2 Environmental Management System

One of Brookhaven National Laboratory's highest priorities is ensuring that its environmental performance measures up to its world-class status in science. The contractor operating the Laboratory on behalf of DOE, Brookhaven Science Associates (BSA), takes environmental stewardship very seriously. As part of their commitment to environmentally responsible operations, they have established the BNL Environmental Management System (EMS). One measure of an effective EMS is recognition of good environmental performance. In 2006, BNL was recognized by DOE's Office of Science with a "Best in Class" award for expanding the envelope of the Laboratory's EMS through voluntary participation, designing a system to compost animal bedding, and for recycling and reusing waste concrete on site. BNL was also honored with a National Partnership for Environmental Priorities award for reducing both its mercury waste generation and its inventory of polychlorinated biphenyls.

An EMS ensures that environmental issues are systematically identified, controlled, and monitored. Moreover, an EMS provides mechanisms for responding to changing environmental conditions and requirements, reporting on environmental performance, and reinforcing continual improvement. The Laboratory's EMS was designed to meet the rigorous requirements of the globally recognized International Organization for Standardization (ISO) 14001 Environmental Management Standard, with additional emphasis on compliance, pollution prevention, and community involvement.

Annual audits are required to maintain EMS registration. Recertification audits of the entire EMS occur every three years. In 2006, an EMS Surveillance Audit determined that BNL remains in conformance with the ISO 14001: 2004 Standard.

BNL continued its strong support of the Pollution Prevention Program. This program seeks ways to eliminate waste and toxic materials and is the preferred approach to resolving environmental issues at the Laboratory. In 2006, pollution prevention projects saved more than $1.8 million and resulted in the reduction or reuse of approximately 13 million pounds of waste. Also in 2006, the BNL Pollution Prevention Council funded 11 new proposals or special projects, investing approximately $37,000. Anticipated annual savings from the projects are estimated at approximately $74,000, for an average payback period of less than one year. The ISO 14001-registered EMS and the nationally recognized Pollution Prevention Program continue to contribute to the Laboratory's success in promoting pollution prevention.

BNL continues to address legacy issues under the Environmental Restoration Program and openly communicates with neighbors, regulators, employees, and other interested parties on environmental issues and cleanup progress on site.

2.1 INTEGRATED SAFETY MANAGEMENT, ISO 14001, AND OHSAS 18001

The Laboratory's Integrated Safety Management System (ISMS) integrates environment, safety, and health management into all work planning. The integrated safety processes within ISMS contributed to BNL's Environmental Management System achieving the International Organization for Standardization (ISO) 14001 registration and the Laboratory's Safety and Health Program achieving Occupational Safety and Health Assessment Series (OHSAS) 18001 Registration.

The ISO 14001 Standard is globally recognized and defines the structure of an organization's EMS for purposes of improving environmental performance. OHSAS 18001 mirrors the ISO14001 structure. The process-based structure of the ISO 14001 and OHSAS 18001 standards are based on the "Plan-Do-Check-Act" improvement cycle. Both standards require an organization to develop a policy, create plans to implement the policy, implement the plans, check progress and take corrective actions, and review the system periodically to ensure its continuing suitability, adequacy, and effectiveness. To gain registration to the ISO 14001 and OHSAS 18001 standards, an organization must comply with the set of requirements listed and described in Table 2-1. Table 2-1 also defines where these requirements fit into the ISMS structure.

BNL's EMS was officially registered to the ISO 14001 Standard in July 2001 and was the first DOE Office of Science Laboratory to obtain third-party registration to this globally recognized environmental standard. Similarly, BNL was offically registered to the OHSAS 18001 Standard in 2006, and was again the first DOE Office of Science Laboratory to achieve this registration. Each certification requires the Laboratory to undergo annual audits by an accredited registrar to assure that the system is maintained.

In 2006, an EMS and OHSAS Surveillance Audit determined that BNL remains in conformance with the ISO 14001 and OHSAS 18001 standards. In their recommendation for continued certification, auditors from NSF-International Strategic Registrations, Ltd. highlighted eight examples of BNL's continual improvement, some of which include the Laboratory's

Table 2-1. Elements of the Environmental Management System (EMS) and their Relationship to OHSAS 18001 and Integrated Safety Management (ISM) – Review of EMS Implementation at BNL.

ISO 14001 EMS Clause	OHSAS 18001 Clause	ISM Guiding Principle and Core Function
4.2 Environmental policy	4.2 OH&S policy	Core function 1: Define scope of work Guiding principle 1: Line manager clearly responsible for ES&H
The Environmental, Safety, Security, and Health Policy is a statement of BNL's intentions and principles regarding overall environmental, safety, security, and health performance. It provides a framework for planning and action. In the policy, BNL has reaffirmed its commitment to the environment, safety, security, health, compliance, the community, and continual improvement.		
4.3.1 Environmental aspects	5.3.1 Planning for hazard identification, risk assessment and risk control	Core function 2: Identify and analyze hazards associated with the work Guiding principle 5: Identify ES&H standards and requirements
When operations have an environmental aspect, BNL implements the EMS to minimize or eliminate any potential impact. BNL evaluates its operations, identifies the aspects of operations that can impact the environment, and determines which of those potential impacts are significant. BNL has determined that the following aspects of its operations have the potential to affect the environment:		
▪ Waste generation ▪ Atmospheric emissions ▪ Liquid effluents ▪ Storage or use of chemicals and radioactive materials ▪ Natural resource usage — power and water consumption	▪ Historical and cultural resources ▪ Environmental noise ▪ Disturbances to endangered species/ protected habitats ▪ Soil activation ▪ Historical contamination	

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Table 2-1. Elements of the Environmental Management System (EMS) and their Relationship to OHSAS 18001 and Integrated Safety Management (ISM) – Review of EMS Implementation at BNL *(continued)*.

ISO 14001 EMS Clause	OHSAS 18001 Clause	ISM Guiding Principle and Core Function
4.3.2 Legal and other requirements	4.3.2 Legal and other requirements	Core function 2: Identify and analyze hazards associated with the work Guiding principle 5: Identify ES&H standards and requirements
BNL has implemented and continues to improve the Standards Based Management System (SBMS), a BNL web-based system designed to deliver Laboratory-level requirements and guidance to all staff. New or revised requirements (e.g., new regulations) are analyzed to determine their applicability, and to identify any actions required to achieve compliance. This may involve developing or revising BNL documents or operating procedures, implementing administrative controls, providing training, installing engineered controls, or increasing monitoring.		
4.3.3 Objectives Targets and Programs	4.3.3 Objectives 4.3.4 OH&S management program(s)	Core function 1: Define the scope of work Guiding principle 5: Identify ES&H standards and requirements
The Performance Based Management System is designed to develop, align, balance, and implement the Laboratory's strategic objectives, including environmental objectives. Objectives and targets are developed by fiscal year (FY). The following were the objectives and targets in FY 06: ▪ Continually improving the EMS ▪ Improving compliance in targeted areas ▪ Integrating pollution prevention into work planning ▪ Improving communications, trust, and relationships with stakeholders on environmental programs and issues ▪ Fully implementing the BNL Groundwater Protection Management Program ▪ Ensuring responsible stewardship of natural and historical resources on site ▪ Implementing environmental restoration projects efficiently Organizations within BNL develop action plans detailing how they will achieve their objectives and targets and commit the necessary resources to successfully implement both Laboratory-wide programs and facility-specific programs. The Laboratory has implemented a Pollution Prevention Program to conserve resources and minimize waste generation. BNL also has a budgeting system designed to ensure that priorities are balanced and that resources essential to the implementation and control of the EMS are provided.		
4.4.1 Resources, roles, responsibilities and authority	4.4.1 Structure and responsibility	Core function 1: Define the scope of work Guiding principle 1: Line manager clearly responsible for ES&H Guiding principle 2: Clear ES&H roles and responsibilities Guiding principle 4: Balanced priorities
All employees at the Laboratory have specific roles and responsibilities in key areas, including environmental protection. Environmental and waste management technical support personnel assist the line organizations with developing and meeting their environmental responsibilities. Every BNL employee is required to develop a Roles, Responsibilities, Accountabilities, and Authorities document signed by the employee, their supervisor, and the supervisor's manager. Specifics on environment, safety, and health performance expectations are included in these documents.		
4.4.2 Competence, training and awareness	4.4.2 Training, awareness and competence	Core function 4: Perform work within controls Guiding principle 3: Competence commensurate with responsibilities
Extensive training on EMS requirements has been provided to staff whose responsibilities include environmental protection. The training program includes general environmental awareness for all employees, regulatory compliance training for selected staff, and specific courses for managers, internal assessors, EMS implementation teams, and operations personnel whose work can impact the environment.		
4.4.3 Communication	4.4.3 Consultation and communication	Core function 4: Perform work within controls Core function 5: Provide feedback on adequacy of controls and continue to improve safety management Guiding principle 2: Clear ES&H roles and responsibilities
BNL continues to improve processes for internal and external communications on environmental issues. The Laboratory solicits input from interested parties such as community members, activists, civic organizations, elected officials, and regulators. This is accomplished primarily through the Citizens Advisory Committee and the Brookhaven Executive Roundtable. At the core of the communication and community involvement programs are the Environmental Safety, Security, and Health Policy and the Community Involvement Plan.		

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Table 2-1. Elements of the Environmental Management System (EMS) and their Relationship to OHSAS 18001 and Integrated Safety Management (ISM) – Review of EMS Implementation at BNL *(continued).*

ISO 14001 EMS Clause	OHSAS 18001 Clause	ISM Guiding Principle and Core Function
4.4.4 Documentation	4.4.4 Documentation	Core function 2: Identify and analyze hazards associated with the work Guiding principle 6: Hazard controls tailored to work Guiding principle 7: Operations authorization
BNL has a comprehensive, up-to-date set of Laboratory-wide environmental documents describing the EMS. Using the SBMS, staff can access detailed information on regulatory requirements, Laboratory-wide procedures, and manuals on how to control processes and perform their work in a way that protects the environment. The SBMS has improved the quality, usability, and communication of Laboratory-level requirements.		
4.4.5 Control of documents	4.4.5 Document and data control	Core function 4: Perform work within controls Guiding principle 6: Hazard controls tailored to work
The SBMS includes a comprehensive document control system to ensure effective management of procedures and other requirements documents. When facilities require additional procedures to control their work, document control protocols are implemented to ensure that workers have access to the most current versions of procedures.		
4.4.6 Operational control	4.4.6 Operational control	Core function 2: Identify and analyze hazards associated with the work Core function 3: Develop and implement hazard controls Core function 4: Perform work within controls Guiding principle 5: Identify ES&H standards and requirements Guiding principle 6: Hazard controls tailored to work Guiding principle 7: Operations authorization
Operations at the Laboratory are evaluated for the adequacy of current controls to prevent impacts to the environment. As needed, additional administrative or engineered controls are identified, and plans for upgrades and improvements are developed and implemented.		
4.4.7 Emergency preparedness and response	4.4.7 Emergency preparedness and response	Core function 2: Identify and analyze hazards associated with the work Core function 3: Develop and implement hazard controls Guiding principle 6: Hazard controls tailored to work
BNL has an Emergency Preparedness and Response Program and specialized staff to provide timely response to hazardous materials or other environmental emergencies. This program includes procedures for preventing, as well as responding to, emergencies.		
4.5.1 Monitoring and measurement	4.5.1 Performance measurement and monitoring	Core function 5: Provide feedback on adequacy of controls and continue to improve safety
Effluent and emission monitoring helps ensure the effectiveness of controls, adherence to regulatory requirements, and timely identification and implementation of corrective measures. BNL has a comprehensive, sitewide Environmental Monitoring Program. Monitoring results are reported to regulatory agencies and are summarized annually in the Site Environmental Report. In addition, BNL tracks and trends its progress and performance in achieving environmental objectives and performance measures.		
4.4.2 Evaluation of compliance	NA	Core function 5: Provide feedback on adequacy of controls and continue to improve safety
Specific environmental legislation and regulations are evaluated and assessed on a program- or facility-specific basis. BNL has established a documented procedure for periodically evaluating its compliance with relevant environmental regulations. This procedure is often integrated in an organization's environmental, safety, and health inspection process, which is performed in a prioritized fashion by a team of experts including one on environmental regulatory issues. Periodically, the environmental support organizations will perform a regulatory assessment in a particular topical area to verify the compliance status of multiple organizations throughout the Laboratory. Lastly, external regulatory agencies and/or technical experts may conduct independent audits of compliance.		
4.5.3 Nonconformance, corrective action and preventative action	4.5.2 Accidents, incidents, non-conformances and corrective and preventative action	Core function 5: Provide feedback on adequacy of controls and continue to improve safety
BNL continues to improve processes that identify and correct problems. A Lessons Learned Program to prevent recurrences, a sitewide Self-Assessment Program, and an electronic web-based assessment and action tracking system have been implemented.		

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Table 2-1. Elements of the Environmental Management System (EMS) and their Relationship to OHSAS 18001 and Integrated Safety Management (ISM) – Review of EMS Implementation at BNL *(concluded).*

ISO 14001 EMS Clause	OHSAS 18001 Clause	ISM Guiding Principle and Core Function
4.5.2 Control of records	4.5.3 Records and records management	Core function 2: Identify and analyze hazards associated with the work Guiding principle 6: Hazard controls tailored to work Guiding principle 7: Operations authorization
EMS-related records, including audit and training records, are maintained to ensure integrity, facilitate retrieval, and protect them from loss.		
4.5.5 Internal audit	4.5.4 Audit	Core function 5: Provide feedback on adequacy of controls and continue to improve safety
To periodically verify that the EMS is operating as intended, audits are conducted. These audits, which are part of the sitewide Self-Assessment Program, are designed to ensure that any nonconformance to the ISO 14001 Standard is identified and addressed. An independent accredited registrar also conducts ISO 14001 registration audits. In addition, compliance with regulatory requirements is verified through routine inspections, operational evaluations, and periodic audits.		
4.6 Management review	4.6 Management review	Core function 5: Provide feedback on adequacy of controls and continue to improve safety Guiding principle 1: Line manager clearly responsible for ES&H
In addition to audits, a management review process has been established to involve top management in the overall assessment of environmental performance, the EMS, and progress toward achieving environmental goals. This review also identifies, as necessary, the need for changes to, and continual improvement of, the EMS.		

commitment to fund pollution prevention and safety projects, improved methods for addressing corrective actions, the use of lessons learned, and management's response to comments and suggestions from employees. The auditors also identified two minor nonconformances in document control and management review and two opportunities for improvement in "objectives, targets and programs," and "nonconformances." A corrective action plan was prepared to track minor nonconformances to closure.

2.2 ENVIRONMENTAL, SAFETY, SECURITY, AND HEALTH POLICY

The cornerstone of an EMS is a commitment to environmental protection at the highest levels of an organization. BNL's environmental commitments are incorporated into a comprehensive Environmental, Safety, Security, and Health (ESSH) Policy. In 2006, the policy was revised to improve its focus for all employees. The policy, issued and signed by the Laboratory Director, makes clear the Laboratory's commitment to environmental stewardship, the safety of the public and BNL employees, and the security of the site. The policy continues as a statement of the Laboratory's intentions and principles regarding overall environmental performance. It provides a framework for planning and action and is included in employee, guest, and contractor training programs. The ESSH Policy is posted throughout the Laboratory and on the BNL website at http://www.bnl.gov. The goals and commitments focusing on compliance, pollution prevention, community outreach, and continual improvement include:

- **ENVIRONMENT:** We protect the environment, conserve resources, and prevent pollution.
- **SAFETY:** We maintain a safe workplace, and we plan our work and perform it safely. We take responsibility for the safety of ourselves, coworkers, and guests.
- **SECURITY:** We protect people, property, information, computing systems, and facilities.
- **HEALTH:** We protect human health within our boundaries and in the surrounding community.
- **COMPLIANCE:** We achieve and maintain compliance with applicable ESSH requirements.
- **COMMUNITY:** We maintain open, proactive, and constructive relationships with our em-

ployees, neighbors, regulators, DOE, and our other stakeholders.

- **CONTINUAL IMPROVEMENT:** We continually improve ESSH performance.

2.3 PLANNING

The planning requirements of the ISO 14001 Standard require BNL to identify the environmental aspects and impacts of its activities, products, and services; to evaluate applicable legal and other requirements; to establish objectives and targets; and to create action plans to achieve the objectives and targets.

2.3.1 Environmental Aspects

An "environmental aspect" is any element of an organization's activities, products, and services that can interact with the environment. As required by the ISO 14001 Standard, BNL evaluates its operations, identifies the aspects that can impact the environment, and determines which of those impacts are significant. The Laboratory's criteria for significance are based on actual and perceived impacts of its operations and on regulatory requirements. BNL utilizes several processes to identify and review environmental aspects. Key among these is the Process Assessment Procedure. This is an evaluation that is documented on a Process Assessment Form, which consists of a written process description, a detailed process flow diagram, a regulatory determination of all process inputs and outputs, identification of pollution prevention opportunities, and identification of any assessment, prevention, and control measures that should be considered. Environmental professionals work closely with Laboratory personnel to ensure that environmental requirements are integrated into each process. Aspects and impacts are evaluated annually to ensure that they continue to reflect stakeholder concerns and changes in regulatory requirements. BNL's list of aspects and significance criteria remained unchanged in 2006.

2.3.2 Legal and Other Requirements

To implement the compliance commitments of the ESSH Policy and to meet its legal requirements, BNL has systems in place to review changes in federal, state, or local environmental regulations and to communicate those changes to affected staff. Laboratory-wide procedures for documenting these reviews and recording the actions required to ensure compliance are available to all staff through BNL's web-based Standards-Based Management System (SBMS) subject areas.

2.3.3 Objectives and Targets

The establishment of environmental objectives and targets is accomplished through BNL's Performance Based Management System. This system is designed to develop, align, balance, and implement the Laboratory's strategic objectives, including environmental objectives. The system drives BNL's improvement agenda by establishing a prioritized set of key objectives, called the Performance Evaluation Management Plan. The Laboratory and BSA work with DOE to clearly define expectations and performance measures. Factors for selecting environmental priorities include:

- Significant environmental aspects
- Risk and vulnerability (primarily, threat to the environment)
- Legal requirements (laws, regulations, permits, enforcement actions, and memorandums of agreement)
- Commitments (in the ESSH Policy) to regulatory agencies, and to the public
- Importance to DOE, the public, employees, and other stakeholders

Laboratory-level objectives and targets are developed on a fiscal year (FY) schedule. In FY06 (October 1, 2005 through September 30, 2006), BNL's environmental objectives included:

- Continually improving the EMS
- Improving compliance in targeted areas
- Integrating pollution prevention into all work planning
- Improving communications, trust, and relationships with stakeholders on environmental programs and issues
- Fully implementing the BNL Groundwater Protection Management Program
- Ensuring responsible stewardship of natural and historical resources on site
- Implementing environmental restoration projects efficiently

2.3.4 Environmental Management Programs

Each organization within BNL develops an action plan detailing how they will achieve their environmental objectives and targets and commit the resources necessary to successfully implement both Laboratory-wide and facility-specific programs. BNL has a budgeting system designed to ensure that priorities are balanced and to provide resources essential to the implementation and control of the EMS. The Laboratory has developed and funded several important environmental programs to further integrate environmental stewardship into all facets of BNL's missions.

2.3.4.1 Compliance

BNL has an extensive system to help ensure full compliance with all applicable environmental regulatory requirements and permits. Legislated compliance is outlined by the Clean Air Act, National Emission Standards for Hazardous Air Pollutants (NESHAPs), State Pollutant Discharge Elimination System (SPDES), and the Resource Conservation and Recovery Act (RCRA) and other programs. Other compliance initiatives at the Laboratory involve special projects, such as upgrading petroleum and chemical storage tank facilities, upgrading the sanitary sewer system, closing underground injection control devices, retrofitting or replacing air conditioning equipment refrigerants, and managing legacy waste. See Chapter 3 for a list of regulatory programs to which BNL subscribes, and a thorough discussion of these programs and their status.

2.3.4.2 Groundwater Protection

BNL's Groundwater Protection Management Program is designed to prevent negative impacts to groundwater and to restore groundwater quality by integrating pollution prevention efforts, monitoring groundwater restoration projects, and communicating performance. The Laboratory has also developed a Groundwater Protection Contingency Plan that defines an orderly process for quickly taking corrective actions in response to unexpected monitoring results. Key elements of the groundwater program are full, timely disclosure of any off-normal occurrences, and regular communication on the performance of the program. In 2005, BNL completed construction of the Strontium-90 Groundwater Treatment system, the last major system scheduled for construction. Chapter 7 and SER Volume II, Groundwater Status Report, provide additional details about this program, its performance, and monitoring results for 2006.

2.3.4.3 Waste Management

As a byproduct of the world-class research it conducts, BNL generates a large range of waste. This includes materials common to many businesses and industries, such as aerosol cans, batteries, paints, and oils. However, the Laboratory's unique scientific activities also generate waste streams that are subject to additional regulation and special handling, including radioactive, hazardous, and mixed waste.

Collecting, storing, transporting, and disposing of waste generated at the Laboratory is the responsibility of BNL's Waste Management Facility (WMF). This modern facility was designed for handling hazardous, industrial, radioactive, and mixed waste and is comprised of three staging areas: a facility for hazardous waste, regulated by RCRA; a mixed-waste building for material that is both hazardous and radioactive; and a reclamation building for radioactive material. The RCRA and mixed-waste buildings are managed under a permit issued by the New York State Department of Environmental Conservation (NYSDEC). These buildings are used for short-term storage of waste before it is packaged or consolidated for off-site shipment to permitted treatment and disposal facilities. In 2006, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 3.9 tons
- Mixed waste: 8.9 ft^3
- Radioactive waste: 3,678 ft^3

Hazardous and mixed waste from routine operations in 2006 decreased substantially from 2005, as shown in Figures 2-1a and 2-1b. The decreased mixed waste generation is attributed to reduced activities within the Collider-Accelerator Department. As shown in Figure 2-1c, the radioactive waste quantity for routine op-

erations in 2006 increased, but remained below quantities typically generated in previous years. This increase is attributed to increased funding and resulting operations within the high-energy nuclear physics program. Wastes generated from nonroutine or one-time events and wastes generated from environmental restoration activities are not included in the figures.

Routine operations are defined as ongoing industrial and experimental operations. BNL is currently cleaning up facilities and areas containing radioactive and chemical contamination resulting from long-past operations. Waste recovered through restoration and decommissioning activities is managed by the Environmental Restoration (ER) group, with oversight by BNL's Environmental and Waste Management Services Division (EWMSD). In 2006, EWMSD continued surveillance and maintenance operations for the Brookhaven Medical Research Reactor (BMRR) and began working with Plant Engineering staff to prepare the Former Hot Laundry and Decontamination Facility for demolition. Waste generation activity associated with the BMRR and the Decontamination Facility is reflected in the nonroutine waste values. Nonroutine waste typically includes construction and demolition waste, environmental restoration waste, legacy waste, lead-painted debris, lead shielding, and polychlorinated biphenyl

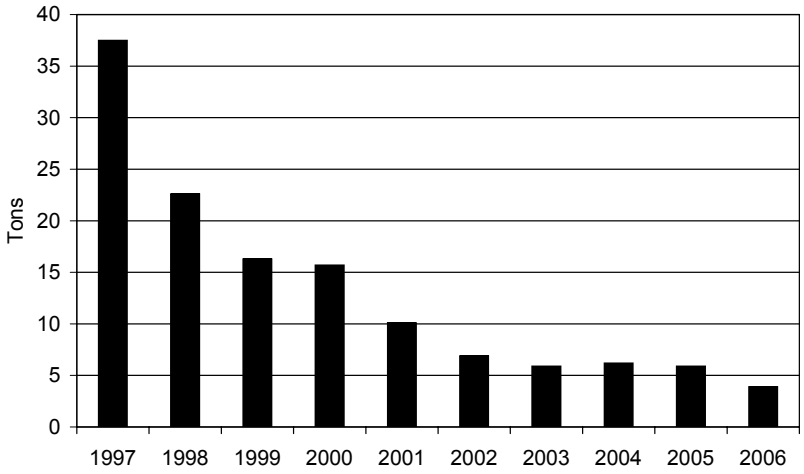

Figure 2-1a. Hazardous Waste Generation from Routine Operations, 1997 – 2006.

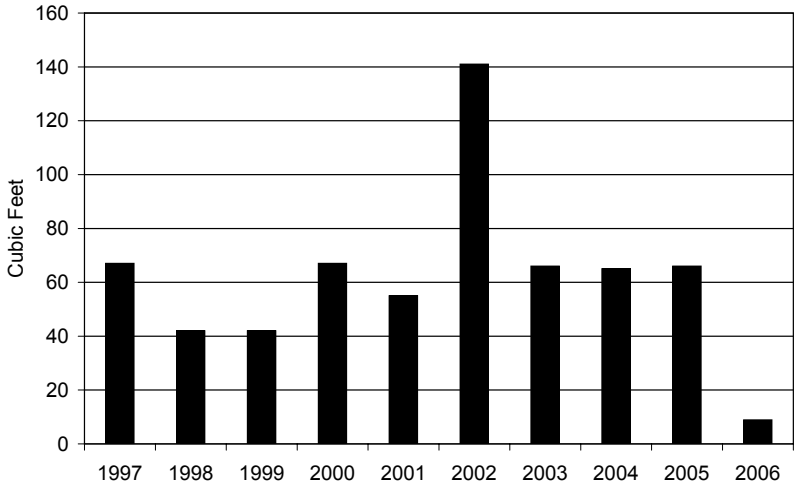

Figure 2-1b. Mixed Waste Generation from Routine Operations, 1997 – 2006.

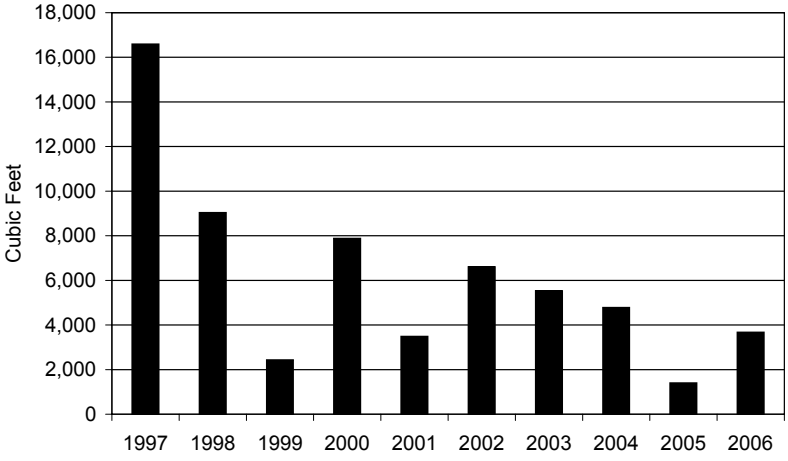

Figure 2-1c. Radioactive Waste Generation from Routine Operations, 1997 – 2006.

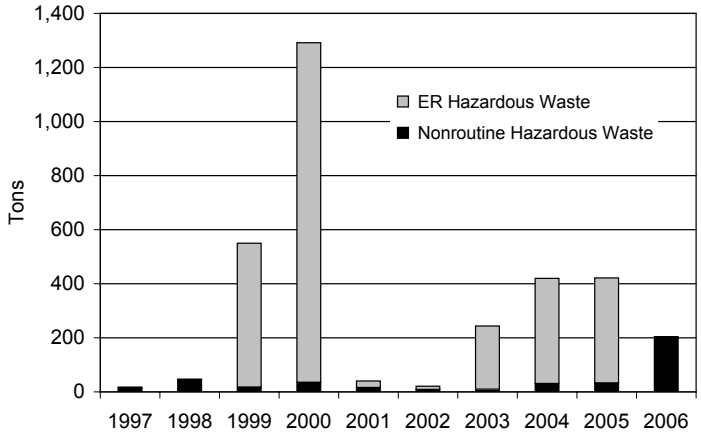

Figure 2-1d. Hazardous Waste Generation from ER and Nonroutine Operations, 1997 – 2006.

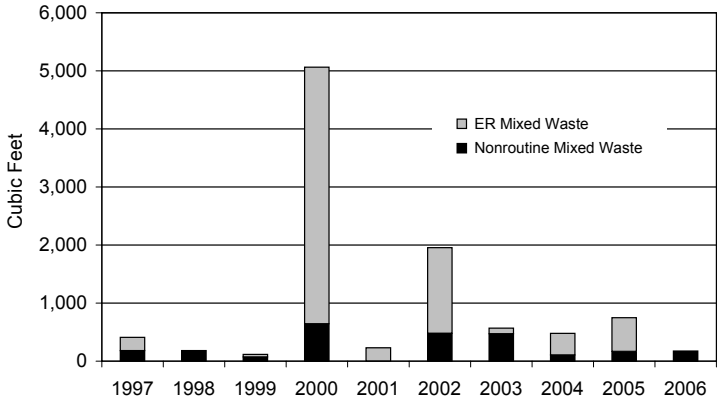

Figure 2-1e. Mixed Waste Generation from ER and Nonroutine Operations, 1997 – 2006.

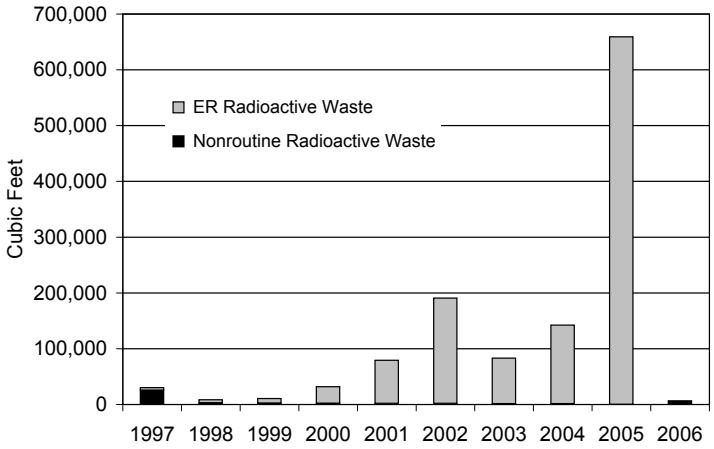

Figure 2-1f. Radioactive Waste Generation from ER and Nonroutine Operations, 1997 – 2006.

(PCB) waste. Figures 2-1d through 2-1f show wastes generated under the ER Program, as well as nonroutine operations. Waste generation from these activities has varied significantly from year to year. This was expected, as environmental restoration activities moved from remedial investigations and feasibility studies to remedial actions, which have changed annually based on the progress of BNL's cleanup schedule. With many large-scale remedial operations completed, waste generation decreased significantly and was mainly attributed to housekeeping and surveillance and maintenance activities.

2.3.4.4 Pollution Prevention and Minimization

The Laboratory's Pollution Prevention (P2) Program is an essential element for the successful accomplishment of BNL's broad mission. It reflects the national and DOE pollution prevention goals and policies and represents an ongoing effort to make pollution prevention and waste minimization an integral part of the Laboratory's operating philosophy.

Pollution prevention and waste reduction goals have been incorporated into the DOE contract with BSA, into BNL's ESSH Policy, and into the critical outcomes associated with the Laboratory's operating contract with BSA. Key elements of the P2 Program include:

- Eliminate or reduce emissions, effluents, and waste

at the source where possible, and ensure that they are as low as reasonably achievable (i.e., uphold the E-ALARA policy)
- Procure environmentally preferable products (known as "affirmative procurement")
- Conserve natural resources and energy
- Reuse and recycle materials
- Achieve or exceed BNL/DOE waste minimization, P2, recycling, and affirmative procurement goals
- Comply with applicable requirements (e.g., New York State Hazardous Waste Reduction Goal, Executive Orders, etc.)
- Reduce waste management costs
- Identify funding mechanisms for evaluating and implementing P2 opportunities
- Implement P2 projects
- Improve employee and community awareness of P2 goals, plans, and progress

Eighteen P2 proposals were submitted to the BNL P2 Council for funding in FY 2006. Seven proposals were funded, in addition to four special projects, for a combined investment of approximately $37,200. The anticipated annual savings from these projects is estimated at $74,200, for an average payback period of less than one year. The four special projects were jointly funded with other BNL divisions and significantly limited future environmental and worker safety risks.

The BNL P2 and recycling programs have achieved significant reductions in waste generated by routine operations, as shown in Figures 2-1a through 2-1c. This continues a positive trend and is further evidence that pollution prevention planning is well integrated into the Laboratory's work planning process. These positive trends are also driven by the EMS emphasis on preventing pollution and establishing objectives and targets to reduce environmental impacts.

Some examples of the Laboratory's P2 accomplishments in 2006 include:
- Three P2 awards from the DOE Office of Science:
  - "Best in Class" award for "On-Site Reuse of Concrete from Demolition Projects for New Construction Projects"
  - "Noteworthy Practice" for "Environmental Stewardship: Expanding the Envelope of the BNL Environmental Management System (EMS) Through Voluntary Participation"
  - "Noteworthy Practice" for "Animal Bedding Composting"
- Several jointly funded P2 projects which greatly decreased both environmental and safety risks to the Laboratory:
  - Disposal of a researcher's #6 fuel oil and BioFuels at the Steam Generating Facility
  - On-site recycling of more than 5,500 tons of concrete from building demolition projects for use as base material for parking lots for two new Laboratory buildings
  - Replacement of Halogen 1211 fire extinguishers
  - Disposal/replacement of BNL's Weather Station mercury barometer
  - Purchase of an Animal Bedding Facility dumpster to allow for composting
- A National Partnership for Environmental Priorities (NPEP) Achievement Award for reducing mercury waste generation and reducing the inventory of PCBs. NPEP encourages public and private organizations to form voluntary partnerships with the U.S. Environmental Protection Agency (EPA) to reduce the use or release of any of 31 priority toxic chemicals and metals identified by the EPA. The goal of the program is to reduce the use or release of four million pounds of these toxic substances by 2011.

Table 2-2 describes the P2 projects implemented through 2006 and indicates the number of pounds of materials reduced, reused, or recycled, as well as the estimated cost benefit of each project. Additional recycling and waste reduction projects are included in the table.

The implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has significantly reduced both waste volumes and management costs. In 2006, these efforts resulted in more than $1.8 million in cost avoidance or savings and approximately 13 million pounds of materials being reduced, recycled, or reused.

The Laboratory also has an active and successful solid waste recycling program, which involves all employees. In 2006, BNL collected

Table 2-2. BNL Pollution Prevention, Waste Reduction, and Recycling Projects.

Waste Description	Type of Project	Pounds Reduced, Reused,Recylced or Conserved in 2006	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Aerosol Can Disposal System	Recycling	528	Hazardous Waste	$7,928	$900	$7,028	Allows spent aerosol cans to be recycled as scrap metal rather than sent to WMD as hazardous waste. Currently there are 8 units in use (F&O=5; CA=1; NSLS=1; BES =1), each handling 66 lbs of hazardous waste.
Formaldetox	Source Reduction	440	Nonhazardous Waste	$2,120	$0	$7,000	Neutralizes non-hazardous para-formaldehyde, chlorix, bleach, and rat blood. In 2006, approximately 55 gal of nonhazardous waste were handled.
Replacement of BES Mercury Thermometers	Substitution	20	Mercury	$2,350	$1,000	$1,350	Approximately 20 lbs of mercury-containing thermometers were removed from BES laboratories during 2006. Savings are based on the cost of one mercury spill and cleanup.
HPLC Solvent Recycler	Reuse	110	Hazardous Waste	$1,755	$2,675	$6,755	Allows the reuse of approximately 50 liters of solvent, and the cost savings of approximately 50 man-hours of labor.
Propane Cylinder De-Valver	Recycling	50	Hazardous Waste	$3,750	$950	$2,800	Collider Accelerator purchased a propane cylinder de-valver. If the cylinders were not de-valved, they would have to go to a vendor for disposal, at $75/cylinder. Once the cylinder is de-valved, it can be recycled as scrap metal.
Fluorescently Labeled Oligonucleotides	Waste Minimization	3,144	Rad, Mixed, Hazardous Wastes	$67,600	$14,000	$43,370	This project was cost-shared with Biology. This process avoids the use of radioactivity, and hence the avoidance of rad waste generation. This year it prevented 396 ft^3 of rad waste, 35 gal of mixed waste, and 108 gal of hazardous waste.
Electronic Recycling	Recycling	140,600	E-Waste	N/A	$1,200	N/A	Previously the Laboratory's e-waste was collected by the scrap metal dealer, but the recycling process was questionable. BNL has partnered with a governmental-based e-waste recycler that takes the product for free, but BNL pays shipping.
Disposal of #6 Fuel oil and Turkey-Based Biofuel	Energy Recovery	12,000	Industrial Waste	$30,000	$500	$29,500	1,500 gallons of #6 fuel oil and biofuels accepted from EENS as fuel stock for the Central Steam Facility.
Electronic Barometer	Substitution	3	Mercury	$2,350	$1,800	$550	An approximately 3-lb mercury-containing barometer was removed from EENS during 2006. Savings are based on the cost of one mercury spill and cleanup.
Building Demolition Recycling	Recycling	11,080,000	Industrial Waste	$748,680	$32,000	$716,680	Segregation, recycling, and reuse of on-site building demolition products (steel and concrete).
System One Parts Cleaner	Substitution	640	Hazardous Waste	$4,000	$2,800	$1,200	Plant Engineering purchased a System One parts washer, which re-distills dirty solvent. The removed grit and sludge are mixed in with the waste oil. This system eleminates the need for a vendor, such as Safety Kleen.

(continued on next page)

Table 2-2. BNL Pollution Prevention, Waste Reduction, and Recycling Projects *(continued).*

Waste Description	Type of Project	Pounds Reduced, Reused,Recylced or Conserved in 2006	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Photon-Counting Spectrofluorimeter	Substitution	54	Mixed Waste	$10,540	$0	$25,540	In 2005, purchase of this equipment eliminated the need for radioactive assays and the subsequent radioactive waste. Cost savings include 1,000 man-hours and savings for 2 ft^3 of mixed waste.
Replacement of Mercury Utility Devices	Substitution	40	Mercury	$2,350	$4,000	$2,350	Approximately 40 lbs of mercury-containing devices were removed from utility devices during 2006. Savings are based on the cost of one mercury spill and cleanup.
Animal Bedding Conveying System	Composting	25 yd^3	Low-Level Rad Waste	$189,000	$5,000	$184,000	Animal bedding material is no longer treated as sanitary waste. It is now conveyed to a dumpster, which is emptied/composted at the stump dump. 25 yd^3 of LLRW were handled this year.
Halogen 1211 Fire Extinguisher Substitution *	Substitution	1,700	Halogenated Ozone-Depleting Substances (ODS)	$4,000	$6,200	$4,000	1,985 pounds of halogen 1211 were removed from service and replaced with non ODS.
EP Grounds Vehicle Wash	Waste Minimization	8,000	Nonhazardous	$16,000	$1,000	$16,000	This multi-year/multiple department-funded initiative will eliminate the potential for oil and grease to be released to the soil.
Organic Solvents	Substitution	678	Hazardous Waste	$1,694	$0	$26,000	Life Sciences purchased a Microwave Peptide Synthesizer in 2004 to significantly reduce the amount of hazardous wastes generated. Saves ~1,000 work hours/year (reflected in cost savings).
Organic Solvents	Purification/ Reuse	44	Hazardous Waste	$110	$0	$3,510	The primary cost savings of the BES solvent purification system is in not purchasing new solvent and man-power savings in not running the stills. This system has been in place since 2004.
Cooling Water	Reuse	63,400	Deionized water	$0	$0	$7,925	A closed-cycle water recycling system for the Building 480 melt spinner saves 7,925 gallons of ultra-pure water annually and extends the life expentancy of equipment worth $100,000.
Mercury Utility Devices	Substitution	10	Mercury	$2,300	$0	$2,300	Plant Engineering replaced mercury-containing utility devices with non mercury-containing equipment in 2006. Savings are based on the cost of one mercury spill and cleanup.
Radioactive Waste	Source Reduction	1,500	Radioactive Waste	$6,000	$0	$6,000	A sorting table was purchased in 2003 for the Waste Yard, so clean waste could be sorted from radioactive waste.
Radioactive Emissions	Emission Reduction	0	Radioactive Emissions			$0	In 2006, a shroud over the 16-inch diameter shaft in the Hot Cell of the BLIP was completed, isolating cooling water from the rapidly moving air of the exhaust system and allowing radiological decay within the water system. Slowing the diffusion into the hot cell air effectively reduces gaseous emissions into the exhaust stack, as these radionuclides have very short half-lives. The shroud/enclosure has been instrumental in reducing short-lived radioactive gaseous emissions. Beyond the environmental benefits associated with the project and due to the efficiency of the enclosure in reducing emissions, the facility has been able to stay below the emissions level that would require additional regulatory burdens.

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Table 2-2. BNL Pollution Prevention, Waste Reduction, and Recycling Projects *(continued).*

Waste Description	Type of Project	Pounds Reduced, Reused,Recylced or Conserved in 2006	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Radioactive Waste generated through wet chemistry	Waste Minimization	30	Mixed Waste/ Liquid Radioactive Waste	$17,600	$0	$22,500	The purchase of a Kinetic Phosphorescence Analyzer (KPA) system in 2003 for uranium analysis eliminated mixed waste generation in this chemistry laboratory, reduced by 90% the volume of liquid waste, reduced by 90% the amount of radioactive material handled, minimized exposure to uranium by Laboratory personnel, and decreased labor time by 75%.
Radioactive Waste from labeled chemicals	Waste Minimization/ Volume Reduction	0	Solid Radioactive Waste	$2,168	$0	$2,168	A vial crusher for glass vials, pipettes, and other glassware was purchased in 2003 to reduce the volume of radioactive waste.
Radioactive and Mixed Wastes from radio-labeled chemicals	Waste Minimization	112	Mixed Waste	$27,690	$0	$27,690	A microplate scintillation counter was purchased in 2003 to reduce mixed waste generation.
Pump Oil	Substitution	51	Hazardous Waste/Industrial Waste	$3,520	$0	$3,520	Oil-displacement pumps were replaced in 2003 with dry pumps for both laboratory and aircraft missions.
Electrophoretic Mini-Gels	Microscale Chemical Use	2,200	Hazardous Waste - Lab Pack	$11,500	$0	$11,500	This system minimizes silver waste from silver-staining electrophoretic mini-gels. Savings reflect avoided waste disposal costs and lower material purchase costs ($6,000).
Sewage Sludge	Volume Reduction	18,450	Radioactive Waste	$387,450	$0	$387,450	Disposal of 60,000 gal of radioactive STP liquid waste by a contractor would cost $910,000. Instead, the waste was dried using rolloffs, absorbent, and lime and shipped via rail to a disposal facility. BNL has a second drying bed to dry sludge (96% volume reduction) from the anaerobic sludge digester.
Film and other radioisotopic imaging	Substitution	300	Hazardous Waste / Industrial Waste	$22,000	$0	$22,000	Replacement of film-based autoradiography and other radioisotopic imaging with a Phosphor Imager in 2002 reduced hazardous waste generation by 200 lbs and industrial waste generation by 100 lbs. Subsequenrt annual savings are in supply costs and labor reduction.
Lead Acid Batteries	Recycled	11,000	Hazardous Waste	$27,500	$0	$27,500	Estimate 40 lb/battery and avoided disposal costs as hazardous waste.
Ion Exchange Wastewater	Source Reduction	1250	Hazardous and Sanitary Wastewater	$3,125	$0	$3,125	Prefilters, added to the deionization system, polish makeup water entering the ion exchange system. This extends the useful life of the ion exchange resins, requiring less frequent regeneration. The regeneration process generates hazardous and sanitary waste.

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Table 2-2. BNL Pollution Prevention, Waste Reduction, and Recycling Projects *(concluded).*

Waste Description	Type of Project	Pounds Reduced, Reused,Recylced or Conserved in 2006	Waste Type	Potential Costs for Treatment and Disposal	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details
Short Half-life Waste	Decay in Storage	495	Radioactive Waste	$20,558	$0	$20,558	Short half-life isotopes, particularly phosphorus-32 and phosphorus-33, are frequently used in life sciences experiments. In 2006, wastes from these operations (29 ft3 and 345 lbs of liquid) were managed in accordance with BNL decay-in-storage requirements, rendering the wastes eligible for volumetric release.
Lubricating Oil	Energy Recovery	7,200	Industrial Waste	$18,000	$500	$15,750	In 2006, ~7,200 lb (900 gal) of lubricating oils and heating fuels were collected, tested for suitable for use as waste oil fuel, and used for energy production at the Central Steam Facility. Avoided disposal cost was $14,400. Cost of testing ($500) was offset by fuel use savings ($1.50/gal).
Cooling Tower Chemicals	Source Reduction	9,563	Industrial Waste	$22,500	$0	$22,500	In 2001, ozone water treatment units were installed on cooling towers at two RHIC experiments to provide biological control of cooling water. These systems eliminate the need for water treatment chemicals (typically toxic biocides), save labor, and reduce analytical costs for monitoring cooling tower blowdown. In 2002, the SEM and NSRL systems had ozone water treatment units installed, and in 2003, the RF system at RHIC had an ozone system installed. Currently the RHIC RF, SEM, and NSRL systems are operational, while the RHIC BRAHMS and PHOBOS systems are not operating, as the experiments have not started.
Blasocut Machining Coolant	Recycled/ Reused	31,760	Industrial Waste	$83,300	$0	$89,700	Central Shops Division operates a recycling system that reclaims Blasocut machining coolant and supplies it labwide. 3,970 gal (31,760 lb) of Blasocut lubricant were recycled in 2006. Recycling involves aeration, centrifuge, and filtration. This avoids cost of disposal as industrial waste plus an avoided cost of procurement of 8 drums of concentrate ($800/ drum) and 78 drums for waste ($50/drum).
Used Motor Oil	Energy Recovery	22,240	Industrial Waste	$58,150	$0	$58,150	Used motor oil from the motor pool and the on-site gas station is picked for free up by Strebel's Laundry Service and used to fire their waste oil boilers. In 2006, 2,780 gal of oil were picked up, avoiding cost for disposal and 51 drums for shipping ($50/drum).
Office Paper	Recycled	368,000	Sanitary Waste	$18,400	$0	$18,400	Estimate $100/ton for disposal as trash.
Cardboard	Recycled	270,000	Sanitary Waste	$13,500	$0	$13,500	Estimate $100/ton for disposal as trash.
Scrap Metal	Recycled	316,000	Sanitary Waste	$15,800	$0	$15,800	Estimate $100/ton for disposal as trash.
Bottles/Cans	Recycled	56,000	Sanitary Waste	$2,800	$0	$2,800	Estimate $100/ton for avoidingdisposal as trash.
Construction Debris	Recycled	594,000	Sanitary Waste	$13,365	$0	$13,365	Estimate $45/ton for avoiding disposal as trash.
	TOTALS	**13,021,612**		**$1,871,453**	**$74,525**	**$1,871,834**	

more than 180 tons of office paper for recycling. Cardboard, bottles and cans, construction debris, motor oil, scrap metals, lead, automotive batteries, electronic scrap, fluorescent light bulbs, drill press machine coolant, and antifreeze were also recycled. Table 2-3 shows the total number of tons (or units) of the materials recycled in 2006.

2.3.4.5 Water Conservation

BNL's strong water conservation program has achieved dramatic reductions in water use since the mid 1990s. The Laboratory continually evaluates water conservation as part of facility upgrades or new construction initiatives. These efforts include more efficient and expanded use of chilled water for cooling and heating/ventilation and air conditioning (HVAC) systems, and reuse of once-through cooling water for other systems such as cooling towers. The goal is to reduce the consumption of potable water and reduce the possible impact of clean water discharges on Sewage Treatment Plant (STP) operations. Figure 2-2 shows the 10-year trend of water consumption. In 2006, BNL used approximately half the water that was used in 1997—a reduction of nearly a half-billion gallons in that one year alone.

2.3.4.6 Energy Management and Conservation

Since 1979, the Laboratory's Energy Management Group has been working to reduce energy use and costs by identifying cost-effective, energy-efficient projects, monitoring energy use and utility bills, and assisting in obtaining the least expensive energy sources possible. The group is responsible for developing, implementing, and coordinating BNL's Energy Management Plan.

The Laboratory has more than 4 million square feet of building space. Many BNL scientific experiments use particle beams generated and accelerated by electricity, with the particles controlled and aligned by large electromagnets. In 2006, the Laboratory used approximately 242 million kilowatt hours (kWh) of electricity, 3.2 million gallons of fuel oil, 36 thousand gallons of propane, and 108 million ft^3 of natural gas. Fuel oil and natural gas produce steam at the Central Steam Facility (CSF). Due to market conditions, fuel oil was predominately used in 2006, resulting in a cost savings of approximately $1,637,000. (See additional information on natural gas and fuel oil use in Chapter 4.)

BNL is a participant in the New York Independent System Operator (NYISO) Special Case Resource (SCR) Program, which is an electric load reduction curtailment program. Through this program, the Laboratory has agreed to reduce electrical demand during critical days throughout the summer when NYISO expects customer demand to meet or exceed the company's available supply. In return, BNL receives a rebate for each megawatt reduced on each curtailment day. In 2006, there were four curtailment days requested, and participation in this program produced a rebate of $165,000, with as much as 6.5 MW of load reduction. The Laboratory also agreed to keep electric loads at a minimum during the summer, in part by curtailing operations at the Relativistic Heavy Ion Collider (RHIC). This scheduling allowed BNL to save more than $4 million in electric costs in 2006.

BNL also maintains a contract with the New York Power Authority (NYPA) that resulted in an overall cost avoidance of $20 million in 2006. The Laboratory will continue to seek alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs. In 2007, the Laboratory will purchase a portion of "green energy" for the newly constructed Research Support Building, as well as some biofuels for certain applications.

In 2006, a solar heating system was installed for the BNL swimming pool. This small project is a first step toward meeting the Laboratory's energy needs with renewable sources. Several other activities were also undertaken to reduce energy use at non-research facilities (e.g., replacement of inefficient chiller, demand control, lighting upgrades, etc.):

- 25 MW of demand was rescheduled to avoid coinciding with the utility summer peak, saving several million dollars in electricity charges
- $486,000 in Federal Energy Management Program funding was obtained to increase the efficiency of a cryogenic cooling sys-

tem; this project reduced the electric demand by 1 MW and will save over 5,000,000 kWh/year

- Construction of a 1,300-ton satellite chiller was completed, displacing older, less efficient chillers
- Replaced aging, inefficient T-40 fluorescent lighting fixtures with new, efficient T-8 and T-5 units; two to three hundred fixtures are typically replaced annually, saving tens of thousands of kWhs and reducing costs by several thousand dollars
- Due to aggressive conservation in various buildings, BNL's overall facilities energy usage for FY06 was approximately 3.7 percent less than in FY05, saving over $1.6 million
- Water consumption for FY06 was 49 million gallons less than in FY05, saving approximately $15,000 in operational costs
- Efficient fuel purchasing strategies (buying and storing oil) saved $109,000, compared to purchasing oil as it is consumed
- The Laboratory's Research Support Building was completed and will receive Leadership in Energy and Environmental Design (LEED) certification
- The Center for Functional Nanomaterials, nearly completed, is also expected to receive LEED certification
- Nearly 34,000 gge (gas gallon equivalents) of natural gas were used in place of gasoline for the Laboratory's vehicle fleet

Table 2-3. BNL Recycling Program Summary.

Recycled Material	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Mixed paper	220	106	196	204	370	336	246	209	182	185	193	184
Cardboard	85	101	103	97	124	132	127	157	176	179	143	135
Bottles/Cans	11	15	21	22	21	20	29	19	23	22	22.1	27.7
Tires	11	17	18.6	11.5	15.2	0	0	3.5	12.3	11	12.8	32.5
Construction debris	627	837	799	527	352	243	289	304	334	367	350	297
Used motor oil (gallons)	3,350	4,275	4,600	3,810	3,570	3,295	3,335	1,920	3,920	3,860	4,590	2,780
Metals	153	158	266	64	47	534	38	48	193	128	559	158
Lead	–	–	4.4	3.7	0.7	2.5	0	0	–	5	0	0
Automotive batteries	0.72	6.8	4.3	2.1	1.1	2.2	4.8	6.3	4.6	5	4.6	5.5
Printer/Toner cartridges (units)	–	–	–	1,480/175	1,575/510	–	363	449	187	105	0	0
Fluorescent bulbs (units)	–	13,664	12,846	867	25,291	5,874	17,112	25,067	13,611	12,592	7,930	11,740
Blasocut coolant (gallons)	–	–	–	–	3,575	7,500	10,660	8,180	5,030	6,450	3890	3,970
Antifreeze (gallons)	–	55	276	448	145	110	200	0	165	325	0	0
Tritium exit signs (each)	–	–	–	–	–	185	190	28	181	142	0	0
Smoke detectors	–	–	–	–	–	–	171	40	0	0	0	0
Road base	–	–	–	–	–	–	–	2,016	0	2,666	0	0
Scrap electronics	–	–	–	–	–	–	–	–	–	–	6.1	70.3
Metals (building demolition)	–	–	–	–	–	–	–	8	23	11	6	35
Concrete (building demolition)	–	–	–	–	–	–	–	891	590	3,000	328	5505
Other construction and debris (building demolition)	–	–	–	–	–	–	–	790	388	1,200	157	818

Notes:
All units are tons unless otherwise noted.
– Denotes not recycled in that year or data not available.

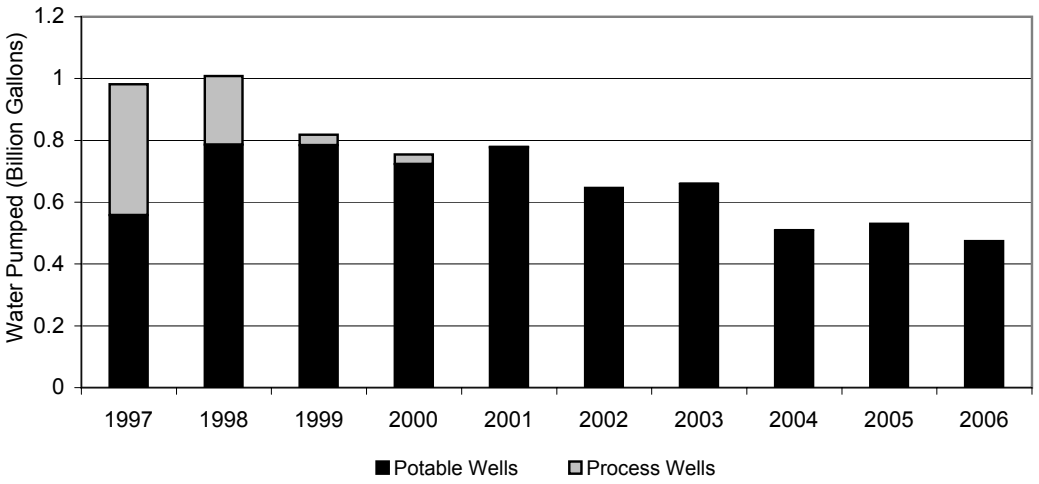

Figure 2-2. BNL Water Consumption Trend.

The National Energy Conservation Policy Act, as amended by the Federal Energy Management Improvement Act of 1988 and the Energy Policy Acts of 1992 and 2005, requires federal agencies to apply energy conservation measures and to improve federal building design to reduce energy consumption per square foot. Current goals are to reduce energy consumption per square foot, relative to 2003, by 2 percent per year from FY06 – FY15. In 2007, an Executive Order signed by the President will increase the target reduction to 3 percent per year, which is a 30 percent reduction by the end of FY2015. These are very aggressive goals, and go significantly beyond the previous goal of 30 percent reduction by 2005, compared to 1985. BNL's energy use per square foot in 2006 was 29 percent less than in 1985 (see Figure 2-3) and 8.2 percent less than 2003. It is important to note that energy use for buildings and facilities at the Laboratory is largely weather dependent.

2.3.4.7 Natural and Cultural Resource Management Programs

BNL continues to enhance its Natural Resource Management Program in cooperation with the U.S. Fish & Wildlife Service, the Upton Ecological and Research Reserve Technical Advisory Group, and the Foundation for Ecological Research in the Northeast (FERN). The Laboratory also continues to enhance its Cultural Resource Management Program. A BNL Cultural Resource Management Plan has been developed to identify and manage properties that are determined to be eligible or potentially eligible for inclusion on the National Register of Historic Places. See Chapter 6 for further information about these programs.

2.3.4.8 Environmental Restoration

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress in 1980. As part of CERCLA, EPA established the National Priorities List, which identifies sites where cleanup of past contamination is required. BNL was placed on the list with 27 other Long Island sites, 12 of which are in Suffolk County (see http://www.epa.gov/superfund/sites/npl/ny.htm).

Each step of the CERCLA cleanup process is reviewed and approved by DOE, EPA, and NYSDEC, under an Interagency Agreement (IAG) contract. This agreement was formalized in 1992. Although not a formal signatory of the IAG, the Suffolk County Department of Health Services also plays a key role in the review process. Most of the contamination at the Laboratory is associated with past accidental spills and outmoded practices for handling, storing, and disposing of chemical and radiological material.

BNL follows the CERCLA process, which includes the following steps:

- Conduct a Remedial Investigation to characterize the nature and extent of contamina-

tion and assess the associated risks
- Prepare a Feasibility Study and Proposed Plan to identify and evaluate Remedial Action alternatives and present the proposed best alternative
- Issue a Record of Decision (ROD), which is the remedy/corrective action agreed to by DOE, EPA, and NYSDEC
- Perform the Remedial Design/Remedial Action, which includes final design, construction specifications, and carrying out the remedy selected

In 2006, work planning continued for the Brookhaven Graphite Research Reactor (BGRR) and High Flux Beam Reactor (HFBR) decommissioning projects. In accordance with the requirements of 10 CFR 830, BNL completed the development of the Documented Safety Analysis (DSA) and submitted to DOE for review and comment. The DSA is a critical document for the BGRR pile removal. Other progress related to the BGRR project included further characterization of the BGRR pile and finalizing the Remedial Design/Remedial Action Workplan. Progress associated with the HFBR project included: additional activation analyses to characterize the HFBR and working with regulators to evaluate potential remedial activities. Other progress at the HFBR complex includes the removal of ancillary buildings and structures, and returning previously developed land to an undeveloped state. The Final CERCLA Five-Year Review was issued and is available to the public at http://www.bnl.gov/ltra/5-year_review.asp . EPA concurs that the remedies selected and implemented to date, as reported in this Five-Year Review, are protective of human health and the environment. 2006 was the first full year of long-term operation and maintenance (O&M) of the groundwater treatment systems following construction completion, as well as post-cleanup monitoring of the Peconic River surface water, sediment, and wetland vegetation. The groundwater systems operate in accordance with the O&M manuals, while the Peconic and surface soil cleanup areas are monitored via the Operable Unit I Soils and Operable Unit V Long-Term Monitoring and Maintenance Plan. Institutional controls are also monitored and maintained for the cleanup

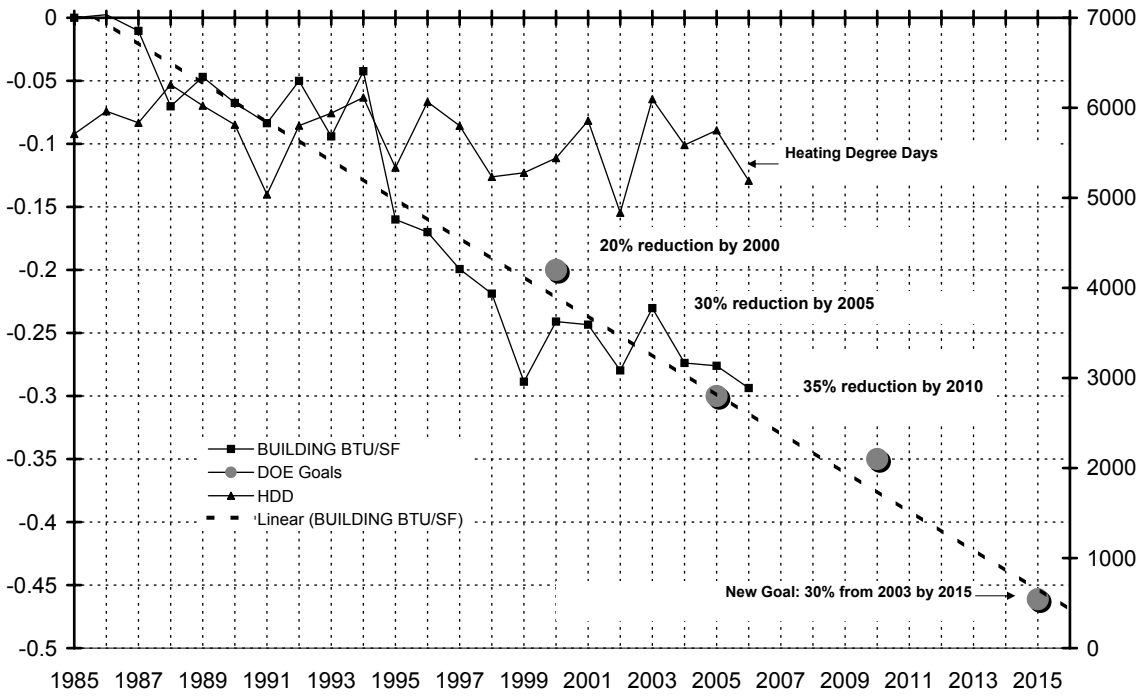

Figure 2-3. BNL Building Energy Performance, 1985 – 2015.

areas in accordance with the RODs to help ensure the remedies remain protective.

A public comment period and public meetings were held for the remedial action plan for the g-2 Tritium Source Area and Groundwater Plume, the Brookhaven LINAC Isotope Producer (BLIP), and the Former Underground Storage Tanks area. The ROD is expected to be signed in the spring of 2007. Table 2-4 provides a description of each operable unit and a summary of environmental restoration actions taken. See Chapter 7 and SER Volume II, Groundwater Status Report, for further details.

2.3.4.9 EPA Performance Track Program

BNL was accepted into the EPA's Performance Track (PTrack) Program in 2004. This program recognizes top environmental performance among participating U.S. facilities of all types, sizes, and complexity, both public and private. It is considered the "gold standard" for facility-based environmental performance—a standard that participating members strive to attain as they "meet or exceed their performance commitment." Under this program, partners provide leadership in many areas, including preventing pollution at its source. The PTrack Program requires that sites commit to several improvement goals for a three-year period and report on the progress of these goals annually. Below are brief descriptions of the goals and progress for 2006.

- *Increase BNL's land and habitat conservation.* To date, the Laboratory has recovered a total of 42 acres of land, including 15 acres recovered during a prescribed burn conducted in October 2006. Prescribed burns improve the health of the forest and allow for forest regrowth by removing dead vegetation, eliminating underbrush and leaf litter, and opening the forest floor to new growth. In addition, an acre of land was restored during building demolition.
- *Reduce Radioactive Air Emissions*. In 2005, the Laboratory made significant progress in achieving a PTrack commitment to reduce radioactive air emissions from the BLIP by 30 percent by 2006. Construction and testing of a Lucite enclosure was completed in 2005. In 2006, additional evaluation of the BLIP emissions showed them to be less than the projected performance goal. The emissions data confirmed that the overall reduction in emissions ranged between 29 and 35 percent under normal operating conditions. BNL will continue to evaluate additional measures to reduce emissions.
- *Reduce BNL's use of ozone-depleting substances (ODS), specifically Class I ODS.* In 2006, BNL continued its commitment to reduce the amount of ODS used at the Laboratory. In total, BNL eliminated 35.5 tons of Class I ODS from 2003 through 2006, which surpassed the original goal by 5.5 tons. In addition, 117 Halon 1211 portable extinguishers were removed from service. The Laboratory's long-term goal is to replace all Halon 1211 portable extinguishers with ABC dry-chemical or with clean agent FE-36 extinguishers by the end of 2010.
- *Reduce BNL's hazardous materials use.* BNL continued to revise its baseline inventory of mercury and mercury-containing devices in 2006, as new devices were located or identified. The total inventory subject to this commitment was 499 pounds. Of the 499 pounds, 194 pounds were determined to be essential and 305 pounds nonessential. By the end of 2006, BNL had removed and recycled approximately 233 pounds of elemental mercury from the nonessential inventory, resulting in a remaining total inventory of 266 pounds. The removed devices included 87 pounds of elemental mercury from a mercury vacuum pump, more than 450 mercury bulb thermometers, several large barometers and sphygmomanometers, and numerous mercury-wetted relays—some with up to 0.5 pounds of mercury each. In total, 47 percent of the mercury inventory was eliminated. While the goal of 80 percent was not achieved, the reduction effort was notable.

2.4 IMPLEMENTING THE ENVIRONMENTAL MANAGEMENT SYSTEM

2.4.1 Structure and Responsibility

All employees at BNL have clearly defined roles and responsibilities in key areas, including

Table 2-4. Summary of BNL 2006 Environmental Restoration Activities.

Project	Description	Environmental Restoration Program Actions
Soil Projects	OU I OU II OU VII	▪ Issued the Final Operable Unit (OU) I Soils and OU V Long-Term Monitoring and Maintenance Plan. ▪ Performed monitoring and maintenance of institutional controls for cleanup areas.
Groundwater Projects	OU III	▪ Continued operations of 12 groundwater treatment systems that treat volatile organic compounds (VOCs) and strontium-90 (Sr-90). ▪ Three groundwater treatment systems continued pulse pumping due to low VOC concentrations in the groundwater near the pumping wells. A fourth VOC system also began pulse pumping. ▪ Two groundwater treatment systems and six individual extraction wells were placed in standby mode. ▪ Performed a third and final application of the oxidizer potassium permanganate to degrade VOC contamination at the Building 96 groundwater plume. Pending further review of continued monitoring data, alternative methods for remediating the contamination in the silt zone will be performed. The fourth Building 96 groundwater treatment system extraction well was placed on standby in June. ▪ Continued monitoring of the High Flux Beam Reactor (HFBR) tritium plume. The contingency at Weaver Drive was triggered in late 2006 with a detection of tritium above the 20,000 pCi/L drinking water standard. As a result, a fourth groundwater extraction well will be installed and begin operation in 2007. ▪ Began characterization of two existing plumes, one VOC and one Sr-90, to evaluate the extent of contamination and determine if any additional extraction wells will be required. ▪ Continued characterization and monitoring of tritium in groundwater from g-2 activated soil. A public comment period and public meeting were held for the g-2 Tritium Groundwater Plume, the Brookhaven LINAC Isotope Producer, and former Underground Storage Tanks Proposed Remedial Action Plan. ▪ During 2006, 1.5 billion gallons of groundwater were treated and 372 pounds of VOCs were removed. Since the first groundwater treatment system started operating in December 1996, approximately 5,592 pounds of VOCs have been removed from more than 11.6 billion gallons of groundwater.
	OU IV	▪ Continued groundwater monitoring.
	OU VI	▪ Continued operation of a groundwater treatment system to treat ethylene dibromide that has migrated beyond BNL property in Manorville.
	Groundwater Monitoring	▪ Completed the BNL 2005 Groundwater Status Report. ▪ Collected and analyzed 2,097 groundwater samples from 727 monitoring wells. ▪ Updated the Environmental Monitoring Plan. ▪ The final sitewide Five-Year Review Report was issued and available to the public at http://www.bnl.gov/ltra/5-year_review.asp.
Peconic River	OU V	▪ Performed first full year of long-term post-cleanup monitoring of Peconic River surface water, sediment, fish, and wetland vegetatin. ▪ Submitted Draft 2006 Peconic River Monitoring Report to the regulators for review.
Reactors	BGRR	▪ Characterized the BGRR pile. ▪ Finalizing Remedial Design/Remedial Action Work Plan. ▪ Documented Safety Analysis submitted to DOE for review and comment.
	HFBR	▪ Continued long-term surveillance and maintenance activities. ▪ Performed additional activation analyses to characterize the HFBR. ▪ Evaluated potential remedial activities with regulators. ▪ Removed ancillary buildings and structures, and returned land to an undeveloped state.
	BMRR (Project managed by the BNL Environmental and Waste Management Services Division	▪ Continued surveillance and maintenance activities at the Brookhaven Medical Research Reactor (BMRR). ▪ Removed and disposed of irradiated reactor vessel components, including Hold Down Grids and Control Rod Blade Guides. ▪ Removed and disposed of radioactively contaminated lead containers.

environmental protection. Employees are required to develop their own Roles, Responsibilities, Accountabilities, and Authorities document to sign and be signed by two levels of supervision. BSA has clearly defined expectations for management and staff which must be included in this document. Under the BSA performance-based management model, senior management must communicate their expectation that all line managers and staff take full responsibility for their actions and be held accountable for ESSH performance. Environmental and waste management technical support personnel assist the line organizations with identifying and carrying out their environmental responsibilities. The Environmental Compliance Representative Program, initiated in 1998, is an effective means of integrating environmental planning and pollution prevention into the work planning processes of the line organizations. A comprehensive training program for staff, visiting scientists, and contractor personnel is also in place, thus ensuring that all personnel are aware of their ESSH responsibilities.

2.4.2 Communication and Community Involvement

Communication and community involvement are commitments under BNL's EMS. The Laboratory maintains relationships with its employees, key stakeholders, neighbors, elected officials, regulators, and other community members. The goals are to provide an understanding of BNL's science and operations, including environmental stewardship and restoration activities, and to incorporate community input in the Laboratory's decision making.

BNL staff participate in on- and off-site meetings, which include discussions, talks, presentations, roundtables, workshops, canvassing, tours, informal information sessions, and formal public meetings held during public comment periods.

2.4.2.1 Communication Forums

To facilitate effective dialogue between BNL and key stakeholders, several forums for communication and involvement have been established. The Brookhaven Executive Roundtable (BER), established in 1997 by DOE's Brookhaven Site Office, meets routinely with BNL and DOE. These meetings enable Laboratory and DOE representatives to update local, state, and federal elected officials and regulatory agencies regarding environmental and operational issues, as well as scientific discoveries and initiatives. The Community Advisory Council (CAC), established by BNL in 1998, advises the Laboratory Director on issues related to the Laboratory that are important to the community. The CAC is composed of approximately 30 member organizations representing business, civic, education, employee, community, and environmental and health organizations. The CAC meets monthly in sessions open to the public, and sets its own agenda in cooperation with the Laboratory.

BNL's Envoy Program educates employee volunteers regarding Laboratory issues and provides a link to local community organizations. Feedback shared by envoys helps BNL gain a better understanding of local community concerns. The Speakers' Bureau provides speakers for educational and other organizations interested in the Laboratory, and the Volunteers in Partnership Program supports employee volunteer efforts for charitable organizations. The BNL Summer Sunday tours enable the Laboratory to educate the public by featuring different facilities and program areas each week. In addition, BNL hosts various events annually in celebration of Earth Day.

To keep employees and the community informed about the Laboratory's research, activities, and issues, including those related to the environment, BNL issues press releases; publishes *Laboratory Link*, a monthly update on BNL science and events; *the Bulletin*, a weekly employee newsletter; and *discover Brookhaven*, BNL's quarterly science magazine. The Laboratory maintains an informative website at http://www.bnl.gov, where these publications are posted, as well as information about BNL's science and operations, past and present. In addition, employees and the community can subscribe to the Laboratory's e-mail update service at http://lists.bnl.gov/mailman/listinfo/bnl-announce-1.

2.4.2.2 Community Involvement in Cleanup Projects

In 2006, BNL stakeholders participated in the decision-making process for cleaning up the g-2 tritium source area and groundwater plume, the BLIP, and eight former underground storage tanks (USTs), and provided early input into the formulation of remediation alternatives for the HFBR complex. Stakeholders were also informed of several environmental compliance initiatives through the public notification process. These initiatives included: a Notice of Complete Application, establishing a public comment period for renewal of BNL's Waste Management Facility; an announcement of the availability of the Five-Year Review report; and a Notice of Availability for the completion of the Environmental Assessment (EA) and Finding of No Significant Impact (FONSI) for the NSLS-II. Stakeholders also were updated on the progress of other issues through presentations given at the monthly CAC and BER meetings, including:

- The Proposed Remedial Act Plan (PRAP) for the g-2 tritium source area called for continued maintenance and monitoring, and outlined contingency plans if unexpected levels of tritium are found in the future. Remedies for BLIP and the USTs also included continued maintenance and monitoring. Stakeholder comments, including those from the CAC, were addressed in a Record of Decision.
- Early input from the CAC on the remediation alternatives being developed for decommissioning and dismantlement of the HFBR highlighted the concerns of some community members regarding the removal and disposal of the highly radioactive control rod blades in the near term.

Working closely with elected officials, regulatory agency representatives, community members, and employees, DOE and BNL openly shared information, extensively solicited input on Laboratory environmental initiatives, and provided feedback on how that input was used.

2.4.3 Monitoring and Measurement

The Laboratory monitors effluents and emissions to ensure the effectiveness of controls, adherence to regulatory requirements, and timely identification and implementation of corrective measures. BNL's Environmental Monitoring Program is a comprehensive, sitewide program that identifies potential pathways for exposure of the public and employees, evaluates what impact activities have on the environment,, and ensures compliance with environmental permit requirements. The monitoring program is reviewed and revised, as necessary or on an annual basis, to reflect changes in permit requirements, changes in facility-specific monitoring activities, or the need to increase or decrease monitoring based on a review of previous analytical results.

As required under DOE Order 450.1, Environmental Protection Program, BNL prepares an Environmental Monitoring Plan, Triennial Update (BNL 2007), which outlines annual sampling goals by media and frequency. The plan uses the EPA Data Quality Objective approach for documenting the decisions associated with the monitoring program. In addition to the required triennial update, an annual electronic update is also prepared.

As shown in Table 2-5, in 2006 there were 9,766 sampling events of groundwater, potable water, precipitation, air, plants and animals, soil, sediment, and discharges under the Environmental Monitoring Program. Specific sampling programs for the various media are described further in Chapters 3 through 8.

The Environmental Monitoring Program addresses three components: compliance, restoration, and surveillance monitoring.

2.4.3.1 Compliance Monitoring

Compliance monitoring is conducted to ensure that wastewater effluents, air emissions, and groundwater monitoring data comply with regulatory and permit limits issued under the federal Clean Air Act, Clean Water Act, Oil Pollution Act, Safe Drinking Water Act, and the New York State equivalents. Included in compliance monitoring are the following:

- *Air emissions monitoring* is conducted at reactors, accelerators, and other radiological emission sources, as well as the CSF. Real-time, continuous emission monitoring equipment is installed and maintained

at some of these facilities, as required by permits and other regulations. At other facilities, samples are collected and analyzed periodically to ensure compliance with regulatory requirements. Analytical data are routinely reported to the permitting authority. See Chapters 3 and 4 for details.

- *Wastewater monitoring* is performed at the point of discharge to ensure that the effluent complies with release limits in the Laboratory's SPDES permits. Twenty-four point-source discharges are monitored under the BNL program: 12 under the ER Program and 12 under the SPDES permit. As required by permit conditions, samples are collected daily, weekly, monthly, or quarterly and monitored for organic, inorganic, and radiological parameters. Monthly reports that provide analytical results and an assessment of compliance for that reporting period are filed with the permitting agency. See Chapter 3, Section 3.6 for details.
- *Groundwater monitoring* is also performed in accordance with permit requirements. Specifically, monitoring of groundwater is required under the Major Petroleum Facility License for the CSF and the RCRA permit for the WMF. Extensive groundwater monitoring is also conducted under the ER Program, as required under the Records of Decision for many of the OUs or Areas of Concern (see Chapter 7 and SER Volume II, Groundwater Status Report, for details). Additionally, to ensure that the Laboratory maintains a safe drinking water supply, groundwater is monitored as required by SCDHS.

2.4.3.2 Restoration Monitoring

Restoration monitoring is performed to determine the overall impact of past operations, to delineate the real extent of contamination, and to ensure that Removal Actions are effective and remedial systems are performing as designed under CERCLA and RCRA.

This program typically involves collecting soil and groundwater samples to determine the lateral and vertical extent of the contaminated area. Samples are analyzed for organic, inorganic, and radiological contaminants, and the analytical results are compared with guidance, standards, cleanup goals, or background concentrations. Areas where impacts have been confirmed are fully characterized and, if necessary, remediated to mitigate continuing impacts. Followup monitoring of groundwater is conducted in accordance with a Record of Decision with the regulatory agencies.

2.4.3.3 Surveillance Monitoring

Pursuant to DOE Order 450.1, surveillance monitoring is performed in addition to compliance monitoring, to assess potential environmental impacts that could result from routine facility operations. The BNL Surveillance Monitoring Program involves collecting samples of ambient air, surface water, groundwater, flora, fauna, and precipitation. Samples are analyzed for organic, inorganic, and radiological contaminants. Additionally, data collected using thermoluminescent dosimeters (devices to measure radiation exposure) strategically positioned on and off site are routinely reviewed under this program. Control samples (also called background or reference samples) are collected on and off the site to compare Laboratory results to areas that could not have been affected by BNL operations.

The monitoring programs can be broken down further by the relevant law or requirement (e.g., Clean Air Act) and even further by specific environmental media and type of analysis. The results of monitoring and the analysis of the monitoring data are the subject of the remaining chapters of this report. Chapter 3 summarizes environmental requirements and compliance data, Chapters 4 through 8 give details on media-specific monitoring data and analysis, and Chapter 9 provides supporting information for understanding and validating the data shown in this report.

2.4.4 EMS Assessments

To periodically verify that the Laboratory's EMS is operating as intended, audits are conducted as part of BNL's Self-Assessment Program. The audits are designed to ensure that any nonconformance to the ISO 14001 Standard is

Table 2-5. Summary of BNL 2006 Sampling Program Sorted by Media.

Environmental Media	No. of Sampling Events*	Purpose
Groundwater	2,097 ER 249 ES/C	Groundwater is monitored to evaluate impacts from past and present operations on groundwater quality, under the Environmental Restoration, Environmental Surveillance, and Compliance sampling programs. See Chapter 7 and SER Volume II, Groundwater Status Report for further detail.
On-Site Recharge Basins	78	Recharge basins used for wastewater and stormwater disposal are monitored in accordance with discharge permit requirements and for environmental surveillance purposes. See Chapter 5 for further detail.
Potable Water	38 ES 181 C	Potable water wells and the BNL distribution system are monitored routinely for chemical and radiological parameters to ensure compliance with Safe Drinking Water Act requirements. In addition, samples are collected under the Environmental Surveillance Program to ensure the source of the Laboratory's potable water is not impacted by contamination. See Chapters 3 and 7 for further detail.
Sewage Treatment Plant (STP)	455	The STP influent and effluent and several upstream and downstream Peconic River stations are monitored routinely for organic, inorganic, and radiological parameters to assess BNL impacts. The number of samples taken depends on flow. For example, samples are scheduled for collection at Station HQ monthly, but if there is no flow, no sample can be collected. See Chapters 3 and 5 for further detail.
Precipitation	8	Precipitation samples are collected from two locations to determine if radioactive emissions have impacted rainfall, and to monitor worldwide fallout from nuclear testing. The data are also used, along with wind speed, wind direction, temperature, and atmospheric stability to help model atmospheric transport and diffusion of radionuclides. See Chapter 4 for further detail.
Air – Tritium	264	Silica gel cartridges are used to collect atmospheric moisture for subsequent tritium analysis. These data are used to assess environmental tritium levels. See Chapter 4 for further detail.
Air – Particulate	441 ES/C 52 NYSDOH	Samples are collected to assess impacts from BNL operations and to facilitate reporting of emissions to regulatory agencies. Samples are also collected for the New York State Department of Health Services (NYSDOH) as part of their program to assess radiological air concentrations statewide. See Chapter 4 for further detail.
Air – Charcoal	52	Samples are collected to assess impacts from BNL operations and to facilitate reporting of emissions to regulatory agencies. See Chapter 4 for further detail.
Fauna	125	Fish, deer, and small mammals are monitored to assess impacts on wildlife associated with past or current BNL operations. See Chapter 6 for further detail.
Flora	17	Vegetation is sampled to assess possible uptake of contaminants by plants and fauna, since the primary pathway from soil contamination to fauna is via ingestion. See Chapter 6 for further detail.
Soils	401	Soil samples are collected as part of the Natural Resource Management Program to assess faunal uptake, during Environmental Restoration investigative work, during the closure of drywells and underground tanks, and as part of preconstruction background sampling.
Miscellaneous	166	Samples are collected periodically from potable water fixtures and dispensers, manholes, spills, to assess process waters, and to assess sanitary discharges.
Groundwater Treatment Systems and Remediation Monitoring	2974	Samples are collected from groundwater treatment systems and as long-term monitoring after remediation completion under the Comprehensive Environmental Response, Compensation, and Liability Act program. The Laboratory has 14 operating groundwater treatment systems. See discussion in Chapter 7.
Vehicle Monitor Checks	246	Materials leaving the Laboratory pass through the on-site vehicle monitor that detects if radioactive materials are present. Any radioactive material discovered is properly disposed of through the Waste Management Program. The vehicle monitor is checked on a daily basis.
State Pollutant Discharge Elimination System (SPDES)	206	Samples are collected to ensure that the Laboratory complies with the requirements of the New York State Department of Environmental Conservation (NYSDEC)- issued SPDES permit. Samples are collected at the Sewage Treatment Plant (STP), recharge basins, and four process discharge sub-outfalls to the STP.
Flow Charts	546	Flowcharts are exchanged weekly as part of BNL's SPDES permit requirements to report discharge flow at the recharge basin outfalls.
Floating Petroleum Checks	102	Tests are performed on select petroleum storage facility monitoring wells to determine if floating petroleum products are present. The number of wells and frequency of testing is determined by NYSDEC licensing requirements (e.g., Major Petroleum Facility), NYSDEC spill response requirements (e.g., Motor Pool area), or other facility-specific sampling and analysis plans.

(continued on next page)

Table 2-5. Summary of BNL 2006 Sampling Program Sorted by Media.

Environmental Media	No. of Sampling Events*	Purpose
Radiological Monitor Checks	743	Daily instrumentation checks are conducted on the radiation monitors located in Buildings 569 and 592. These monitors are located 30 minutes upstream and at the STP. Monitoring at these locations allows for diversion of wastes containing radionuclides before they are discharged to the Peconic River.
Quality Assurance/ Quality Control Samples (QA/QC)	325	To ensure that the concentrations of contaminants reported in the Site Environmental Report are accurate, additional samples are collected. These samples detect if contaminants are introduced during sampling, transportation, or analysis of the samples. QA/QC samples are also sent to the contract analytical laboratories to ensure their processes give valid, reproducible results.
Total number of sampling events	**9,766**	The total number of sampling events includes all samples identified in the Environmental Monitoring Plan (BNL 2006), as well as samples collected to monitor Environmental Restoration projects, air and water treatment system processes, and by the Environmental and Waste Management Services Division Field Sampling Team as special requests. The number does not include samples taken by Waste Management personnel, waste generators, or Environmental Compliance Representatives for waste characterization purposes.

Notes:
* A sampling event is the collection of samples from a single georeferenced location. Multiple samples for different analyses (i.e..,tritium, gross alpha, gross beta, and volatile organic compounds) can be collected during a single sample event.
C = Compliance
ER = Environmental Restoration
ES = Environmental Surveillance

identified and addressed. In addition, compliance with regulatory requirements is verified through routine inspections, operational evaluations, and focused compliance audits. BNL's Self-Assessment Program consists of several processes.

- *Self-assessment* is the systematic evaluation of internal processes and performance. The approach for the environmental self-assessment program includes evaluating programs and processes within organizations that have environmental aspects. Conformance to the Laboratory's EMS requirements is verified, progress toward achieving environmental objectives is monitored, operations are inspected to verify compliance with regulatory requirements, and the overall effectiveness of the EMS is evaluated. BNL environmental staff routinely participate in these assessments. Laboratory management conducts assessments to evaluate BNL environmental performance from a programmatic perspective, to determine if there are Laboratory-wide issues that require attention, and to facilitate the identification and communication of "best management" practices used in one part of the Laboratory that could improve performance in other parts. BNL management also routinely evaluates progress on key environmental improvement projects. The Laboratory and DOE periodically perform assessments to facilitate the efficiency of assessment activities and ensure that the approach to performing the assessments meets DOE expectations.
- *Independent assessments* are performed by BNL staff members who do not have line responsibility for the work processes involved, to ensure that operations are in compliance with Laboratory requirements. These assessments verify the effectiveness and adequacy of management processes (including self-assessment programs) at the division, department, directorate, and Laboratory levels. Special investigations are also conducted to identify the root causes of problems, as well as corrective actions and lessons learned.

The Laboratory's Self-Assessment Program is augmented by programmatic, external audits conducted by DOE. BSA staff and subcontractors also perform periodic independent reviews. An independent third party conducts ISO 14001 registration audits of BNL's EMS. BNL is also subject to extensive oversight by external regulatory agencies (see Chapter 3 for details).

Results of all assessment activities related to environmental performance are included, as appropriate, throughout this report.

2.5 ENVIRONMENTAL STEWARDSHIP AT BNL

BNL has unprecedented knowledge of its potential environmental vulnerabilities and current operations due to programs such as the Facility Review Disposition Project, process evaluations, the work planning and control system, and the management systems for groundwater protection, environmental restoration, and information management. Compliance assurance programs have improved the Laboratory's compliance status; pollution prevention projects have reduced costs, minimized waste generation, and reused and recycled significant quantities of materials.

BNL is openly communicating with neighbors, regulators, employees, and other interested parties on environmental issues and progress. To regain and maintain stakeholder trust, the Laboratory will continue to deliver on commitments and demonstrate improvements in environmental performance. The Site Environmental Report is an important communication mechanism, as it summarizes BNL's environmental programs and performance each year. Additional information about the Laboratory's environmental programs is available on BNL's website at http://www.bnl.gov. The Laboratory continues to pursue other ways to communicate timely data in a more user-friendly, visual manner.

BNL's EMS is viewed as exemplary within DOE. Due to external recognition of the Laboratory's knowledge and unique experience implementing the EMS program, several DOE facilities and private universities have invited BNL to extend its outreach activities and share its experiences, lessons learned, and successes. The Laboratory's environmental programs and projects have been recognized with international, national, and regional awards.

Audits have consistently observed a high level of management involvement, commitment, and support for environmental protection and the EMS. Audits and EMS management reviews have noted the following improvements made since BSA began managing BNL:

- The EMS has been strengthened, integrated with other Laboratory management systems, and formalized.
- Line ownership for environmental stewardship has been established, key roles and responsibilities have been identified and clarified, and expectations have been made explicit.
- A comprehensive environmental training program has been implemented.
- From the process evaluation project, BNL has improved its understanding of environmental aspects, waste streams, and applicable requirements.
- There is much greater formality with regard to control of EMS documents, manuals, and procedures. Procedures and requirements have been updated, and environmental management programs have been improved.
- The Laboratory has been very successful in achieving its environmental goals. There have been successes in ISO 14001 registration and recertification, compliance improvements (e.g., facility modifications, implementation of SBMS, enhanced operational controls), and increased environmental knowledge and awareness on the part of management, employees, contractors, and visitors.
- Communication on environmental issues has improved, occurs at the highest levels of management, and reporting is more formal. Managers are better informed about environmental aspects, issues, and performance.
- Core EMS teams representing many organizations have been formed. A consensus process is used to develop the system, improving acceptance and support.
- There has been strong implementation of the EMS throughout the organizations, and cultural change has been notable.

For more than 50 years, the unique, leading-edge research facilities and scientific staff at BNL have made many innovative scientific contributions possible. Today, BNL continues its research mission while focusing on cleaning up and protecting the environment. The Laboratory's environmental motto, which was generated

in an employee suggestion contest, is "Exploring Earth's Mysteries … Protecting Its Future," and reflects BNL's desire to balance world-class research with environmentally responsible operations.

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