Plant Engineering team, the CEGPA helped to plan and execute a groundbreaking ceremony for the Research Support Building in March. Over 100 employees and users participated, along with representatives from the architectural and construction companies, members of the Community Advisory Council and NYS Assemblyman Fred Thiele.
- **Communications and Activity Checklist:** The CEGPA developed and implemented a communications and activity checklist to coordinate BNL's events and to ensure the promotion of the DOE.
- **Natural Resources Management Program:** In collaboration with the Natural Resources manager, the CEGPA developed and established a community involvement and communications plan that focused on the following areas:
 - Wild fire and control burn management – conducted a successful internal and external communications and outreach preparing for preparation of the Laboratory's first controlled burn in October 2004.
 - Cultural resource protection and management – conducted communications and outreach through the Speakers Bureau, Berkner Hall exhibit, tours and a special Summer Sunday that highlighted the site's history.
 - Education and outreach – utilized the Office of Educational Program's visiting students and faculty to explore six areas of interest under BNL's Natural Resources Management program.

MEASURE 3.6.1.2 Expanding Partnership Opportunities

Outstanding: 4.0

Summary of Performance Measure

Expanding partnership opportunities with targeted educational institutions in New York City, Long Island, New York State, Historically Black Colleges and Universities, minority serving institutions, target agencies and professional societies.

Specific Status of Metric

- Expanded partnerships with National Science Foundation, supported Historically Black Colleges and Universities (HBCUs) and minority serving institutions to further reduce the DOE cost per student at BNL by another 13%, beyond the 40% reductions in FY2004.
- Expanded relationships with Hofstra and Stony Brook Universities to include 200 middle and high school students and over 200 teachers in multiple programs. Also, partnered with the DOE/NSF funded Center for Environmental Molecular Science to receive a \$90M supplement for student and teacher programs.
- Expanded the impact of the Urban Dispersion Program through coordination of multiple university participation in the data collection events.
- Evaluated the existing Educational Programs focusing on relationships that are most valuable to the Laboratory. A number of programmatic changes were made, as well as an increased effort to target the participation of elected officials during program events.
- Established a Workforce Development/Science Education Committee.
- Promoted and supported the U.S. Dept. of Energy by conducting Middle School and High School Science Bowls and participating in the following DOE sanctioned events: Junior Academy of Scientists, What's Next Expo, Senator Bingaman teacher development conference and the National Science Teachers Association Annual Conference

Performance Metric

An independent third-party review team, the Communications and Trust Advisory Panel, will evaluate the results of meeting the objective 3.6. The individuals on the panel are recognized as experts in the fields of public affairs, community, communications and web design.

The program will be measured against the nationally recognized Baldrige Criteria for Approach, Deployment and Results.

- Promoted DOE workforce development programs through participation at numerous conferences and interfaced with dozens of universities and colleges

Accomplishments

- **Evaluation of Existing Educational Programs:** Substantial changes in CEGPA's Office of Educational Programs were focused on relationship building, programmatic impact and overall value to the Laboratory. The evaluation process was conducted through both formal and informal mechanisms with the following primary audiences considered: Program participants, Laboratory researchers and technical staff, DOE's Office of Workforce Development for Teachers and Scientists and the Lab's newly formed Workforce Development/Science Education Committee.
 - A mid-year review from DOE's Office of Workforce Development for Teachers and Scientists stated that the Office of Educational Programs was well managed in terms of efficiency and application of DOE funding. The Office of Educational Programs was cited as a "...model of how program managers working as a team can leverage each others' efforts to support the entire WDTS and National Laboratory goals. They are also a model for integrating the strategic goals of OEP, the guidelines of WDTS and the needs of the students."

Accomplishments (cont.)

- The Workforce Development Science Education Committee was established in May 2005. The Committee gave feedback in the following areas: educational programs, student safety, graduate/postdoctoral participation, benefits of educational initiatives in research productivity and opportunities.
- **Expanding Partnership Opportunities:** CEGPA achieved outstanding results in cultivating existing partnerships, developing new ones and leveraging the Department of Energy funded programs.
 - Faculty and student teams – BNL has substantially increased the participation from one team in 2003 to 10 teams in 2005. Continued relationships in 2005 with the 2004 participants has led to \$6.1 million in collaborative research proposals submitted to various funding agencies. Of the ten teams hosted in 2005, five were from HBCUs, two from minority serving institutions and two from Hispanic serving institutions.
 - Hofstra University partnership – This new partnership led to educational programs presenting at a plenary session to approximately 40 New York State colleges and universities. This made possible the participation of students from 10 New York State schools in the Urban Dispersion Program.
 - Center for Environmental Molecular Science – BNL and SUNY Stony Brook submitted a joint proposal to NSF supporting research conducted at NSLS. The \$100M educational outreach grant was awarded in which BNL received \$80M for FY2005- 2006.
 - Dowling College partnership – BNL and Dowling expanded a two-week program to six weeks in support of the Center for Minority Teacher Development and Training.
 - New York State Office of Science, Technology and Academic Research (NYSTAR) – NYSTAR and BNL partnered in supporting middle school teachers and students in several under-performing districts in New York State.

MEASURE 3.6.1.3 Internal Communications and Involvement

Outstanding: 4.0

Summary of Performance Measure

Developing and implementing a policy, plan and process for internal communications and involvement.

Specific Status of Metric

- Developed an internal communications and involvement policy, plan and procedure with input from the Internal Communications and Involvement Working Group.
- Identified top internal challenges/issues and worked with Lab managers to develop and implement communications and involvement plans for each, including:
 - Lab priority initiatives/strategic planning process
 - Budget/layoffs/benefits/salary changes
 - Severance/vacation/hiring changes
 - Security badge requirement changes
- Supported the Lab Director's goal of increasing employee understanding of the Lab's priority initiatives and strategic planning process.

Performance Metric

An independent third-party review team, the Communications and Trust Advisory Panel, will evaluate the results of meeting the objective 3.6. The individuals on the panel are recognized as experts in the fields of public affairs, community, communications and web design.

The program will be measured against the nationally recognized Baldrige Criteria for Approach, Deployment and Results.

Accomplishments

- Internal Communications/Involvement policy, plan and procedure: CEGPA worked with the Lab's Internal Communications and Involvement Working Group to develop a policy, plan and procedure and to make those documents part of the Lab's Standards-Based Management System.
 - This new process was specifically designed to enhance employee communications and involvement and more strongly tie Lab managers to issue identification and two-way communication responsibilities.
 - The working group, which represents a cross section of employees, managers and users, served as a sounding board/mini-focus group at several points during the year, helped to identify specific and immediate concerns and quantified the effectiveness of communications on these issues.
- Identifying issues and topics of interest important to the internal community: FY2005 was a year of multiple and continual challenges for internal communications and involvement. As the Laboratory faced serious funding, staffing, safety, and other issues, a broad range of activities were planned to meet the information needs of the internal community and provide timely, complete and honest facts regarding these issues. A total of five formal communications plans was developed and implemented during the year. In addition, CEGPA supported DOE-BHSO on a sixth plan regarding workforce-restructuring communications.

Accomplishments (cont.)

- Lab priority initiatives/strategic plan – The Lab Director’s focus for FY2005 was to help employees understand his strategic plan for the Lab’s future growth and success. CEGPA played a key role in helping to implement a communications plan that included preparations for two all-employee meetings (November and July), Monday Memo, Bulletin, intra- and internet content and streaming video.
- Benefits/Budget/Layoffs – During FY2005 the Lab underwent two rounds of benefit/salary impacts. In response to anticipated employee concerns, two separate communications plans were developed and implemented. Preparations included two brown bag sessions, Bulletin, Monday Memo and web communications and streaming video. In addition, CEGPA supported DOE on developing and implementing a workforce restructuring communications and involvement plan.
- Severance/vacation/hiring changes – The Lab implemented three modifications to employee benefits and hiring in FY2005, due to flat budgets and increased costs. Changes included a blanket hiring freeze, a new cap on severance pay for laid-off employees and a four-day reduction in allowable vacation carryover balance. In anticipation of the effects this would have on employee morale, CEGPA supported Lab management in preparing a communications strategy and messages for communication with employees on these issues.
- Security – In anticipation of a Presidential directive on access to federal sites that requires standardized identification of all federal employees and contractors, CEGPA helped coordinate a communications effort to begin preparing employees and users for the changes in security badge requirements. A communications team was formed; a communications plan was written and implementation began in August.

Abbreviations and Acronyms

A/R	Accounts Receivable	CBT	Computer Based Training
AAU	Association of American Universities	CD	Critical Decision
ACI	Asset Condition Index	CEGPA	Community, Education, Government and Public Affairs
ACWP	Actual Cost of Work Performed	CERF	Controlled Environment Radiation Facility
AF	Alternative Financing	CERN	European Centre for Nuclear Research
AGS	Alternating Gradient Synchrotron	CFN	Center for Functional Nanomaterials
ALD	Assistant/Associate Laboratory Director	CFO	Chief Financial Officer
AMIP	Acquisition Management System Improvement Plan	CFR	Code of Federal Regulations
AP	Accounts Payable	CIO	Chief Information Officer
AS	Acquisition Strategy	CMS	Chemical Management System
ASAP	Association for Students and Postdocs	CNG	Compressed Natural Gas
ATS	Assessment Tracking System	CO	Chemistry Department
BCWP	Budgeted Cost of Work Performed	COTS	Commercial Off-the-Shelf
BERA	Brookhaven Employees Recreation Association	CPI	Cost Performance Index
BES	Basic Energy Sciences	CRADA	Cooperative Research and Development Agreement
BGRR	Brookhaven Graphite Research Reactor	CSHL	Cold Spring Harbor Laboratory
BHSO	Brookhaven Site Office	CTAP	Communications and Trust Advisory Panel
BJV	Budget Journal Voucher	CUNY	City University of New York
BMRR	Brookhaven Medical Research Reactor	CY	Calendar Year
BNL	Brookhaven National Laboratory	D&D	Decontamination and Decommissioning
BO	Biology	DARPA	Defense Advanced Research Projects Agency
BSA	Brookhaven Science Associates	DART	Days Away, Restricted, or Transferred
BSB	Bio Chemistry and Structural Biology	DOD	Department of Defense
BSC	Balanced Scorecard	DOE	Department of Energy
BSD	Business Systems Division	DOE-CH	Chicago Operations Office
BTMS	Brookhaven Training Management System	DOE-HQ	DOE/Headquarters
C&A	Certification and Accreditation	DOELAP	Department of Energy Laboratory Accreditation Program
CA	Consequence Assessment	DOE-OA	DOE Office of Independent Oversight and Performance Assurance
CAA	Clean Air Act		
CAC	Community Advisory Council	DSL	Digital Subscriber Line
C-AD (CAD)	Collider-Accelerator Department	EAL	Emergency Action Level
CBS	Chemical Bulk Storage	ECR	Environmental Compliance Representative

Abbreviations and Acronyms (cont.)

EENS	Energy, Environment & National Security	HMTS	Hazardous Material Transportation Safety
EM	DOE Environmental Management	HP	Health Physics
EMS	Environmental Management System	HR	Human Resources
EPA	United States Environmental Protection Agency	HSPD	Homeland Security Presidential Directive
EPHA	Emergency Preparedness Hazards Assessments	IA&O	Internal Audit and Oversight Office
EPZ	Emergency Planning Zone	IDA	Industrial Development Agency
ERO	Emergency Response Organization	IEEE	Institute of Electrical and Electronics Engineers
ERP	Enterprise Resource Planning	IH	Industrial Hygiene
ES&H	Environment, Safety and Health	INEL	Idaho National Engineering Laboratory
ESDC	Empire State Development Corporation	IRB	Institutional Review Board
ESH	Environment, Safety and Health	ISD	Information Services Division
ESOL	English for Speakers of Other Languages	ISM	Integrated Safety Management
ESR	Electrical System Reliability	ISSM	Integrated Safeguards and Security Management
ETR	Electronic Timecard Reporting	ITD	Information Technology Division
EVMS	Earned Value Management System	JTA	Job Training Assessment
EWMS(D)	Environment and Waste Management Services Division	LANL	Los Alamos National Laboratory
F&O	Facilities & Operations Directorate	LCD	Liquid Crystal Display
FTEs	Full-Time Employees	LDRD	Laboratory Directed Research and Development
FUA	Facility Use Agreement	LIPA	Long Island Power Authority
FWP	Field Work Proposal	LIRR	Long Island Railroad
FY	Fiscal Year	LLP	Limited Liability Partnership
FYE	Fiscal Year End	LS	Light Source
GAC	General Advisory Council	LTRA	Long Term Response Action
GCRC	General Clinical Research Center	MBE	Molecular-Beam-Epitaxy
GEM	Gas Electron Multiplier	MC&A	Material, Control and Accountability
GIS	Guest Information System	MCT	Micro Computed Tomography
GPP	General Plant Projects	MII	Maintenance Investment Index
GSS	Global System Shops	MOSF	Major Oil Storage Facilities
HBCU	Historically Black Colleges and Universities	MOT	Materials of Trade
HBD	Hadron Blind Detector	MOU	Memorandum Of Understanding
HFBR	High Flux Beam Reactor	MRI	Magnetic Resonance Imaging
HHMI	Howard Hughes Medical Institute	MRSEC	Materials Research Science and Engineering Centers

Abbreviations and Acronyms (cont.)

MS	Management System	OSHA	Occupational Safety and Health Administration
MS	Master of Science	PAAA	Price Anderson Amendment Act
NARA	National Archives and Records Administration	PCBs	Polychlorinated Biphenyls
NFPA	National Fire Protection Association	PERT	Program Evaluation and Review Technique
NIMS	National Incident Management System	PET	Positron Emission Tomography
NNSA	National Nuclear Security Administration	PNNL	Pacific Northwest National Laboratory
NP	Nuclear Physics	PO	Physics Department
NRTL	Nationally-Recognized Testing Laboratory	PO	Purchase Order
NSF	National Science Foundation	POC	Point of Contact
NSLS	National Synchrotron Light Source	POM	Procurement Operations Manual
NSSI	Nuclear Source Services, Inc.	PPM	Procurement and Property Management
NTS	Non-compliance Tracking System	PuBe	Plutonium-238 Beryllium
NY&AR	New York & Atlantic Railroad	QA	Quality Assurance
NYPA	New York Power Authority	QMS	Quality Management System
NYS	New York State	R&D	Research and Development
NYSDEC	New York State Department of Environmental Conservation	R2A2	Roles, Responsibilities, Accountabilities, and Radiological Control Division
NYSERDA	New York State Energy Research & Development	RCD	Resource Conservation and Recovery Act
NYSTAR	New York State Office of Science, Technology, and Academic Research	RCRA	RESidual RADioactive Material Computer Code
NYU	New York University	RESRAD	Request for Proposal
OA	DOE Office of Independent Oversight and Performance Assurance	RFP	Request for Quotation
OEP	Office of Educational Programs	RFQ	Relativistic Heavy Ion Collider
OGC	Office of Government Commerce	RHC	Infrastructure Reliability Index
OHSAS	Occupational Health and Safety Assessment Series	RI	Records Management Application
OIG	Office of Inspector General	RMA	Real Property Asset Management
OM	Occupational Medicine	RPAM	Rensselaer Polytechnic Institute
OMB	Office of Management and Budget	RPI	Research Support Building
OMC	Occupational Medicine Clinic	RSB	Rare Symmetry Violating Processes
OPSEC	Operations Security	RSVP	Science and Technology
ORNL	Oak Ridge National Laboratory	S&T	Suspect/Counterfeit Item
ORPS	Occurrence Reporting and Processing System	S/CI	Self-Assessment
OSH	Occupational Safety and Health	SA	Small Business Innovation Research
		SBIR	Standards-Based Management System
		SBMS	

Abbreviations and Acronyms (cont.)

SBU	Stony Brook University
SC	DOE Office of Science
SCBA	Self-Contained Breathing Apparatus
SCDHS	Suffolk County Department of Health Services
SER	Site Environmental Report
SGL	Standard General Ledger
SMACS	Special Material Accountability Control System.
SPDES	State Pollution Discharge Elimination System
SPI	Schedule Performance Index
SPI	Standard Practice Instruction
SSD	Safeguards and Security Division
STARS	Standard Accounting and Reporting System
STOP	Safety Training Observation Program
STP	Sewage Treatment Plant
SUNY	State University of New York
SUR	Shared University Research
SUV	Special-Use Vehicle
TCEAP	Transportation Compliance Evaluation/Assistance Program
TEC	Total Estimated Cost
TIA	Timely Initial Assessment
TPC	Total Project Cost
TRC	Total Recordable Case
TRU	Transuranic Waste
USAF	United States Air Force
VP	Vice President
WCC	Work Control Coordinator
WCM	Work Control Manager
WDTS	Workforce Development for Teachers and Scientists
WFO	Work for Others
WIPP	Waste Isolation Pilot Plant
WP&C	Work Planning & Control
WYoP	World Year of Physics