

Environmental Management System

One of Brookhaven National Laboratory's highest priorities is ensuring that the Laboratory's environmental performance measures up to its world-class status in science. Brookhaven Science Associates, the contractor operating the Laboratory on behalf of the Department of Energy, takes environmental stewardship very seriously. As part of their commitment to environmentally responsible operations, they have established an Environmental Management System (EMS).

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.

BNL's EMS became officially registered to the ISO 14001 standard in July 2001. Annual audits are required to maintain the registration. The audits are conducted by NSF-International Strategic Registrations, LTD, an accredited ISO 14001 registrar. The purpose of the audits is to validate that the EMS is being maintained and to identify evidence of continual improvement (a requirement of the ISO 14001 standard). In 2003, an EMS Surveillance Audit determined that BNL remains in conformance with the ISO 14001 Standard. The audit identified two minor non-conformances, two opportunities for improvement, and 10 examples of continual improvement.

In 2003, 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 BNL. Work planning processes incorporate the prevention approach, and benefits continue to accumulate. Pollution prevention projects have saved more than \$1.5 million to date and have resulted in the reduction or reuse of approximately 2.3 million pounds of waste through 2003. In FY03, the BNL Pollution Prevention Council funded eight proposals, investing approximately \$96,000. Anticipated savings from the projects are estimated at \$88,000, for an average payback period of 1.2 years. The ISO 14001-registered EMS and the nationally recognized Pollution Prevention Program continue to contribute to BNL's success in promoting pollution prevention. BNL also continues to address legacy issues under the Environmental Restoration program and is openly communicating with neighbors, regulators, employees, and other interested parties on environmental issues and cleanup progress on site.

2.1 ENVIRONMENTAL STEWARDSHIP AT BNL

The International Organization for Standardization's ISO 14001 is a globally recognized standard that defines the structure of an organization's EMS for purposes of improving the organization's environmental performance. The process-based structure of ISO 14001 is based on the "Plan-Do-Check-Act" improvement cycle. The standard requires an organization to develop an environmental policy, create plans to implement the policy, implement the plans, check progress and take corrective actions, and review the system annually to ensure its continuing suitability, adequacy, and effectiveness. To gain registration to the standard, an organization must comply with the set of 17 ISO 14001 requirements that are listed and described in Table 2-1.

BNL's EMS was first 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. To achieve registration, the Laboratory underwent an independent audit of its EMS to verify that the system conformed to all ISO requirements and that it was effectively implemented. The certification also requires BNL to undergo annual audits by an accredited registrar to assure that the system is maintained.

In 2003, an EMS Surveillance Audit determined that BNL remains in conformance with the ISO 14001 Standard. The audit identified two minor nonconformances and two opportunities for improvement. In its recommendation for continued certification, NSF-International Strategic Registrations, Ltd. (NSF-ISR) highlighted 10 examples of BNL's continual improvement, some of which include BNL's ongoing improvement to and use of the process assessment tool, minimizing the use and storage of hazardous materials, and considerable improvements in pollution prevention and material reuse.

2.2 ENVIRONMENTAL STEWARDSHIP POLICY

The cornerstone of an EMS is a commitment to environmental protection at the highest

levels of the organization. The Environmental Stewardship Policy, issued and signed by the Laboratory Director, is a statement of BNL'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 Environmental Stewardship Policy is posted throughout the Laboratory and on the BNL website at www.bnl.gov.

The Environmental Stewardship Policy contains the following goals and commitments, focusing on compliance, pollution prevention, cleanup, community outreach, and continual improvement:

- Achieve and maintain compliance with applicable environmental requirements. These requirements include more than 100 local, state, and federal laws and regulations; DOE Directives; Executive Orders; and numerous operating permits.
- Integrate pollution prevention/waste minimization, resource conservation, and compliance into BNL activities during planning and decision making. Adopt cost-effective practices that eliminate, minimize, or mitigate environmental impacts, including conserving natural resources and adhering to the policy known as "E-ALARA": ensuring that Environmental emissions, effluents, and waste generation are As Low As Reasonably Achievable.
- Define, prioritize, and aggressively correct and clean up existing environmental problems. This commitment encompasses removal or treatment of contamination caused by historical practices. It also includes strengthening the environmental monitoring program to ensure that controls designed to protect the environment are working, and to provide early detection of a potential threat to the environment (see Section 2.4.3).
- Maintain a positive, proactive, and constructive relationship with the local community, regulators, DOE, employees, and other stakeholders. Openly communicate with stakeholders about program planning, progress, and performance (see Section 2.4.2).
- Continually improve the environmental

Table 2-1. Elements of the Environmental Management System (EMS): Implementation of ISO 14001 at BNL.

Environmental Policy	The Environmental Stewardship Policy is a statement of BNL's intentions and principles regarding overall environmental performance. It provides a framework for planning and action. In the policy, BNL has reaffirmed its commitment to compliance, pollution prevention, cleanup, community outreach, and continual improvement.
Environmental Aspects and Impacts	When operations have an environmental aspect, BNL implements the EMS to minimize or eliminate any potential impact. As required by the ISO 14001 Standard, BNL evaluates its operations, identifies the aspects of operations that can impact the environment, and determines which of those impacts are significant. BNL has determined that the following aspects of its operations have the potential to affect the environment: <ul style="list-style-type: none"> ▪ 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 ▪ Other facility-specific compliance aspects
Legal and Other 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.
Objectives and Targets	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 objectives and targets were established in FY 2003: <ul style="list-style-type: none"> ▪ Maintain and improve the EMS ▪ Achieve full compliance with applicable environmental requirements ▪ Invest in specific Pollution Prevention Projects ▪ Improve communications, trust, and relationships with stakeholders on environmental programs ▪ Fully implement the groundwater protection program ▪ Ensure responsible stewardship of natural and historical resources on site
Environmental Management Program	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. BNL has 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.
Structure and Responsibility	All employees at BNL 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.
Training, Awareness, and Competence	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 select staff, and specific courses for managers, internal assessors, EMS implementation teams, and operations personnel whose work can impact the environment.
Communication and Community Involvement	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 Stewardship Policy and the Community Involvement Plan.

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Table 2-1. Elements of the Environmental Management System (EMS): Implementation of ISO 14001 at BNL (concluded).

EMS Documentation	BNL has a comprehensive, up-to-date set of Laboratory-wide environmental documents describing the EMS. Using SBMS, staff can access detailed information on regulatory requirements, Laboratory-wide procedures, and manuals on how to control processes and perform work at BNL in a way that protects the environment. SBMS has improved the quality, usability, and communication of Laboratory-level requirements.
Document Control	SBMS contains 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.
Operational Control	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.
Emergency Preparedness and Response	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.
Monitoring and Measurement	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 summarized annually in the Site Environmental Report. In addition, BNL tracks and trends its progress and performance in achieving environmental objectives and performance measures.
Nonconformance, and Corrective and Preventive Actions	BNL continues to improve processes that identify and correct problems. A Lessons Learned Program to prevent recurrences, a robust Self-Assessment Program, and an electronic web-based assessment and action tracking system have been implemented.
Records	EMS-related records, including audit and training records, are maintained to ensure integrity, facilitate retrieval, and protect them from loss.
EMS Audit	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.
Management Review	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.

management system and performance. Establish appropriate environmental objectives and performance indicators to guide these efforts and measure progress. To maintain certification, BNL employs proactive measures to prevent problems. When problems do occur, the approach is to investigate the root cause and take corrective actions as appropriate.

2.3 PLANNING

The planning requirements of the ISO 14001 Standard require BNL to identify the environmental aspects and impacts of its activities, products, or services; to evaluate applicable legal and other requirements; to establish objec-

tives 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, or services that can interact with the environment. As required by the ISO 14001 Standard, BNL evaluates its operations, identifies the aspects of operations that can impact the environment, and determines which of those impacts are significant. BNL’s criteria for significance are based on both 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 procedure is an evaluation that is documented on a Process Assessment Form (PAF). The PAF consists of a written process description, a detailed process flow diagram, a regulatory determination of all process outputs, identification of pollution prevention opportunities, and identification of any Assessment, Prevention, and Control (APC) measures that should be considered. Environmental professionals worked closely with revision teams to ensure that environmental requirements were integrated into the process. Aspects and impacts are evaluated annually to ensure that the significant aspects and potential impacts continue to reflect stakeholder concerns and changes in regulatory requirements. BNL's list of aspects and significance criteria remained unchanged in 2003.

2.3.2 Legal and Other Requirements

To implement the compliance commitments of the Environmental Stewardship 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 the 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 "critical outcomes." BNL works 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 Environmental Stewardship Policy, to regulatory agencies and to the public)
- Importance to DOE, the public, and other stakeholders

Laboratory-level objectives and targets are developed on a Fiscal Year (FY) schedule. In FY 2003 (October 1, 2002 through September 30, 2003), these objectives included:

- Maintain and improve the Environmental EMS
- Achieve full compliance with applicable environmental requirements
- Integrate pollution prevention into work planning and expand participation
- Improve communications, trust, and good relationships with stakeholders on environmental programs
- Fully implement the groundwater protection program
- Ensure responsible stewardship of natural and historical resources on site
- Implement environmental restoration projects efficiently

2.3.4 Environmental Management Programs

Each organization within BNL develops an action plan detailing how they will achieve their 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 that resources essential to the implementation and control of the EMS are provided.

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 program to help ensure full compliance with all applicable environmental regulatory requirements and permits. Some programs are routine, such as the National Emission Standards for Hazardous Air Pollutants (NESHAPs), National Pollutant

Discharge Elimination System (NPDES), and Resource Conservation and Recovery Act (RCRA) compliance programs. Other programs are special projects or initiatives, 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 thorough discussion of these programs and their status.

2.3.4.2 Groundwater Protection

BNL's Groundwater Protection Management Program is designed to prevent impacts to groundwater and to restore groundwater quality by integrating pollution prevention efforts, monitoring groundwater restoration projects, and communicating performance. BNL has also developed a Groundwater Protection Contingency Plan that defines an orderly process for taking corrective actions quickly in response to unexpected monitoring results. Key elements of the groundwater program are the full and timely disclosure of any off-normal circumstances and regular communication on the performance of the program. Chapter 7 provides additional details about the Groundwater Protection Management Program and monitoring results for 2003.

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, BNL's unique scientific activities also generate waste streams that are subject to additional regulation and special handling, including radioactive, hazardous, and mixed waste.

In 2003, waste management operations were streamlined by combining the Environmental Services Division and the Waste Management Division. This successful merger resulted in significant cost savings to BNL. The combined group, known as the Environmental and Waste Management Services Division (EWMSD), is responsible for the collection, transportation,

storage, and off-site disposal of site-generated waste. Waste is managed at a state-of-the-art facility designed especially for managing hazardous, industrial, radioactive, and mixed materials.

The EWMSD Waste Management Facility complex 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 2003, BNL generated the following types and quantities of waste from routine operations:

- Hazardous waste: 5.9 tons
- Mixed waste: 66 cubic feet
- Radioactive waste: 5,534 cubic feet

These quantities represent significant reductions from previous years, as shown in Figures 2-1a through c. Routine operations are defined as ongoing industrial and experimental operations. The picture is not complete, however, without consideration of waste generated from "nonroutine" or one-time events and waste generated from environmental restoration activities. BNL is currently cleaning up facilities and areas containing radioactive and chemical contamination resulting from historical operations. Waste recovered through restoration and decommissioning activities is managed by the Environmental Restoration (ER) group with oversight by BNL's EWMSD. Nonroutine waste includes construction and demolition waste, environmental restoration waste, legacy waste, lead-painted debris, lead shielding, and PCB waste. Figures 2-1d through 2-1f show wastes generated under the ER Program, as well as non-routine operations. Waste generation from these activities varies significantly from year to year. This is to be expected as environmental restoration activities move from remedial investigations and feasibility studies to remedial actions, which change annually based on the progress of BNL's cleanup schedule.

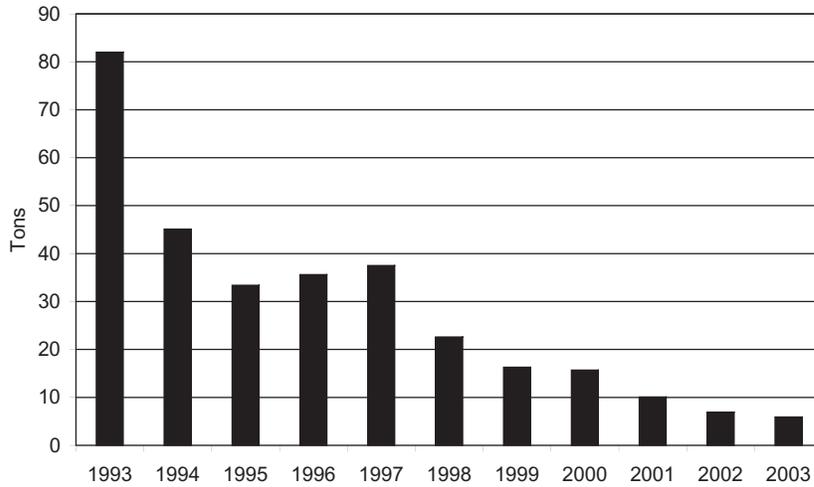


Figure 2-1a.
Hazardous Waste Generation
from Routine Operations,
1993 – 2003.

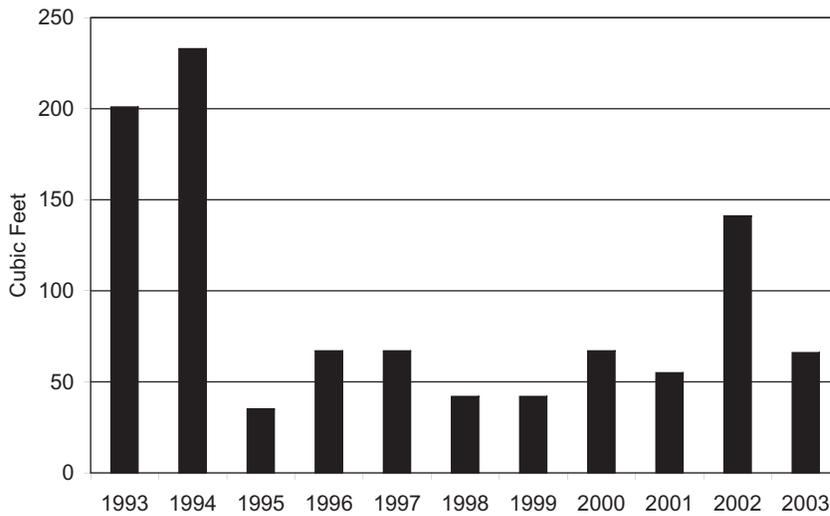


Figure 2-1b.
Mixed Waste Generation
from Routine Operations,
1993 – 2003.

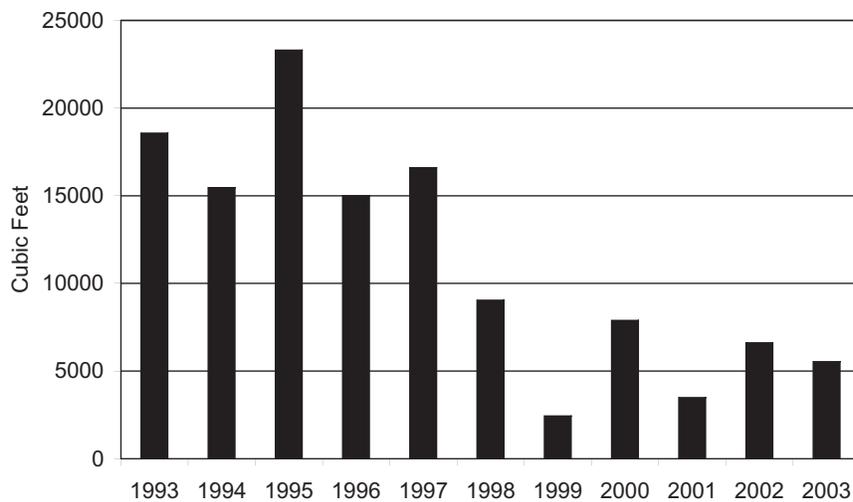


Figure 2-1c.
Radioactive Waste Generation
from Routine Operations,
1993 – 2003.

Figure 2-1d.
Hazardous Waste Generation from ER and Nonroutine Operations, 1997 – 2003.

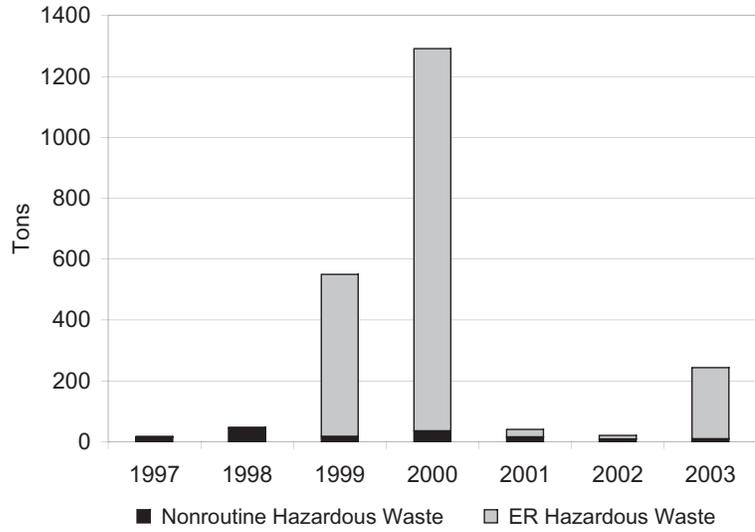


Figure 2-1e.
Mixed Waste Generation from ER and Nonroutine Operations, 1997 – 2003.

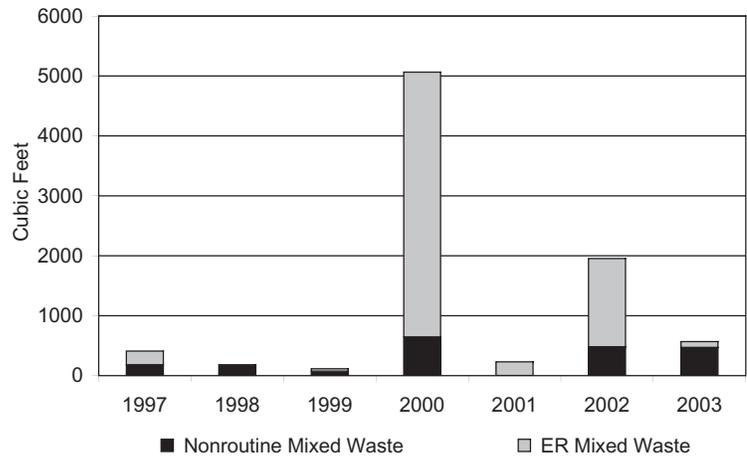
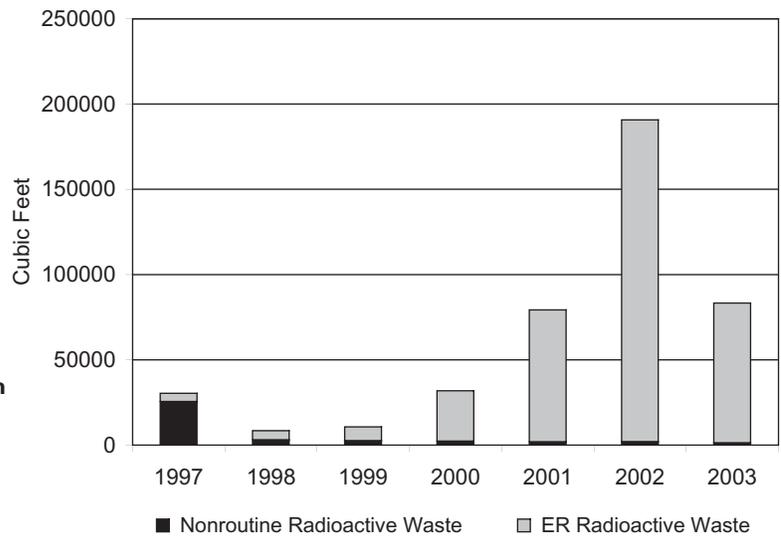


Figure 2-1f.
Radioactive Waste Generation from ER and Nonroutine Operations, 1997 – 2003.



2.3.4.4 Pollution Prevention and Minimization

The BNL Pollution Prevention (P2) Program is an essential element for 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 BNL operating philosophy.

DOE has incorporated pollution prevention and waste reduction goals into its contract with Brookhaven Science Associates (BSA). BSA recognizes its environmental stewardship responsibilities, the importance of stakeholder concerns, and the potential for savings, and has incorporated pollution prevention elements into its Environmental Stewardship Policy and the critical outcomes associated with the operating contract. 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 ("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 outreach and awareness of P2 goals, plans, and progress.

Proposals for funding pollution prevention opportunities are submitted to the BNL P2 Council. In January 2003, the P2 Council announced the winners of the "Return on Investment" funding competition. In FY03, the P2 Council funded eight proposals, investing approximately \$96,000. The savings generated

by these projects is estimated at \$88,000, for an average payback period of 1.2 years.

The efforts of 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 work planning process. These positive trends are also driven by the ISO 14001 EMS's emphasis on preventing pollution and establishing objectives and targets to reduce environmental impacts.

Implementation of pollution prevention opportunities, recycling programs, and conservation initiatives has significantly reduced both waste volumes and management costs. By 2003, these efforts had resulted in more than \$1.5 million in cost avoidance or savings and approximately 2.3 million pounds of materials being reduced, recycled, or reused. Table 2-2 describes the projects that were implemented through 2003 and includes the number of pounds of materials reduced, reused, or recycled and the estimated cost benefit of each project.

BNL also has an active and successful solid waste recycling program. The on-site recycling program involves all employees. In 2003, BNL collected more than 182 tons of paper for recycling. In addition to paper, the program recycles cardboard, bottles and cans, construction debris, motor oil, scrap metals, lead, automotive batteries, printer and toner cartridges, fluorescent light bulbs, machine coolant, and antifreeze. Table 2-3 shows the total number of tons (or units) of the materials recycled through 2003.

2.3.4.5 Water Conservation

BNL has a strong water conservation program and 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 systems, and reuse of once-through cooling water for other systems such as cooling towers. BNL's goal is to reduce the consumption of potable

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

Waste Description	Project Type	Pounds Saved* in 2003	Waste Type	Potential Cost for Status Quo	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details **
Radioactive Waste	Source Reduction	1,500	Radioactive Waste	\$6,000	\$2,500	\$6,000	Waste Yard sorting table surveying to sort clean waste from radioactive waste.
Radioactive Emissions	Emission Reduction	0	Radioactive Emissions	TBD in 2004 after data are analyzed	\$13,400	\$0	Installation of a shroud to fit over the 16-in. diameter shaft within the BLP hot cell, thereby isolating the 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 will effectively reduce gaseous emissions to the exhaust stack because these radionuclides have very short half lives.
Waste generated through wet chemistry	Waste Minimization	30	Mixed waste/ Liquid Radioactive Waste	\$17,600	\$20,000	\$22,500	Elimination of mixed waste with a Kinetic Phosphorescence Analyzer (KPA) system for uranium analysis. Eliminates mixed waste generation, reduces the volume of liquid waste by 90%, reduces the amount of radioactive material handled in the laboratory by 90%, minimizes exposure of Laboratory personnel to uranium, and decreases total labor time by 75%.
Waste from labeled chemicals	Waste Minimization/ Volume Reduction	0	Solid Radioactive Waste	\$2,168	\$3,795	\$2,168	Vial crusher for glass vials, pipettes, and other glassware.
Waste from radio-labeled chemicals	Waste Minimization	112	Mixed Waste	\$27,690	\$35,000	\$27,690	Microplate scintillation counter for a reduction in mixed waste generation.
Pump Oil	Substitution	51	Hazardous / Industrial Waste	\$3,520	\$6,000	\$3,520	Replaced oil-displacement pumps with dry pumps.
Photographic Waste	Substitution	3,840	Hazardous / Industrial Waste	\$7,600	\$13,860	\$16,489	New photographic processor reduces the amount of chemicals used and waste generated by up to 80%.
Electrophoretic Mini-Gels	Microscale Chemical Use	2,200	Hazardous Waste (Lab Pack)	\$10,400	\$0	\$10,400	Minimization of silver waste from silver-staining electrophoretic mini-gels; savings reflect avoided waste disposal costs and lower material purchase costs (\$6,000).
Hydraulic Oil	Product Substitution	1,000	Industrial Waste	\$17,000	\$0	\$17,000	Retrofit of garbage truck hydraulics with steel-braded hydraulic lines and a vegetable based hydraulic oil; this project will reduce the number of reportable spills and subsequent cleanup costs (\$15,000).
Hydraulic Oil	Product Substitution	3,000	Industrial Waste	\$26,000	\$0	\$26,000	Retrofit of hydraulic lift bays in Motor Pool Shop to vegetable-based hydraulic oil; this project minimized the potential for petroleum-based hydraulic oil leaks/spills and subsequent cleanup costs (\$20,000).

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

Waste Description	Project Type	Pounds Saved* in 2003	Waste Type	Potential Cost for Status Quo	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details **
Sewage Sludge	Volume Reduction	234,000	Radioactive Waste	\$910,000	\$193,400	\$716,600	60,000 gal of radioactive STP liquid waste could have been disposed of through a contractor at a cost of \$910,000. Instead, the waste was dried using rollofs, absorbent, and lime and sent for disposal via rail cars. In addition, a second drying bed was built to dry sludge (96% volume reduction) from the anaerobic sludge digester.
CO2 Snow Cleaning	Source Reduction	0	Hazardous Waste/ Industrial Waste	\$5,000	\$0	\$0	Equipment purchased to evaluate CO2 Snow Cleaning for NSLS, Instrumentation, and Collider-Accelerator Department applications; this project has the potential to reduce solvent usage (hazardous waste), and aqueous cleaning wastes (industrial waste). Limited success due to moisture condensation.
Film and other radioisotopic imaging waste	Substitution	300	Hazardous Waste/ Industrial Waste	\$22,000	\$0	\$22,000	Replacement of film-based autoradiography and other radioisotopic imaging with a phosphor imager reduced hazardous waste generation by 200 pounds and industrial waste generation by 100 pounds. There are additional projected savings in annual supply costs (\$3,000) and labor reduction (\$15,000).
Digital Imaging System waste	Substitution	282	Hazardous, Radioactive, and Industrial Waste	\$25,000	\$0	\$25,000	Reduction of hazardous (134 lbs), radioactive (80 lbs), and industrial waste (68 lbs) with a digital imaging system. There are additional projected savings in annual supply costs (\$3,000) and labor reduction (\$20,000).
Fluorescence-Based Assay	Substitution	200	Mixed Waste	\$30,550	\$0	\$30,550	Development of a fluorescence-based assay for the DNA-dependent protein kinase (DNA-PKcs) to replace current 32P assay.
Photographic Waste	Segregation	2,320	Hazardous Waste	\$5,500	\$0	\$5,500	Photography and Graphic Arts Division implemented a pollution prevention project that segregates hazardous fixer from non-hazardous developer; this reduced the hazardous waste stream by approximately 2,320 lbs.
Photographic waste from X-ray film processor	Source Reduction	765	Hazardous Waste	\$3,115	\$0	\$3,115	The X-ray film processor at the clinic was replaced with a more efficient processor, reducing hazardous waste generation by 90 gal/yr; this avoids the cost of disposal (765 lbs) and saves \$1,585 from reduced labor.
Photoresist waste	Source Reduction	500	Hazardous Waste	\$1,000	\$0	\$1,000	A fully aqueous developer solution was installed in the printed circuit laboratory for processing dry film photoresist. The system replaced a solvent-based process that formerly generated approximately 500 lbs of hazardous waste annually.

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

Waste Description	Project Type	Pounds Saved* in 2003	Waste Type	Potential Cost for Status Quo	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details **
Heavy metal solutions from crystallography experiments	Source Reduction	10,200	Hazardous Waste	\$26,400	\$0	\$26,400	Installed a xenon pressure cell to allow preparation of samples for protein crystallography without the use of toxic heavy metal solutions. The project is estimated to eliminate 1,200 gal of heavy metal hazardous waste (10,200 lbs). Additionally, approximate \$6,000 in savings is estimated from reduced labor and handling.
Lead Acid Batteries	Recycled	9,200	Hazardous Waste	\$18,400	\$0	\$18,400	Estimate 40 lbs/battery and avoided disposal costs as hazardous waste.
Ion Exchange Wastewater	Source Reduction	1250	Hazardous and Sanitary Wastewater	\$2,500	\$100	\$2,400	Prefilters were added to the deionization system to polish makeup water entering the ion exchange system; this extended the useful life of the ion exchange resins, requiring less frequent regeneration. The regeneration process generates hazardous and sanitary wastewaters.
Tritium Exit Signs	Source Reduction	724	Mixed Waste	\$152,040	\$6,000	\$146,040	Removed 28 tritium Exit signs from service and returned them to the manufacturer. Replaced the Exit signs with energy-efficient light emitting diode (LED) signs; project reduced risk of tritium gas release and avoided disposal as mixed waste (70 ft ³).
Cooling Water	Reuse	153,000	Radioactive Waste	\$153,000	\$0	\$153,000	Approximately 18,000 gal (153,000 lbs) of cooling water were reused in the main magnet cooling water system, avoiding disposal as radioactive waste water.
Short Half-life Waste	Decay in Storage	625	Radioactive Waste	\$380	\$0	\$380	Short half-life isotopes, particularly phosphorus-32 and phosphorus-33, are frequently used in life sciences experiments. Wastes generated from these operations (14.5 ft ³ solids and 6 gal liquids) were managed in accordance with BNL decay-in-storage requirements, rendering the wastes eligible for volumetric release.
Oily Waste Water	Source Reduction	6,240	Industrial Waste	\$20,280	\$0	\$20,280	Installed automatic oil-water separators on compressor blowdown stations. These units capture the oily discharge and save significant labor hours compared to the previous system. Labor savings is estimated at \$7,800/yr.
Lubricating Oil	Energy Recovery	8,000	Industrial Waste	\$16,500	\$500	\$16,500	Approximately 1,000 gal of lubricating oils were collected, tested for suitable use as waste oil fuel, and used for energy production at the Central Steam Facility. Cost of analysis is estimated at \$500. The fuel use savings are estimated at \$50/gallon.

(continued on next page)

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

Waste Description	Project Type	Pounds Saved* in 2003	Waste Type	Potential Cost for Status Quo	Cost of Recycle, Prevention	Estimated Cost Savings	Project Description Details **
Cooling Tower Chemicals	Source Reduction	6,375	Industrial Waste	\$15,000	\$0	\$15,000	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. Savings are estimated at \$15,000/yr.
Hydraulic Oil	Source Reduction	6,000	Industrial Waste	\$33,000	\$0	\$33,000	Replaced hydraulic lines on heavy equipment with steel-braided lines and replaced the petroleum-based hydraulic oils with bio-based vegetable oils. Hydraulic line breaks were responsible for a significant number of reportable spills and costly response and cleanup. This project reduced the frequency of spills and resulting response and cleanup costs. The biodegradable vegetable oil is subject to fewer reporting requirements. Avoided disposal costs are based on 6,000 lbs of industrial waste and savings from reduced response and cleanup costs are estimated at \$33,000.
Blasocut Machining Coolant	Recycled/Reused	40,240	Industrial Waste	\$80,480	\$0	\$92,780	The Central Shops Division operates a recycling system that reclaims Blasocut machining coolant and supplies it Laboratory-wide. 8,180 gal (65,440 lbs) of Blasocut lubricant were recycled in 2002. Recycling involves aeration, centrifuge, and filtration. Avoids cost of disposal as industrial waste plus an avoided cost of procurement of 6 drums of concentrate (\$800/drum) and 150 drums for waste (\$50/drum). The cost of recycle is estimated to be the same as cost of procurement and preparation of proper dilution for use.
Used Motor Oil	Energy Recovery	31,360	Industrial Waste	\$67,470	\$0	\$67,470	Used motor oil from the motor pool and the on-site gas station is picked up free of charge by Strebels Laundry Service and used to fire their waste oil dryers. In 2002, 4,655 gal of oil were picked up, avoiding cost for disposal and shipping of 95 drums (\$50/drum).
Office Paper	Recycled	364,000	Sanitary Waste	\$14,560	\$0	\$14,560	Estimate \$80/ton for disposal as trash.
Cardboard	Recycled	352,000	Sanitary Waste	\$14,080	\$0	\$14,080	Estimate \$80/ton for disposal as trash.
Scrap Metal	Recycled	386,000	Sanitary Waste	\$15,440	\$0	\$15,440	Estimate \$80/ton for disposal as trash.
Bottles/Cans	Recycled	46,000	Sanitary Waste	\$1,840	\$0	\$1,840	Estimate \$80/ton for disposal as trash.
Construction Debris	Recycled	668,000	Sanitary Waste	\$8,350	\$0	\$8,350	Estimate \$25/ton for disposal as trash.
	TOTALS	2,339,314			\$294,555		

Notes:
 * Pounds saved = Disposal avoided by reduction, reuse, recycling, or conservation.
 ** Cost savings of projects funded by the BNL Pollution Prevention Council will be tracked for 3 years.
 TBD = To be determined

Table 2-3. BNL Recycling Program Summary.

Recycled Material	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
Mixed paper	155	136	197	220	106	196	204	370	336	246	209	182
Cardboard	21	81	164	85	101	103	97	124	132	127	157	176
Bottles/Cans	12	12	18	11	15	21	22	21	20	29	19	23
Tires	9	21	7	11	17	18.6	11.5	15.2	0	0	3.5	12.3
Construction debris	809	495	495	627	837	799	527	352	243	289	304	334
Used motor oil (gallons)	–	–	4,000	3,350	4,275	4,600	3,810	3,570	3,295	3,335	1,920	3920
Metals	201	210	33	153	158	266	64	47	534	38	48	193
Lead	–	–	–	–	–	4.4	3.7	0.7	2.5	–	–	–
Automotive batteries	–	5	0.81	0.72	6.8	4.3	2.1	1.1	2.2	4.8	6.3	4.6
Printer/Toner cartridges (units)	–	–	–	–	–	–	1480/175	1575/510	–	363	449	187
Fluorescent bulbs (units)	–	–	–	–	13,664	12,846	867	25,291	5,874	17,112	25,067	13611
Blasocut coolant (gallons)	–	–	–	–	–	–	–	3,575	7,500	10,660	8,180	5030
Antifreeze (gallons)	–	–	–	–	55	276	448	145	110	200	0	165
Tritium Exit signs (each)	–	–	–	–	–	–	–	–	185	190	28	181
Smoke detectors	–	–	–	–	–	–	–	–	–	171	40	0

Notes:

All units are tons unless otherwise noted.

– Denotes not recycled in that year or data not available.

water and reduce the possible impact of clean water discharges on Sewage Treatment Plant operations. Figure 2-2 shows the 9-year trend of water consumption. In 2003 (as in 2002), BNL used approximately half as much water as in 1995—nearly 700 million gallons less, in each of those years.

2.3.4.6 Energy Management and Conservation

BNL's Energy Management Group has been in place since 1979. This group works to reduce energy use and costs by identifying cost-effective, energy-efficient projects, by monitoring energy use and utility bills, and by assisting in obtaining the least expensive energy sources possible. The group is responsible for developing, implementing, and coordinating BNL's Energy Management Plan (BNL 2003a).

BNL 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 2003, BNL used approximately 290 million kilowatt hours (kWh) of electricity, 4.7 million gallons

of fuel oil, 39.4 thousand gallons of propane, and 568 thousand cubic feet of natural gas. Fuel oil and natural gas produce steam at the Central Steam Facility. Fuel oil use increased in 2003, due to a larger number of heating degree days, but favorable market conditions resulted in a cost savings of approximately \$1 million. See additional information on fuel use in Chapter 4.

BNL is a participant in the Long Island Power Authority's (LIPA) Peak Load Reduction Curtailment Program. Through this program, the Laboratory has agreed to reduce electrical demand during critical days throughout the summer when LIPA expects customer demand to meet or exceed the company's available supply. In return, BNL receives a rebate for each megawatt reduced on each critical day. In 2003, participation in this program produced a rebate of \$65,000. The Laboratory's participation is significant to LIPA: BNL's portion represents more than 12 percent of the 95-megawatt load-curtailment program total, making the Laboratory the single largest program contributor. In 2003, additional projects for energy reduction included lighting improvements in

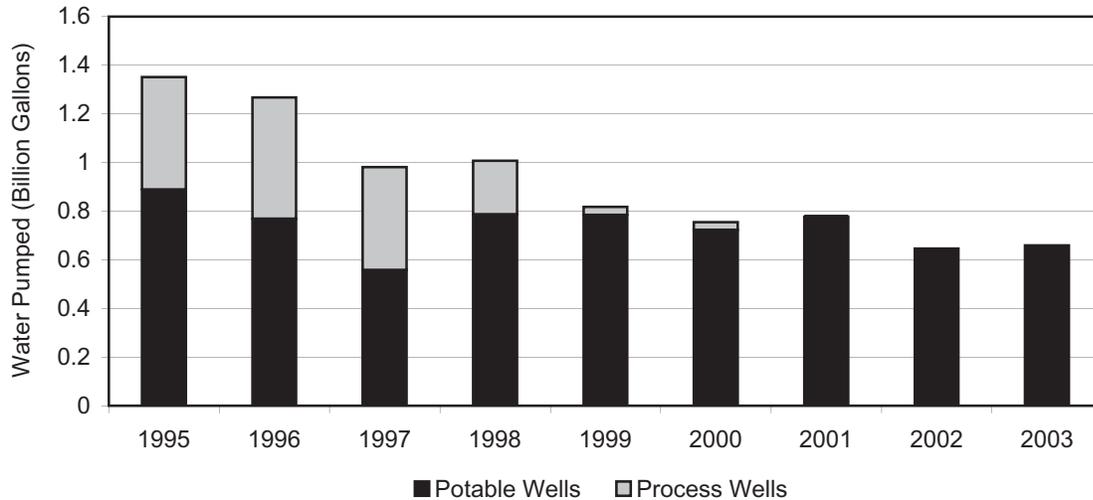


Figure 2-2. BNL Water Consumption Trend.

Buildings 510 and 515 that are expected to generate an estimated savings of \$10,000.

The National Energy Conservation Policy Act, as amended by the Federal Energy Management Improvement Act of 1988 and the Energy Policy Act of 1992, 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 1985, by 20 percent in 2000, 30 percent by 2005, and 35 percent by 2010. BNL energy use per square foot in 2003 is 23 percent less than in 1985 (see Figure 2-3).

BNL also maintains a contract with New York Power Authority (NYPA), resulting in an overall cost avoidance of \$15 million. Participation in NYPA's 2003 Load Curtailment Program produced a rebate worth \$1 million. BNL will continue to seek out alternative energy sources to meet its future energy needs, support federally required "green" initiatives, and reduce energy costs.

2.3.4.7 Natural and Cultural Resource Management

The Laboratory continues to develop, enhance, and implement its Natural Resource Management Program, building on a foundation established by the Wildlife Management Plan (Naidu 1999). BNL has begun to develop a Cultural Resource Management Program to

identify and manage properties that are determined to be eligible or potentially eligible for inclusion on the National Register of Historic Places. For more information about these programs, see Chapter 6.

2.3.4.8 Environmental Restoration

The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), commonly known as Superfund, was enacted by Congress on December 11, 1980. As part of CERCLA, EPA established the National Priorities List (NPL), which identifies sites where cleanup of past contamination is required. BNL is listed on the NPL, 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 Superfund cleanup process is reviewed and approved by DOE, EPA, and NYSDEC, under a contract called the "Interagency Agreement." This agreement was formalized in 1992. Most of the contamination at BNL 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 contamination and assess the associated risks

- Prepare a Feasibility Study and Proposed Plan to list and evaluate remedial action alternatives and present the proposed alternative
- Issue a Record of Decision (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

The BNL site was initially divided into seven Operable Units (OUs), some of which were later combined (OU I/VI and OU II/VII). Significant progress was made in environmental restoration in 2003. Table 2-4 provides a description of each OU and a summary of environmental restoration actions taken during 2003. The goal of BNL’s ER Program is to complete cleanup activities and install all groundwater treatment systems by 2006 (see Chapter 7 for further details).

2.3.4.9 The Facility Review Project

The Facility Review Project was a comprehensive examination of all site facilities, existing or demolished, to identify any past or current activities with the potential to degrade the environment. During this project,

BNL reviewed the entire operating history of the site and more than 900 systems, facilities, and operations. This review included tanks, pipes, sumps, cesspools, storage areas, historical discharges, and current and past operating practices. Personnel from other DOE facilities provided high-level technical and management support during the review. A final report was issued on October 7, 1998 (BNL 1998).

The report identified 75 issues as having the highest priority, due to their potential to contaminate groundwater above drinking water standards. Additionally, more than 1,675 issues that had the potential to impact the environment were identified as needing further evaluation and then subdivided into operational and legacy issues. In March 2000, a plan (BNL 2000) for the Facility Review Disposition Project (FRDP) was approved. This three-year project provided the mechanisms needed to risk-rank, schedule, and resolve the issues identified during the Facility Review Project.

In 2003, a Final Report for the Facility Review Disposition Project was prepared (BNL 2003a). The report described the methods and processes used to deal with the 2,216 issues identified during the FRDP. In addition, a Memorandum of Understanding (MOU) was drafted on December 23, 2003, transferring the

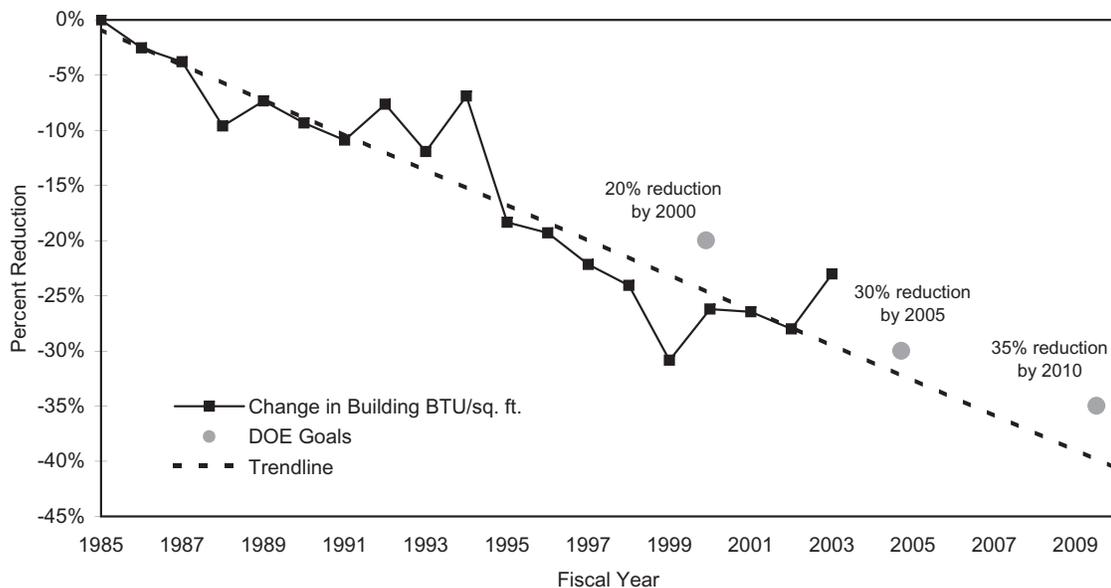


Figure 2-3. BNL Building Energy Performance, 1985 – 2010.

Table 2-4. Summary of BNL 2003 Environmental Restoration Activities.

Project	Description	Environmental Restoration Program Actions
Soil Projects	OU I OU II OUVII	<ul style="list-style-type: none"> ▪ Completed the remediation of the Ash Pit with the installation of a soil cap. ▪ Completed the Meadow Marsh remediation that maintained a Tiger Salamander habitat. ▪ Completed the decontamination and decommissioning of nine buildings in the former hazardous waste management facility. ▪ Completed the decontamination and decommissioning of the Building 811 evaporator system.
Groundwater Projects	OU III	<ul style="list-style-type: none"> ▪ Completed construction and began operations of an on-site groundwater treatment system Pilot Study for Sr-90 at the Chemical Holes area. ▪ Performed pre-design characterization, groundwater modeling, and initiated the design for the on-site Sr-90 treatment system for the BGRR/Waste Concentration Facility groundwater plumes. ▪ Completed construction of an off-site groundwater treatment system at the eastern portion of the Industrial Park for volatile organic compounds (VOCs). ▪ Issued the final designs and began construction of four additional off-site groundwater treatment systems for VOCs in East Yaphank and Manorville. ▪ Continued monitoring of the HFBR tritium plume. ▪ Continued characterization and monitoring of tritium in groundwater from g-2 activated soil. Further preparation and review of the Engineering Evaluation and Cost Analysis was postponed pending collection of additional data. (This is not included under any specific OU at this time but it is an AOC.) ▪ Successfully completed property access negotiations with seven off-site property owners for the installation and operation of the planned groundwater treatment systems. ▪ During 2003, 1.3 billion gallons of groundwater were treated and 510 pounds of VOCs were removed. Since the first groundwater treatment system started operating in December 1996, approximately 4,200 pounds of VOCs have been removed from more than 5 billion gallons of groundwater.
	OU IV	<ul style="list-style-type: none"> ▪ Regulators approved a petition for system closure of the OU IV air sparge and soil vapor extraction soil and groundwater treatment system. The system was subsequently dismantled. ▪ The Five-Year Review Report for OU IV was approved by the regulators and submitted to the information repositories for public availability. ▪ Continued groundwater monitoring.
	OU VI	<ul style="list-style-type: none"> ▪ Continued monitoring the ethylene dibromide plume. ▪ Issued the final design and began construction of the off-site groundwater treatment system in Manorville for ethylene dibromide. ▪ Successfully completed property access negotiations with two off-site property owners for the installation and operation of the planned groundwater treatment system.
	Groundwater Monitoring	<ul style="list-style-type: none"> ▪ Completed the BNL 2002 Groundwater Status Report. ▪ Collected and analyzed 2,510 groundwater samples from 629 monitoring wells. ▪ Updated Environmental Monitoring Plan groundwater chapter.
Peconic River	OU V	<ul style="list-style-type: none"> ▪ Completed the Sewage Treatment Plant Sand Filter Beds and Berms Project. Approximately 1,320 cubic yards of soil was shipped to Envirocare. ▪ Shipped approximately 1,500 cubic yards of contaminated sediment from the Peconic River Pilot Study project to Envirocare. ▪ Completed the Pre-Design Sampling and Analysis program for the Peconic River remediation project. An Action Memorandum for on-site cleanup was approved.
Reactors	BGRR	<ul style="list-style-type: none"> ▪ Completed the draft Characterization of Building 701 Aboveground Surfaces, Systems, and Structures Report. ▪ Completed the Characterization Report on the Building 701 Belowground Structures, 702 Pile, and Remaining Soils. ▪ Began removal of the below grade duct filters and primary liner.
	HFBR	<ul style="list-style-type: none"> ▪ Continued Long Term Surveillance and Maintenance Activities.
	BMRR	<ul style="list-style-type: none"> ▪ Completed fuel removal.

responsibility for management of FRDP follow-up activities to the Environmental and Waste Management Services Division. These activities include closure of the remaining 36 open issues, tracking and ultimate disposition of all 332 transferred issues, and maintenance of the database and website for the project.

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 environmental protection. Every BNL employee is required to develop a Roles, Responsibilities, Accountabilities, and Authorities document signed by the employee, his or her supervisor, and the supervisor's manager. Specifics on environment, safety, and health performance expectations are included in this document.

BSA has clearly defined expectations for staff and management. Under the BSA performance-based management model, senior management has communicated their expectation that all line managers and staff take full responsibility and be held accountable for environmental, safety, and health 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 in place, thus ensuring that all personnel are aware of their environmental responsibilities.

2.4.2 Communication and Community Involvement

When BSA was awarded the contract to manage BNL in 1998, they made a commitment to establish an effective partnership among DOE, the Laboratory, and community members to address issues that affect the community's quality of life. At the core of the Laboratory's commu-

nication and community-involvement programs are two documents: the Environmental Stewardship Policy and the Community Involvement Plan (BNL 1999).

The Environmental Stewardship Policy is the Laboratory's commitment to maintain a positive, proactive, and constructive relationship with the community and regulators, and to promote open communication on environmental performance. Written with input from both internal and external stakeholders, the Community Involvement Plan documents BSA's commitment to ensure that: it will keep the public informed of issues; it will actively seek and consider input from regulators, stakeholders, and the general public; and it will continue to provide opportunities for an open exchange of information, knowledge, and concerns.

The Laboratory continues efforts to build positive relationships with regulatory agencies by sharing information and working to resolve issues on plans, priorities, and corrective actions. BNL meets regularly with regulators from the New York State Department of Environmental Conservation (NYSDEC), U.S. Environmental Protection Agency (EPA) Region II, and the Suffolk County Department of Health Services (SCDOHS). A SCDOHS inspector has a permanent office on site.

Another forum for communication is the Brookhaven Executive Roundtable, which was established by DOE in August 1997 and includes staff from the offices of local, state, and federal elected officials, regulatory agencies, and representatives from DOE and the Laboratory. Members are updated on the Laboratory's science initiatives, operations, and environmental issues at bimonthly meetings.

In addition, the Community Advisory Council (CAC) was established in September 1998, and consists of representatives from different stakeholder groups, including civic, business, union, health, education, employee, and environmental organizations. The CAC meets monthly and sets its own agenda in cooperation with the Laboratory to discuss issues regarding environmental remediation activities, including groundwater cleanup, the final disposition of the Brookhaven Graphite Research Reactor

(BGRR), and plans for cleaning up portions of the Peconic River. Feedback and recommendations from the CAC on issues that are of concern to the community are considered in the Laboratory's decision making.

In 2003, the CAC advised the Laboratory Director of the community's priorities regarding the cleanup of the Peconic River, as well as the cleanup of the Magothy Aquifer on and off the Laboratory site. Also in 2003, to gain a better understanding of the topics the CAC is considering, they hosted a panel discussion with EPA, NYSDEC, and SCDHS representatives, as well as a presentation on cleanup remedies by a consultant to Neighbors Expecting Accountability and Remediation (NEAR). Due to their interest in BNL's Pollution Prevention Program, the CAC plans to host a Pollution Prevention Workshop at BNL in April 2004.

Through working groups, roundtables, and one-on-one interactions with BNL managers and subject-matter experts, stakeholders are provided with many other opportunities to learn about and provide input on issues of importance to them. In 2003, BNL reached out to the public through briefings to local civic and community groups; meetings with and presentations to local, state and federal regulators, and elected officials; canvassing of community members; and regular interactions with nearby businesses and local educators.

Laboratory employees and retirees, who are well educated and up to date on current issues at BNL, regularly interact with their neighbors and community groups, thereby acting as the Laboratory's envoys. They provide information about Laboratory science, gather feedback, and respond to concerns.

During 2003, BNL hosted more than 29,000 visitors to the Laboratory site, including students, teachers, and other community members who participated in "Summer Sunday" open houses, science-museum visits, tours for students from high school through college, and other outreach programs. One Summer Sunday was devoted to increasing the community's awareness of the local environment through activities, demonstrations, information dissemination, and displays. During this event, visitors

learned about the Laboratory's research initiatives in energy conservation and energy alternatives, such as fuel cells, improved residential oil burners, and alternative-fuel vehicles.

The Laboratory maintains an informative website at <http://www.bnl.gov>; issues press releases; and publishes *The Bulletin* (a weekly employee newsletter), *discover Brookhaven* (the Laboratory's science magazine), *cleanupupdate* (a periodic newsletter on environmental cleanup), *Laboratory Link* (a monthly brief on research activities), and e-mail updates to keep the public and employees informed about the Laboratory's research, activities, and issues, including those concerning the environment.

In 2003, BNL celebrated Earth Day with a variety of activities involving BNL staff and the community, including environmental awards, a student art contest, a 4-mile running race, and an on-site office-supply swap event. The Laboratory also participated with other local organizations and businesses in the nearby Heckscher State Park Spring Festival, using interactive displays to promote environmental awareness. BSA contributed corporate funds in support of these events as part of their commitment to environmental stewardship.

2.4.3 Monitoring and Measurement

Effluent and emissions 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. This program identifies potential pathways for exposure of the public and the environment, as well as evaluating what impact BNL activities may be having on the environment. It also 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 the review of previous analytical results. As required under DOE Order 450.1, BNL's Environmental Monitoring Plan, Triennial Update (BNL 2003b) outlines annual sampling

goals by media and frequency. The 2003 plan also specifies the data quality objectives associated with the monitoring program.

There were 6,189 sampling events of groundwater, potable water, precipitation, air, plants and animals, soil, sediment, and discharges in 2003 under the Environmental Monitoring Program, as shown in Table 2-5. This does not include samples taken to characterize waste for disposal purposes or nonroutine samples collected in support of restoration characterization activities. Specific sampling programs for the various media are described further in Chapters 3 through 8.

There are three components to the Environmental Monitoring Program: 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 Central Steam Facility. Real-time, continuous emission monitoring equipment is installed and maintained at some of these facilities or samples are collected and analyzed periodically to ensure compliance with regulatory requirements. Analytical data are routinely reported to the permitting authority. See Chapter 3, Section 3.5 for details.
- *Wastewater discharge monitoring* is performed at the point of discharge to ensure that the effluent complies with release limits in BNL's State Pollutant Discharge Elimination System (SPDES) permits. Nineteen point-source discharges are monitored under the BNL program: seven 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, or 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 Central Steam Facility, and the RCRA permit for the Waste Management Facility. Extensive groundwater monitoring is also conducted under the ER program as required under the Records of Decision for many of the Operable Units or Areas of Concern (see Chapter 7 for details). Additionally, to ensure that the Laboratory maintains a viable potable water supply, groundwater is monitored as required by the New York State Department of Health.

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 that 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.

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

Table 2-5. Summary of BNL 2003 Sampling Programs Sorted by Media.

Environmental Media	No. of Sampling Events*	Purpose
Groundwater	2,817	To evaluate impacts of past and present operations on groundwater quality, under the Environmental Restoration, Environmental Surveillance, and Compliance programs.
On-site recharge basins	150	Recharge basins used for wastewater and stormwater disposal are monitored in accordance with discharge permit requirements and for environmental surveillance purposes.
Potable water	193	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 and for environmental surveillance purposes.
Sewage Treatment Plant	416	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 discussion in Chapters 3 and 5.
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 and direction, temperature, and atmospheric stability, to help model atmospheric transport and diffusion of radionuclides.
Air – Tritium	235	Silica gel cartridges are used to collect atmospheric moisture for subsequent tritium analysis. These data are used to assess environmental tritium levels. Due to several years of nondetectable measurements and the shutdown of the HFBR, monitoring was reduced from weekly to monthly in several areas of the site in 1999. See discussion in Chapters 4 and 8.
Air – Particulate	409	Gamma analysis is performed on samples of particulate matter collected from air samples. The purpose is to look for any impact from BNL operations.
Air – Charcoal	102	Charcoal samples are used to assess for radioiodines, which could be a byproduct of the production of radiopharmaceuticals.
Fauna	93	Fish, deer, and small mammals are monitored to assess impacts on wildlife associated with past (or current) BNL operations.
Flora	21	Since the primary pathway from soils to fauna is via ingestion, vegetation is sampled to assess possible uptake of contaminants by plants and hence to fauna.
Soils	1,634	Soil samples are collected from adjacent farms and other local areas to confirm that Laboratory emissions have no impact on surrounding areas. Soil samples are also collected as part of Environmental Restoration investigative work.
Miscellaneous	111	Samples are collected periodically from manholes and other locations to assess compliance with regulatory requirements.
Total number of sampling events	6,189	This number includes all the samples identified in the EMP (BNL 2003), plus samples collected by the field sampling team as special requests. The number does not include samples collected to monitor Environmental Restoration projects and air and water treatment system processes, waste generators, or Environmental Compliance Representatives for waste characterization purposes.

Note:

* In one sampling event, multiple samples may be collected from a single location. For example, during one sampling event, separate samples for tritium, gross alpha and beta, and VOCs may be collected from a groundwater monitoring well.

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 by thermoluminescent dosimeters (devices to measure radiation exposure) on and off site are routinely reviewed under this program.

Control samples (also called background or reference samples) also are collected on and off the site to compare BNL results to areas that could not have been impacted 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 EMS is operating as intended, audits are conducted. These audits are part of the Laboratory's Self-Assessment Program and are designed to ensure that any nonconformance to the ISO 14001 Standard is identified and addressed. An independent, accredited registrar also conducts annual ISO 14001 registration audits. 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 ISO 14001 EMS requirements is verified, progress toward achiev-

ing environmental objectives is monitored, operations are inspected to verify compliance with regulatory requirements, and the overall effectiveness of the EMS is evaluated. Environmental experts routinely participate in these assessments. Management also conducts assessments to evaluate Laboratory 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. Laboratory management also routinely evaluates progress on key environmental improvement projects. BNL periodically coordinates with the local DOE office to 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 staff who do not have line responsibility for the work processes. 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. Staff from the offices of Battelle Memorial Institute and BSA subcontractors also perform periodic independent reviews. An independent third party conducts ISO 14001 registration audits of the Environmental Management System.

In July 2003, an ISO 14001 EMS Surveillance Audit was conducted by NSF-ISR, an independent and accredited ISO 14001 registrar. The independent registrar determined that BNL's EMS remains in conformance with the ISO 14001 standard. The auditors identified two minor nonconformances, two opportunities for improvement, and strong evidence of

continuous improvement. A corrective action plan that BNL prepared for the minor nonconformances was tracked to closure.

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 TODAY

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

The Laboratory is openly communicating with neighbors, regulators, employees, and other interested parties on issues and progress. To regain and maintain stakeholder trust, BNL will continue to deliver on commitments and demonstrate real improvements in environmental performance. This annual Site Environmental Report is an important communication mechanism, as it summarizes BNL's environmental programs and performance for 2003. Additional information about BNL's environmental programs is available on BNL's website at <http://www.bnl.gov>. The Laboratory continues to pursue other mechanisms to communicate data in a more user friendly, visual, and timely manner.

The existing BNL Environmental Management System is viewed as exemplary within DOE. BNL was the first DOE Office of Science national laboratory to obtain third-party registration to ISO 14001. Due to external recognition of BNL's knowledge and unique experience implementing the ISO 14001 EMS program, several DOE facilities and private universities have invited BNL to extend its outreach activities and share its experiences, lessons learned, and successes. As noted above,

BNL'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 the Laboratory:

- The EMS has been strengthened, integrated with other BNL 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 evaluations, BNL has an improved 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.
- BNL has been very successful in achieving environmental goals and critical outcomes. 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, and visiting scientists.
- 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.

CHAPTER 2: ENVIRONMENTAL MANAGEMENT SYSTEM

- There has been strong penetration of the EMS throughout organizations, and cultural change has been sweeping.

For more than 50 years, the unique, leading-edge research facilities 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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