ISO 14001 Implementation At A National Laboratory

Paper # 440

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ABSTRACT

After a tumultuous year discovering serious lapses in environment, safety and health management at Brookhaven National Laboratory, the Department of Energy established a new management contract. It called for implementation of an ISO 14001 Environmental Management System and registration of key facilities. Brookhaven Science Associates, the managing contractor for the Laboratory, designed and developed a three-year project to change culture and achieve the goals of the contract. The focus of its efforts were to use ISO 14001 to integrate environmental stewardship into all facets of the Laboratory's mission, and manage its programs in a manner that protected the ecosystem and public health.

A large multidisciplinary National Laboratory with over 3,000 employees and 4,000 visiting scientists annually posed significant challenges for ISO 14001 implementation. Activities with environmental impacts varied from regulated industrial waste generation, to soil activation from particle accelerator operations, to radioactive groundwater contamination from research reactors. A project management approach was taken to ensure project completion on schedule and within budget. The major work units for the Environmental Management System Project were as follows: Institutional EMS Program Requirements, Communications, Training, Laboratory-wide Implementation, and Program Assessments. To minimize costs and incorporate lessons learned before full-scale deployment throughout the Laboratory, a pilot process was employed at three facilities. Brookhaven National Laboratory has completed its second year of the project in the summer of 2000, successfully registering nine facilities and self-declaring conformance in all remaining facilities. Project controls, including tracking and reporting progress against a model, have been critical to the successful implementation. Costs summaries are lower than initial estimates, but as expected legal requirements, training, and assessments are key cost centers. Successes to date include the pilot process, heightened employee awareness, registration of the first DOE National Laboratory facility, line ownership of the program, and senior management commitment.

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INTRODUCTION

The Environmental Management System (EMS) Project establishes a comprehensive Laboratory system for planning, implementing, monitoring and assessing environmental issues at Brookhaven National Laboratory (BNL). This system enhances environmental management at BNL through adoption of the ISO 14001 Standard[1] and increased emphasis on compliance assurance, community outreach and pollution prevention. To maximize effectiveness and minimize resource expenditures, the EMS is implemented at BNL within the framework of the Department of Energy (DOE) Integrated Safety Management (ISM)[2], and integrated with other related BSA management systems. The project has also been initiated to satisfy a voluntary agreement between the DOE and Environmental Protection Agency (EPA), and satisfy requirements contained in the DOE management contract with Brookhaven Science Associates (BSA).

The scope of the EMS project during its first year included developing a laboratory-wide program that defines the basic set of requirements and operational procedures for managing environmental activities. These procedures were developed using a facilitated team approach. Staff members who were ultimately responsible for implementing the procedures, were key participants on the team. Representation of affected organizations on the development teams resulted in effective and efficient processes that were easily implemented. Most importantly, it resulted in acceptance, buy-in, and increased compliance with requirements. Initially, three pilot facilities implemented the system. The lessons learned from the pilot facilities were incorporated into the institutional EMS program as improvements and later deployed throughout the remaining organizations during the following year. Training programs were expanded to address a full array of environmental training needs. Communications, both internal among staff members and external with community, were launched. Lastly, a rigorous program to self-identify and correct weaknesses in the program was implemented. This proved to be an essential factor leading to the successful registration of nine facilities at BNL and Laboratory-wide improvements in the way environmental activities are managed.

The EMS Project was designed and implemented using a project management approach with requisite controls to ensure satisfactory completion of milestones and commitments. The total cost for the EMS Project has been $1.87 M (through 2.5 years), however less than 20% was a direct cost. Annual costs to maintain the EMS Program are estimated at $0.3 M. This paper describes the events leading to the program's initiation and project management techniques utilized to ensure success. It also provides details on Brookhaven's implementation methodology

and the positive results achieved to date.

BACKGROUND

BNL is a multi-program national laboratory operated by BSA for the DOE. The Laboratory's broad mission is to produce excellent science and advanced technology to support the DOE missions in a safe, environmentally responsible manner with the cooperation and support of the community. Specifically, the elements of the BNL mission, which support the DOE strategic missions, are the following:

- To design, and operate complex research facilities, such as colliders and accelerators;
- To carry out basic and applied research in physics, chemistry, materials science, biology, medicine and forefront technologies; and
- To educate new generations of scientists and promote scientific awareness in the general public.

In addition, BNL operates and maintains a support infrastructure much like a municipality, including a Sewage Treatment Plant, Water Treatment Plant, and Central Steam Facility. Other activities include environmental restoration/decommissioning of facilities, operation of a fleet system, as well as an array operations to support the conduct of research. Brookhaven National Laboratory is a 5,000 acre site located near the geographical center of Long Island, about 60 miles east of New York City.

In May 1997, the EPA conducted a multi-media audit of BNL. This assessment came on the heels of a DOE ISM Evaluation that found serious safety management concerns and resulted in the termination of the management contract. The findings of these audits prompted the DOE to enter into a voluntarily agreement with EPA. The commitment in this agreement was to perform four environmental initiatives, one being the implementation of an EMS with an enhanced emphasis on compliance assurance, pollution prevention, and community outreach. Independent of this agreement, BSA's commitment to DOE as the new management contractor was to change culture and fully integrate the environmental stewardship principles of ISO 14001 into the management of all programs at the Laboratory. Lastly, the DOE/BSA contract required formal registration of facilities that have a high potential to impact the environment to the ISO 14001 Standard, and "self declaration of conformance" for the balance of the Laboratory. All three drivers required BSA to fulfill these commitments within a short thirty-month time period.

ISO 14001 is an international standard. The system is based on the Deming philosophy of continual improvement, and is achieved through the implementation of five principles:

- define the organization's environmental policy and ensure commitment;
- formulate a plan to fulfill its environmental policy;
- develop capabilities and support mechanisms to achieve the policy, and objectives and targets;
- measure, monitor and evaluate its environmental performance; and
- review and continually improve the EMS, with the objective of improving performance.

The ISO 14001 Standard includes seventeen required elements: policy; environmental aspects; legal and other requirements; objectives and targets; environmental management programs; structure and responsibility; training awareness and competence; communication; EMS documentation; document control; operational controls; emergency preparedness and response;

monitoring and measurement; nonconformance and corrective/preventive actions; records; EMS audits; and management review. The intent of the standard is to provide organizations with the required elements of an effective management system that can be easily integrated with other management and business systems to achieve environmental and economic goals.

BNL's approach for managing environmental matters is embedded within a site-wide integrated system for Environment, Safety and Health (ES&H). This system incorporates ES&H requirements into work planning and operations, and is designed to protect workers, the public, and the environment. It is based on the DOE ISM Policy, which embody many of the essential elements of a sound EMS. These elements, as they relate to BNL' environmental program, are provided in Table 1.

Table 1: Brookhaven's Integrated Safety Management System Policy Applied to Environmental Issues

Guiding Principles

- Line Management Responsibility for Safety: BNL managers are directly responsible and accountable for protecting the environment.
- Clear Roles and Responsibilities: Clear and unambiguous lines of authority and responsibility for ensuring environmental protection and compliance are formally established and maintained at all organizational levels, including visiting scientists and contractors.
- Competence Commensurate with Responsibilities: Staff possess the experience, knowledge, skills, and abilities necessary to discharge their environmental responsibilities.
- Balanced Priorities: Resources for environmental activities and operations are effectively allocated. Protecting the environment is a priority whenever activities are planned and carried out.
- Identification of Environmental Standards and Requirements: Before work is started, environmental hazards are evaluated, then an agreed-upon set of requirements and standards is established which, when properly implemented, adequately assures that the environment is protected from adverse consequences.
- Hazard Controls Tailored to Work Performed: Administrative and engineering controls are designed to prevent and mitigate environmental hazards associated with the work performed.
- Operations Authorization: The environmental conditions and requirements to be satisfied before operations can be initiated are established and agreed-upon before work is conducted.

Core Functions

- Definition of the site's environmental assets, including important ecological systems, as well as the activities, products or services, that can potentially interact with the environment and cause a significant impact.
- Definition and promulgation of policies, standards, expectations, and identification of legal requirements that govern the work activity are appropriate to the environmental hazards associated with that work.
- Development and implementation of practices and work controls that either eliminate or minimize the potential environmental hazards.
- Responsibility and accountability reside with all staff to perform work within the established controls to ensure environmentally sound operations.
- Assessment and evaluation of work performance and systems performance leads to continuous improvement in both compliance and pollution prevention. Feedback is provided to both internal and external stakeholders.

PROJECT INITIATION AND PLANNING

The EMS Project was first initiated with the signing of the new management contract and

voluntary agreement with EPA in March, 1998. The EMS Project is the third in a series of environmental projects focused on understanding the aspects of research activities that could, and in some cases did, impact the environment. The EMS project was designed to build on the technical knowledge of these other projects and establish the supporting systems to manage both current activities and future growth. The supporting systems established ensure environmental concerns are identified, controlled, and monitored, potential impacts are eliminated or minimized, and system requirements are institutionalized into routine work processes. It is the intention of BSA that BNL will be recognized as a leader in environmental protection, just as it is viewed as a leader in scientific research.

The project was organized to ensure project goals and objectives are achieved in a resource efficient manner and that the deliverables meet the requirements specified by its stakeholders, EPA, DOE, and BNL senior managers. These stakeholders judge the level of project success, and thus imperative that this project be operated efficiently to assure effective implementation, value-added benefits to the scientific programs, and achievement of the Laboratory goals. A project management approach was utilized to ensure these expectations were met.

Project Management Plan

First a project manager was assigned to design and develop the EMS Program. The project manager started by reviewing the scope and requirements for an EMS and evaluating the existing systems potential. A workable scheme to accomplish the requirements was devised and documented in an EMS Project Management Plan[3]. This project management plan included the following elements: Program Goals and Objectives; Management Organization and Responsibilities; Project Baseline (scope, cost, schedule); Project Control System; Project Transition and Closeout.

Underpinning the technical basis of the project design and schedule/cost estimates are certain assumptions and conditions. It is imperative that these assumptions be communicated and approved, however uncertain they are. Three types of assumptions exist: critical assumptions (must be satisfied in order to conduct the project), resource assumptions (related to labor, funding and costs), and schedule assumptions (related to project sequence and duration). Validity of the assumptions is monitored during the life of the project. If an assumption proves false or conditions change during the implementation, midcourse corrections are made and the project design modified accordingly. Examples of assumptions used in the EMS Project include:

- *The scope of the project addresses the requirements in the BSA/DOE contract, ISO 14001 and DOE/EPA Memorandum of Agreement.*
- *The Process Evaluation Project shall provide the technical information for identifying environmental aspects, operational controls & monitoring requirements, legal and other requirements, and pollution prevention.*
- *Implementation of the tasks will be completed on or ahead of the published schedule*
- *Facility resources assigned to this project are not committed to other initiatives*
- *The estimated cost does not incorporate efficiencies that will be pursued during project implementation, such as cost reductions that may result from the pilot process, joint multi-purpose audits, or use of DOE sponsored assistance for specific tasks.*

Next was obtaining management commitment. A project charter and project management plan

was approved by senior management, formally authorizing funding. Most of the costs were contributed resources, that is, time and effort from existing staff to complete tasks. To prevent over-commitment and conflicting priorities, specific resource needs were estimated, identified, and then formally assigned to the EMS Project Manager via a "Commitment Authorization Package" (CAP). The CAP, a contract between the project manager and each senior manager, documented the scope of work expected, schedule for delivery of products, and estimated level of effort from their staff to complete the tasks. The CAP was critical to the success of the project. It was an important tool for communicating expectations and ensuring availability of matrix staff who do not report directly to the project manager.

Organization and Responsibilities

Roles, responsibilities, authorities and accountabilities for successful implementation of the EMS program were identified and assigned. The Director for Environment, Safety, Health & Quality (ESH&Q) was accountable to the Laboratory Director for providing oversight, guidance, and assistance. The EMS Project Manager planned, coordinated, and directed project execution and was accountable to the Director of ESH&Q for successful implementation. The project manager was responsible for project planning, technical quality, day-to-day management, and control/reporting of project activities. Senior managers were responsible for committing the necessary resources to implement the EMS. They appointed a Management Representative to serve on the EMS Project Team and facilitate implementation of the program in their organizations. More importantly, senior managers exhibited ownership and support of the EMS project goals, and were responsible for their performance.

An EMS project team was formed, consisting of the EMS Project Manager, the managers for each of the related management systems (such as Environmental Services, Training, Quality Management, Emergency Response, Public Affairs, etc), the Management Representatives, and project support personnel. This team was responsible and accountable for completing the tasks assigned to them on schedule and within budget. The EMS Project Team consisted of 60 persons working anywhere from 10% to 100% of their time for a selected period. The team, augmented at times with purchased consultant services, was comprised of the following:

- one full-time project manager for the entire project duration for 3 years
- eight management system managers, ~25% level of effort, for six months
- thirteen Management Representatives, 25-33% level of effort for a twelve months
- thirteen teams of four to eight members, each dedicated 10–25% for twelve months
- support: coordinator (50%), administrative support (33%), project controls (25%) for 3 years
- trainer (40% for one year) and technical editor (20% for one year).

PROJECT EXECUTION

The BNL EMS project is comprised of six major initiatives: development of Institutional EMS program requirements, pilot facility implementation, Laboratory–wide implementation, communication, training, and assessment. The following sections provide summary descriptions of each.

Institutional EMS Program

BSA committed to the DOE to implement an improved, comprehensive set of management systems to assure that business and ESH obligations are met. To maximize effectiveness and minimize expenditures, the EMS was integrated with these new systems. Where existing systems were already established, enhancements were made to conform with the ISO requirements. In fact, many of the requirements were easily incorporated into existing programs. Examples include including the ISO *14001 Training, Awareness, and Competence* requirements into the existing *Training and Qualification System*; using the *Quality Management* program to satisfy the ISO requirements for *Document Control* and *Records*; and incorporating the *EMS Audit* and *Management Review* requirements into the *Integrated Assessment Program*. Table 2 shows the BSA management systems and related ISO 14001 elements.

One of the key supporting management systems, Standards-Based Management System (SBMS), provides a web-based repository for Laboratory requirements. Requirements are translated into a user- friendly format, and are focused on what staff need to know to conduct their work. All Laboratory-wide environmental support staff, designed and developed the BNL procedural requirements that govern requirements reside in this system including ISO 14001 requirements. Teams of employees, assisted by

Table 2: Integration of BNL Management Systems and EMS Elements

ENVIRONMENTAL MANAGEMENT • Policy • Legal and Other Requirements • Structure and Responsibilities • Monitoring and Measurement **INTEGRATED PLANNING** • Objectives and Targets • Environmental Management Programs • Monitoring and Measurement **INTEGRATED SAFETY MANAGEMENT** • Aspects and Impacts • Operational Control **STANDARDS-BASED MANAGEMENT** • Legal and Other Requirements • EMS Documentation • Document Control • Communications **EXTERNAL/INTERNAL COMMUNICATIONS** • Communications	**TRAINING AND QUALIFICATION** • Training, Awareness and Competence **LIFE CYCLE ASSET MANAGEMENT** • Operational Control **QUALITY MANAGEMENT** • Document Control • Monitoring and Measurement • Nonconformance and Corrective and Preventive Action **ENVIRONMENTAL RESTORATION** • Monitoring and Measurement **RECORDS MANAGEMENT** • Records **EMERGENCY RESPONSE/EMERGENCY PREPAREDNESS AND OFF-NORMAL EVENT REPORTING** • Emergency Preparedness & Response **INTEGRATED ASSESSMENT** • EMS Audits • Monitoring and Measurement • Management Review

environmental management. A facilitated team approach was used to ensure buy-in from the staff who had to implement the requirements. These procedures were augmented by facility level protocols when necessary. Input from the regulators on the compliance procedures was sought and resulted in constructive and positive feedback. Table 3 presents the titles of the twenty-six procedures that were developed. The following sections describe how BNL implemented the ISO requirements.

Environmental Policy

The Laboratory Director developed the BNL Environmental Stewardship Policy to specifically address the unique facilities, operations and environmental issues at BNL. The policy contains commitments to **C**ompliance, **C**lean-up, **C**ommunity Outreach, **C**ontinual Improvement, and **P**ollution **P**revention, commonly referred to as "***C^4P^2***". The policy is posted on WebPages, published in reports, and hangs on walls throughout the Laboratory. The policy logo shown in Figure 1 is found on informational brochures and mouse pads to help staff remember the policy commitments. The Laboratory Director sent a personal letter to all employees outlining his commitment to environmentally responsible operations and his expectation that all staff would participate in a new way of doing business. The policy commitments are reinforced at routine meetings and in the training that is received by staff and visiting scientists.

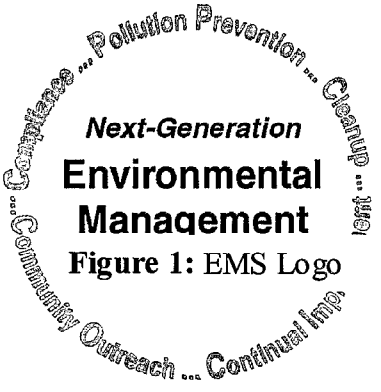


Figure 1: EMS Logo

Table 3: BNL EMS Procedures

COMPLIANCE SUBJECT AREAS	EMS SUPPORT SUBJECT AREAS
▪ Pollution Prevention & Waste Minimization ▪ NEPA & Cultural Resource Evaluation ▪ Environmental Monitoring ▪ Non-Radioactive Airborne Emissions ▪ Radioactive Airborne Emissions ▪ Drinking Water ▪ Liquid Effluents ▪ Underground Injection Control ▪ Storage & Transfer of Hazardous Materials ▪ Oil/PCB Management ▪ Hazardous Waste Management ▪ Radioactive Waste Management ▪ Mixed Waste Management ▪ Regulated Medical Waste ▪ Spill Response	▪ Identifying Significant Environmental Aspects and Impacts, Objectives/Targets & EM Programs, and Operational Controls ▪ Environmental Evaluation of Industrial Processes & Experiments ▪ Requirements Management ▪ Requesting Variances ▪ Correspondence & Commitment Tracking System ▪ Laboratory-wide Procedures & Guidelines Development ▪ Internal, Controlled Documents ▪ Calibration ▪ Nonconformance & Corrective/Preventive Action ▪ Records Management ▪ Environmental Assessments

Significant Aspects and Impacts

A large multidisciplinary National Laboratory with over 3,000 employees and 4,000 visiting scientists annually poses significant challenges for ISO 14001 implementation. Activities with environmental impacts covers a full spectrum: regulated industrial waste generation in machining operations; hazardous waste generation during experiments; radioactive groundwater contamination from research reactors; soil activation from particle accelerator operations; impacts on endangered species or protected habitats during conventional construction activities. The EMS program design needs to be adequate and appropriate to protect the environment from an array of impacts from a variety of activities. BNL has conducted several environmental reviews of its operations over the years. Most recently, two extensive evaluations have been performed, the Facility Review Project and the Process Evaluation Project. These studies, in

conjunction with the deployment of the EMS, provide the technical basis for evaluating the environmental aspects associated with historical, current, and future operations.

The Facility Review Project was a comprehensive examination of historical facility configuration and operations that had the potential to impact the environment. The Process Evaluation Project was an intensive effort to evaluate current experimental and industrial-type operations to identify all air emissions, effluents, and waste produced. A determination of the regulatory status of each identified waste stream was made, to ensure that all were managed in compliance with regulations. In addition, pollution prevention/waste minimization opportunities and assessment/control measures were identified, evaluated and tracked through implementation. These projects established a baseline assessment of operations, provided the technical basis for an aspects analysis, and will continue to be used to assess operations into the future. Coupled with an evaluation of environmental performance and community/stakeholder concerns, significant environmental aspects were identified (see Table 4). BNL based the determination of significance on both the real and perceived impacts of its operations, and regulatory compliance requirements. Because of its location over a sole source aquifer that provides drinking water, groundwater is a significant resource and protection of it is a high priority. Because of community member concerns, radioactivity in any environmental media (air, water, soil) is significant. As the EMS matures, impacts will be reevaluated to ensure that the significant aspects continue to reflect the concerns of stakeholders, changes in regulatory requirements, and new impacts that might arise.

Table 4: Significant Environmental Aspects

- **Waste Generation:** Regulated industrial, hazardous, radioactive, mixed, medical, transuranic wastes
- **Atmospheric Emissions:** Radioactive, non-radioactive
- **Liquid Effluents:** Chemical, radioactive
- **Storage/Use Hazardous Materials:** Chemicals, radioactive
- **Resource Usage:** Power, water
- **Existence of Historical Monuments/Cultural Resources**
- **Environmental Noise**
- **Disturbance to Sensitive Habitats/Endangered Species**
- **Historical Contamination**
- **Soil Activation**
- **Facility specific compliance requirements**

Legal and Other Requirements

Requirements have several sources, including contract obligations, regulatory requirements, and formal commitments made by management. A program was established for controlling the receipt and analysis of external requirement documents. Once applicability is determined, the actions required for achieving compliance, if any, are identified. This may involve developing new programs, revising procedures, developing training, implementing control technologies, or other methods as appropriate. New requirements are translated into SBMS documents. The responsible support organization ensures that it has timely information on proposed and new regulations by attending conferences, training, and subscribing to an environmental regulation service. Communication of these requirements to affected staff is achieved through several mechanisms: formal transmittal to senior managers; electronic notification to staff of new or revised SBMS documents; staff participation on procedure development teams; and direct communications with the respective organization via field deployed environmental professionals.

BNL has also designed its EMS with an enhanced emphasis on compliance assurance. To that end, it has used the ISO 14001 elements as follows:

- *Legal & Other Requirements*, to establish programs and procedures to proactively identify, communicate and implement environmental requirements to BNL staff, visitors, and contractors;
- *Legal & Other Requirements* and *Monitoring & Measurement*, to submit reports on time
- *EMS Audit* and *Nonconformance & Corrective/Preventive Action*, to implement self-assessment and corrective action programs; and
- *Communications*, to maintain positive and proactive relationships with regulatory agencies.

Objectives and Targets

The Laboratory sets annual goals, objectives and performance measures, including environmental "objectives and targets" as part of its Critical Outcome, Objective, Performance Measures (CO/O/PM) process. Based on DOE guidance and consistent with BSA management philosophy, these CO/O/PM are developed in partnership and formally documented. The environmental CO/O/PM embody the improvement goals based on compliance status, views of interested parties, and site-specific concerns. As such they are consistent with the policy commitments of compliance, clean-up and community outreach. They also take into account operational requirements, business interests, as well as any financial or technological constraints and thus are consistent with the commitment to pollution prevention. Since the CO/O/PM reflect the Laboratory priorities and establish the improvement agenda for the year, they are also consistent with the policy commitment to continual improvement.

Deployment of CO/O/PM through the relevant levels of the organization is achieved by ascribing Laboratory-level performance objectives to individual processes or activities that have significant environmental aspects and developing specific targets for those activities. Organizational units may also develop additional facility-specific targets depending on their operational performance or particular improvement goals. Finally, employees who have an important role in achievement of these CO/O/PM or facility targets have specific goals incorporated into their annual performance goals.

Environmental Management Program

A Strategic Planning infrastructure assures clarity in the Laboratory's resource investments, including alignment of investments with strategic goals, allocation of resources, clear definition of expected results, and accountability for management of those resources. Laboratory-wide projects are developed to achieve key goals and objectives, These projects are defined and prioritized through a formal risk-ranking process. Project or work plans, assigning responsibility and a schedule for completion, are developed for complex projects, such as the projects mentioned already and CERCLA Remediation.

Each organization within BNL has a responsibility to assist the Laboratory in successfully achieving the CO/O/PM. Action plans are developed to augment the activities conducted at the Laboratory level. These plans focus on achieving and maintaining compliance, implementing pollution prevention opportunities, or improving the environment management system at the

organizational level. Managers conduct assessments to monitor and evaluate performance, including progress on their action plans.

EMS Structure and Responsibility

An essential element of the Performance Based Management approach used at BNL is the identification of employee roles, responsibilities, authorities, and accountability (R2A2s). All staff have the following environmental responsibilities:

- Comply with Laboratory policies and procedures, and regulatory requirements.
- Maintain awareness of the environmental impact of work and apply pollution prevention.
- Identify potential environmental hazards at work and implement controls to minimize risk.
- Respond to emergency situations, alarms or occurrences in an appropriate manner.

Select personnel, such as managers, environmental professionals, and staff whose work can directly impact the environment have additional responsibilities in their R2A2s. Performance appraisals are conducted to assess individual performance against pre-assigned goals and responsibilities. Mechanisms for both counseling employees whose performance does not meet expectations and acknowledging good performers through personal recognition or financial reward are established.

As described above, leadership and overall responsibility for establishing and maintaining the site-wide EMS is assigned to a senior Laboratory Manager, who relies on assistance from the environmental support organization. Routine reports on EMS performance are made to the senior managers in technical reports, in assessment reports, and at a variety of periodic meetings.

Training, Awareness, and Competency

The Training and Qualifications Management System was established to define, assess, complete and document training requirements and ensure staff are qualified to perform their jobs. Training programs and procedures ensure consistent implementation of requirements across the Laboratory, particularly for new employees/guests (including visiting scientists) and contractors/vendors. Competency of staff is determined based on education, training, and/or experience. Management is responsible for ensuring that all personnel whose work may create a significant impact on the environment receive appropriate training. Training and qualification records are maintained in a centralized, web-based database.

Communications

Programs have been established for internal and external communications on environmental aspects, EMS, and environmental program activities. Examples of internal communication channels are: Routine management meetings; SBMS subscription/electronic notification service for new or revised requirements; Direct communiqués with staff on specific environmental issues; BNL publications and use of BNL WebPages; ES&H Hot Line for staff to express concerns or ask ESH questions.

BSA is committed to maintaining a positive, proactive, and constructive relationship with its stakeholders and communicating openly on its significant environmental aspects. The Laboratory maintains a tracking system for controlling official correspondence and requests for from

stakeholders. A formal program for communicating with the media and community groups was established. The compliance experts in the environmental support organizations assist DOE personnel on communications with environmental regulatory agencies. Methods for communicating to external parties include: Routine meetings with stakeholder groups; Formal channels as required by the NEPA and/or CERCLA processes, such as public meetings; Direct communiqués by environmental support organization personnel with regulators; Publications and reports, such as newsletters to community members, annual environmental reports, routine regulatory reports as required, and BNL WebPages; Involvement in external, community-based environmental organizations; Special events such as Earth Day activities, Science Fairs, educational lectures, and tours.

EMS Documentation

The *ISO 14001 "Plus" EMS Manual* describes the core elements of BNL's EMS and provides reference to related documentation. These documents and supporting procedures are available on SBMS. In addition, each organization maintains a document that describes how their EMS is implemented.

Document Control

Formal procedures identify responsibilities and establish controls for issuing, revising, and approving Laboratory documents in SBMS. The official copy of most documents with its revision history are stored in electronic format, on-line and readily available to staff. Using a graded approach, a less rigorous process for reviewing, revising and approving facility level procedures has also been established. Managers are responsible for ensuring accessibility of these controlled documents by staff that need them. This is accomplished via an online delivery system, by placing a copy in a central workplace, several staff sharing a copy assigned to one person, or by assigning each person a controlled copy.

Operational Controls

Experimental activities and routine operations are evaluated for hazards. Early identification of hazards and their mitigation is a proven technique to minimize the risk of an impact, assure environmental protection, and avoid unnecessary costs or delays caused by incidents. Formal work planning processes enable the identification of operational requirements before work begins thus ensuring that environmental hazards, a.k.a. aspects and impacts, are appropriately managed and adequately controlled. A hierarchy of controlling hazards, first considering engineered controls (ie., double-wall piping), then administrative controls (ie., operating limits), and then protective equipment (ie., absorbents) is used to identify the appropriate operational control for the hazard.

Communications with suppliers/contractors are conducted formally via contracting documents. They define responsibility and accountability for compliance, expectations for ES&H performance, and use of environmentally preferable products. Once on-site, job specific requirements are communicated.

Emergency Preparedness and Response
A comprehensive emergency program to identify and respond to accidents or emergency situations had already been established. Only minor enhancements to incorporate EMS requirements were needed. A Laboratory-wide Hazard Assessment had been conducted to identify potential emergencies. Periodic exercises and critiques were performed to assess readiness and identify lessons learned, including procedure revisions. Existing accident investigation processes were used to identify the causes and corrective actions necessary to prevent an environmental release from recurring. Individual organizational units developed Local Emergency Plans to describe expected scenarios and response.

Monitoring and Measurement
Managers are required to collect performance data, monitor progress on objectives, and evaluate the results to identify areas for improvement. A central electronic database is used to collect and report semi-annually on CO/O/PM progress. Internal monitoring systems are used for organizational goals.

The program design and schedule for measuring effluents, emissions, and background levels of pollutants are described in a Environmental Monitoring Plan. The environmental support organizations provide sampling and analysis services and maintain internal operating procedures describing these processes. Calibration requirements for equipment used to measure environmental indicators are defined. The annual BNL Site Environmental Report publishes the facility monitoring data to assess the environmental impact of operations. In addition, regulatory required environmental reports are filed. Compliance with specific environmental legislation and regulations is also evaluated and assessed on a program- or facility-specific basis. BNL has established a compliance audit process that is often performed in conjunction with an ES&H inspection by a team including an environmental expert. Periodically, the environmental support organizations perform regulatory assessments verifying the compliance status of multiple organizations across the Laboratory. Lastly, external regulatory agencies and/or technical experts may conduct independent audits of compliance.

Nonconformance and Corrective/Preventive Action
All staff are assigned the responsibility and authority to identify nonconforming processes, determine the cause, identify actions to prevent recurrence, and document closure of the actions taken. Individual organizations are responsible for tracking their nonconforming conditions and corrective actions to completion. Managers are responsible for verifying that the corrective action is complete. A graded approach is applied to ensure the level of formality is commensurate with the risk. If a nonconformance exceeds established thresholds, a formal DOE Occurrence Reporting and Processing System is triggered. Incidents are evaluated for root and contributing causes using either formal accident investigation techniques or a less formal Critique process. These processes provide input to a Lessons Learned Program and shared with others. Electronic tracking systems are used to track corrective actions from nonconformance reports, occurrences, investigations, and assessments.

Records
A records management system for identifying, maintaining, and dispositioning records previously

existed at the Laboratory. It provided guidelines to ensure that records were readily retrievable and protected against damage, deterioration, and loss. Retention times for records were based on DOE requirements. Enhancements were made to ensure environmental records were appropriately identified.

Environmental Audits

BNL has a number of methods to assess or evaluate the effectiveness of their EMS. In accordance with the Laboratory's Integrated Assessment Program, organizational managers are responsible to plan and conduct assessments to monitor and evaluate organizational performance. The program recommends an array of assessment methods combining internal and independent reviews. The organizational unit defines and documents the audit scope, schedule, responsible person/organization, and methodology in its annual self-assessment plan. A procedure entitled Environmental Assessments states the requirements for EMS audits, compliance audits, and management reviews. This procedure covers not only the technical requirements for planning and conducting these assessments, but also includes requirements for training and qualification of assessors, documenting the assessment, and correcting deficiencies.

Management Review

A second focus of the Integrated Assessment Program requires an evaluation of overall performance for the purpose of identifying strengths, weaknesses and areas for improvement. Through this concept of an annual "self - evaluation", senior managers analyze data gathered from various assessment activities - both internal and external - conduct a holistic evaluation of performance, and identify strategic improvement opportunities for the next planning cycle. The ISO 14001 Management Review requirement is synonymous with the BNL self-evaluation on environmental performance. Senior managers themselves evaluate environmental performance measures, audit results, community concerns, financial investments/returns from environmental improvement projects, and actively decide on the effectiveness, suitability, and adequacy of the EMS. Because of this process, changes to policy, objectives, and system elements are identified.

Pilot Program and Implementation

Initial implementation was tested during the first year of the project in three pilot facilities: Reactor Operations, Waste Management Division and the RHIC Project. These facilities were chosen to:

- Enable facilities with a high potential to impact environment to expedite implementation and prepare for ISO registration.
- Provide input on the Institutional EMS program requirements as they are being developed.
- Develop case studies for EMS implementation and prototypes for Laboratory wide application.

The lessons learned from the pilot facilities were incorporated into the institutional EMS Program requirements, initiating the first improvement cycle before deploying to the balance of the Laboratory during the second year of the project. By developing a corporate system augmented with facility specific procedures only as required, as opposed to a decentralized system, costs were reduced. This strategy also increased the likelihood of conformance when evaluated by an independent assessor.

Tools and techniques developed by the pilot organizations were shared, thus streamlining the effort needed by the rest of the organizations. Examples include computer-based training programs for delivering job-specific training, specifically the software developed to administer the training using e-mail and interface directly with the training records system. Also, internal protocols for using existing ESH Committees to review new or modified operations for significant aspects. Successful communication techniques, including the contents of presentations, memos and job aids, were also provided so that the teams could adopt or adapt to their needs. False starts experienced by the pilot implementation teams, and the associated costs and schedule impacts, were avoided by the other teams. A 20-25% reduction in costs was observed because lessons learned in the pilot process were shared.

EMS Communications

An EMS Communications plan was developed to ensure employee awareness and share information with external stakeholders, including EMS professional organizations. The goal of this plan was to:

- assure employees and stakeholders that BNL is managing their scientific and operational activities in an environmentally responsible manner, complying with regulations and industry standards, preventing pollution, and responding to community concerns.
- Familiarize key stakeholders with BNL's EMS characteristics and methodology
- Communicate changes made to activities that can impact the environment.
- Reinforce employee's understanding of their role in the success of the EMS and their responsibility for sound environmental practices.

This communications plan augmented the training programs and public affairs programs established at the Laboratory. The plan provided the content for messages and presentations to an array of targeted audiences – employees, regulators, media and community groups. The focus of the messages were on the Environmental Stewardship Policy, the new organizational structure, environmental training, ISO 14001 and EMS Requirements, environmental performance review, and compliance assurance. Communication strategies were developed, both top-down and bottom-up, routine interactions with regulators, civic organizations, and the media, and networking with ISO and EMS professional organizations. Communications coincided with key events, such as registration of facilities and completion of major milestones. Printed materials like posters, brochures and job-aid cards, electronic materials like WebPages and videos, and mementos such as mouse pads imprinted with the environmental logo. Most importantly, celebrations and recognition of EMS efforts were conducted. Certificates of appreciation were given to team members and framed registration certificates provided to facility managers who successfully underwent ISO registration. This effort successfully raised employee awareness and Laboratory-wide support for the new way of managing environmental activities.

EMS Training

Programs to train all employees, visiting scientists and contractors, were established to reinforce their role and responsibility in successful environmental practices. Targeted training was conducted for select personnel such as managers, ESH staff, assessors, and employees whose work could have a direct impact on the environment. Table 5 shows the major components of

this training program. To date, nearly 11,000 hours of environmental training has been administered since the project began. This compares to a nominal 300 hours of waste generator training per year provided to the staff previously. Most training programs developed on site by training professionals. In certain cases, training was procured from professional training organizations. These included the ISO 14000 EMS Overview and EMS Implementation training programs, provided by a leading U.S. expert on ISO 14001[4], and the Internal and Lead EMS Auditor courses, provided by an accredited course provider.

Table 5: Environmental Training Courses

Type	Course	Target Audience
Environmental Awareness Training	Environmental Protection (computer based training)	All staff and visiting scientists
	Contractor/Vendor Orientation	Contractors and vendors
	ISO 14000 EMS Overview	Managers and ESH professionals
	General Employee Training	Short term visitors
Specialized Task Training	Internal EMS Auditor	Internal assessors
	Lead EMS Auditor	Experienced internal assessors
	EMS Implementation	Implementation team members
	Environmental Laws and Regulations	Key ESH professional and select staff
Job-specific Training	Hazardous Waste Generator	Waste generators
	Radioactive waste Generator	Waste generators
	Emergency Responder	Emergency response personnel
	HAZWOPER	Waste handlers
	Facility Specific Environmental	Select staff, contractors, & visiting scientists
	Job specific Environmental	Staff whose work can impact the environment

EMS Program Assessments and Improvements

Lastly, to assure our neighbors, the regulators and DOE that BNL is operating in accordance with industry standards for environmental management, BNL implemented a formal audit program. Several mechanisms were employed to assess the readiness of the EMS program. In addition to the Gap Analyses conducted at the project onset, a series of self-assessments were conducted, including independent assessments. Assessment of the EMS Project conformance to schedule and cost baselines was conducted routinely. Internal, yet independent assessments of the Institutional EMS program requirements were conducted by an ISO expert and by the regulators. Independent assessments of the pilot programs were conducted to validate the implementation process. Lastly, external corporate oversight and DOE audits were performed annually. Finally, an independent accredited ANSI-RAB registrar assessed the conformance and implementation of the EMS to the ISO 14001 Standard at select facilities. Nine facilities were registered to the ISO Standard, making BNL the first Long Island based organization, the first DOE National Laboratory, and first DOE Office of Science program to do so. All other facilities have been independently verified as conforming to the ISO 14001 Standard. BNL is on track to register the entire Laboratory to the ISO 14001 standard in 2001.

Initiation of program improvements started early in the project. Examples include expansion of significant environmental aspects, lessons learned from pilots, revision of EMS procedures, and

updates to the EMS WebPages with links to the SBMS, external resources, and environmental database queries. A rigorous and robust assessment program coupled with a focus on continual improvement assured BNL of a successfully designed and implemented EMS program that met stakeholder expectations.

PROJECT CONTROLS

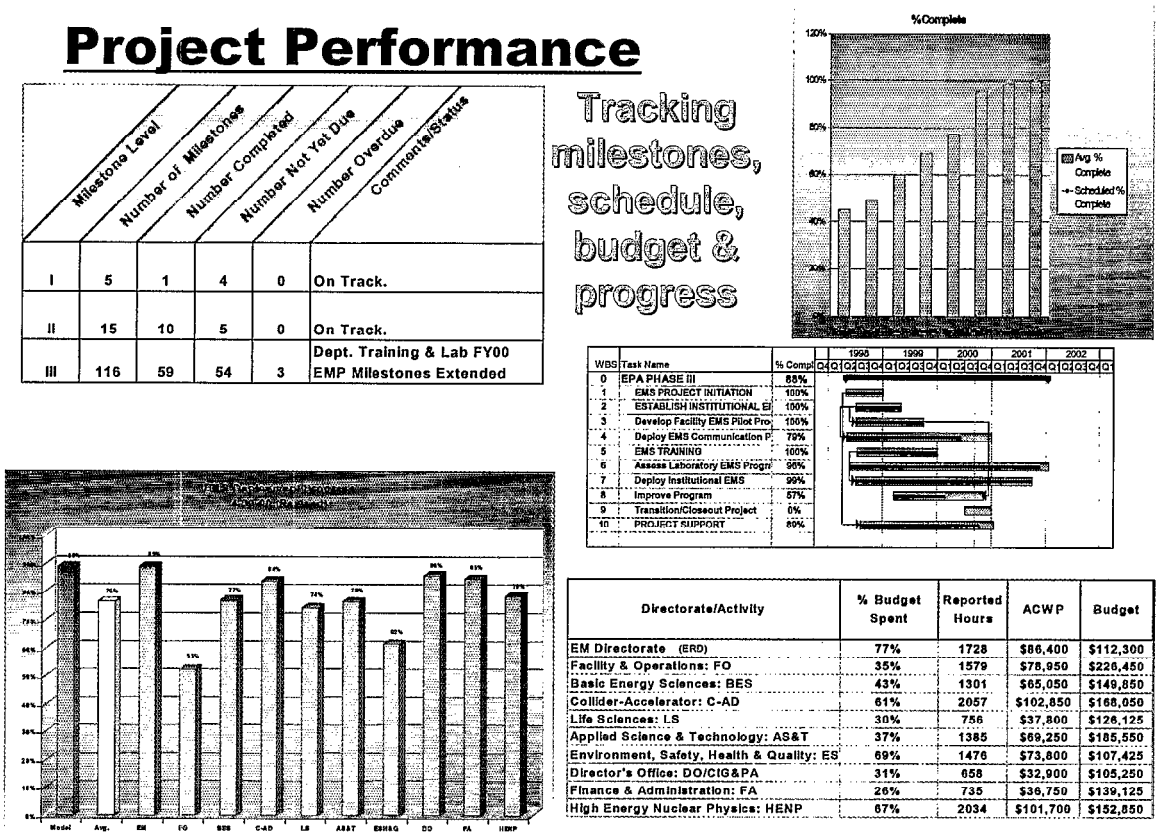
Project control activities included the tracking, reporting, and management of project conformance to technical quality, schedule, and cost baselines. This also included reporting progress to senior management on a quarterly basis. These meetings presented project highlights, progress, costs, problems or concerns, corrective actions, and issues requiring management action.

Schedule and Cost Baseline

Key project activities were defined, assigned and tracked to completion in an integrated project schedule. The critical path schedule was identified and monitored closely. The baseline schedule was used to measure and evaluate the EMS project performance. Baseline change control was administered and required concurrence of the EMS Project Manager at a minimum, and in cases where critical path was impacted, approval by senior managers or DOE. The teams reported their progress (% complete) on each task on a bimonthly frequency for the first six months and monthly thereafter. The cost baseline for this project is the application of dollars (cost) to scope (tasks, or work breakdown structure). It is predicated on the estimated resources required to develop an Institutional EMS Program and deploy it throughout BNL organizations. Earned Value—the calculated value of work satisfactorily completed based on a target plan- was used to determine project performance, enabling the project manager to monitor past spending and schedule trends for the project, as well as forecast future costs. The monthly expenditures of the project were monitored to assure adherence to cost baselines. Figure 2 illustrates the mechanisms and tools used to monitor schedule and cost performance.

The time and costs required to complete the planned tasks were estimated by the pilot organizations. The cost of programs that were already in place, such as waste management/disposal, records management system, etc, were not included. These estimates were used to develop a model that projected the costs for full deployment. The key factors used in the model included the nature of the work conducted by each facility (for assigning an administrative or technical baseline), the number of employees (for estimating training and

Figure 2: Tools to Track EMS Project Performance



Directorate/Activity	% Budget Spent	Reported Hours	ACWP	Budget
EM Directorate (ERD)	77%	1728	$86,400	$112,300
Facility & Operations: FO	35%	1579	$78,950	$226,450
Basic Energy Sciences: BES	43%	1301	$65,050	$149,850
Collider-Accelerator: C-AD	61%	2057	$102,850	$168,050
Life Sciences: LS	30%	756	$37,800	$126,125
Applied Science & Technology: AS&T	37%	1385	$69,250	$185,550
Environment, Safety, Health & Quality: ES	69%	1476	$73,800	$107,425
Director's Office: DO/CIG&PA	31%	658	$32,900	$105,250
Finance & Administration: FA	26%	735	$36,750	$139,125
High Energy Nuclear Physics: HENP	67%	2034	$101,700	$152,850

emergency drill resource requirements), and the number of operations with significant aspects (for predicting additional efforts needed to address operational controls and facility specific training). Actual costs were collected and compared to the model estimates, demonstrating a 25% positive bias in the model. If the pilot data showed that the model underestimated the actual costs, a re-baseline would have been performed. A summary of the project costs is provided in Table 6, showing the total actual costs (staff time plus direct out-of-pocket expenses), and direct costs, separately. As can be seen, an EMS program requires a large commitment of existing staff resources, however only 15-20% of the total costs were additional direct funds.

Project Closeout

Although the project continues to work on improvement initiatives and final registration activities, preparations for the final phase, project closeout, have begun. These activities include transition of responsibility for program administration and maintenance to the respective support organizations and line managers. Staff committed to this project are released as the deliverables they are responsible for are received, reviewed and approved. A final project report will be developed to conclude this project.

Table 6: BNL EMS Project Costs

TASK DESCRIPTION	ACTUAL	DIRECT
Project Initiation	$59,200	$0
Institutional EMS Program	$187,500	$18,000
Pilot Program	$255,300	$16,900
Deploy Institutional EMS	$795,000	$66,700
EMS Communications	$139,600	$44,600
EMS Training	$84,700	$58,100
Program Assessments & Improvements	$280,000	$121,400
Project Support & Controls	$66,800	$0
TOTALS	**$1,868,100**	**$325,700**

CONCLUSIONS

BNL is committed to continually improving its environmental program. To further these ends, the Laboratory developed and implemented an improved EMS to ensure that it operates in an environmentally responsible manner that protects the ecosystem and human health. It employs the ISO 14001 Standard as a framework, with enhanced emphasis in the areas of compliance assurance, pollution prevention, and community outreach. The EMS provides a systematic approach to eliminate, reduce or control environmental risks and impacts, and achieve and demonstrate environmental excellence. The BNL EMS involves systemic, fundamental changes to the way business is done at every level of the organization, by integrating compliance, pollution prevention, waste minimization and conservation of resources into the planning, decision-making, implementation and assessment phases of all BNL work activities.

Positive results have been observed, even at this early phase of completion. BNL now has an unprecedented knowledge of potential environmental impacts of its current operations. Compliance assurance programs are improving BNL's compliance status. Pollution prevention projects have resulted in $1.6 M of cost savings/costs avoided this year alone. BNL facilities have registered to an international standard for EMS, becoming the first Long Island-based organization and the first DOE National Laboratory to achieve this level of recognition. BNL is achieving its environmental performance goals. A survey indicated that the majority of employees felt that senior managers believed environmental stewardship was important. The Laboratory is openly communicating with neighbors, regulators, employees and other interested parties on issues and progress. Trust with EPA has improved. While the stakeholders are encouraged by the commitments and programs that the Laboratory is putting in place, some remain skeptical. BNL must continue to deliver on commitments and continue to demonstrate improvement in their environmental performance in order to regain their trust. For 50 years, the unique, leading-edge facilities at BNL have made many scientific contributions possible. Today, BNL continues its research mission while paying much closer attention to protecting and cleaning up the environment. The Laboratory's new environmental motto, "Exploring Earth's Mysteries...Protecting Its Future," reflects a desire to balance world class research with operating in harmony with the natural environment.

Acknowledgements

This work has been performed under contract No. DE-AC02-98CH10886 with the U.S. Department of Energy. The successful implementation of this program is due in large part to the unwavering management commitment demonstrated by BSA, and the dedicated efforts of the Brookhaven EMS Project Team, Management Representatives on EMS, and all BNL staff.

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