PREVENTING POLLUTION USING ISO 14001 AT A PARTICLE ACCELERATOR THE RELATIVISTIC HEAVY ION COLLIDER PROJECT

Susan L.K. Briggs
Environmental Management System Project Manager
Brookhaven National Laboratory
Upton, New York

Stephen V. Musolino
Assistant to RHIC Project Manager on Environment, Safety & Health
Brookhaven National Laboratory
Upton, New York

ABSTRACT: In early 1997 Brookhaven National Laboratory (BNL) discovered that the spent fuel pool of their High Flux Beam Reactor was leaking tritium into the groundwater. Community members, activist groups, politicians and regulators were outraged with the poor environmental management practices at BNL. The reactor was shut down and the Department of Energy (DOE) terminated the contract with the existing Management Company. At this same time, a major new scientific facility, the Relativistic Heavy Ion Collider (RHIC), was nearing the end of construction and readying for commissioning. Although environmental considerations had been incorporated into the design of the facility, some interested parties were skeptical that this new facility would not cause significant environmental impacts. RHIC management recognized that the future of its operation was dependent on preventing pollution and allaying concerns of its stakeholders.

Although never done at a DOE National Laboratory before Brookhaven Science Associates, the new management firm, committed to implementing an Environmental Management System (EMS) and RHIC managers volunteered to deploy it within their facility on an extremely aggressive schedule. Several of these ISO requirements contribute directly to preventing pollution, an area where particular emphasis was placed. This paper describes how Brookhaven used the following key ISO 14001 elements to institutionalize Pollution Prevention concepts: Environmental Policy, Aspects, Objectives & Targets, Environmental Management Program, Structure and Responsibility, Operational Controls, Training, and Management Review. In addition, examples of implementation at the RHIC Project illustrate how BNL's premiere facility was able to demonstrate to interested parties that care had been taken to implement technological and administrative controls to minimize environmental impacts, while at the same time reduce the applicability of regulatory requirements to their operations.

Preventing Pollution Using ISO 14001 At A Particle Accelerator: The Relativistic Heavy Ion Collider Project

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Susan L.K. Briggs
Environmental Management System Project Manager
Building 535A, Environmental Services Division
Brookhaven National Laboratory
Upton, New York

Stephen V. Musolino
Assistant to RHIC Project Manager on Environment, Safety & Health
Building 1005, RHIC
Brookhaven National Laboratory
Upton, New York

INTRODUCTION

In early 1997, Brookhaven National Laboratory (BNL) discovered that tritium had leaked into the groundwater from the High Flux Beam Reactor and the spent fuel pool was the possible source. This event coupled with the previous designation of BNL to the National Priorities List by the U.S. Environmental Protection Agency (EPA) caused community members, activist groups, politicians and regulators to become even more outraged about the poor environmental management practices at BNL. After the tritium discovery in the groundwater, the Department of Energy (DOE) terminated the contract with the existing management contractor, Associated Universities, and initiated a search for a new organization to operate the Laboratory. Included in the new contract was a requirement to implement the tenets of ISO 14001[1], identify facilities that have a high potential to impact the environment and register those facilities to the ISO Standard, and self declare conformance to the standard at the remaining facilities. Although never undertaken at a DOE National Laboratory before, the new management firm, Brookhaven Science Associates (BSA), committed to the implementation and ISO 14001 registration of its Environmental Management System (EMS) Laboratory-wide. The EMS provides a systematic framework for ensuring BNL programs are managed in a manner that protects public health and the ecosystem.

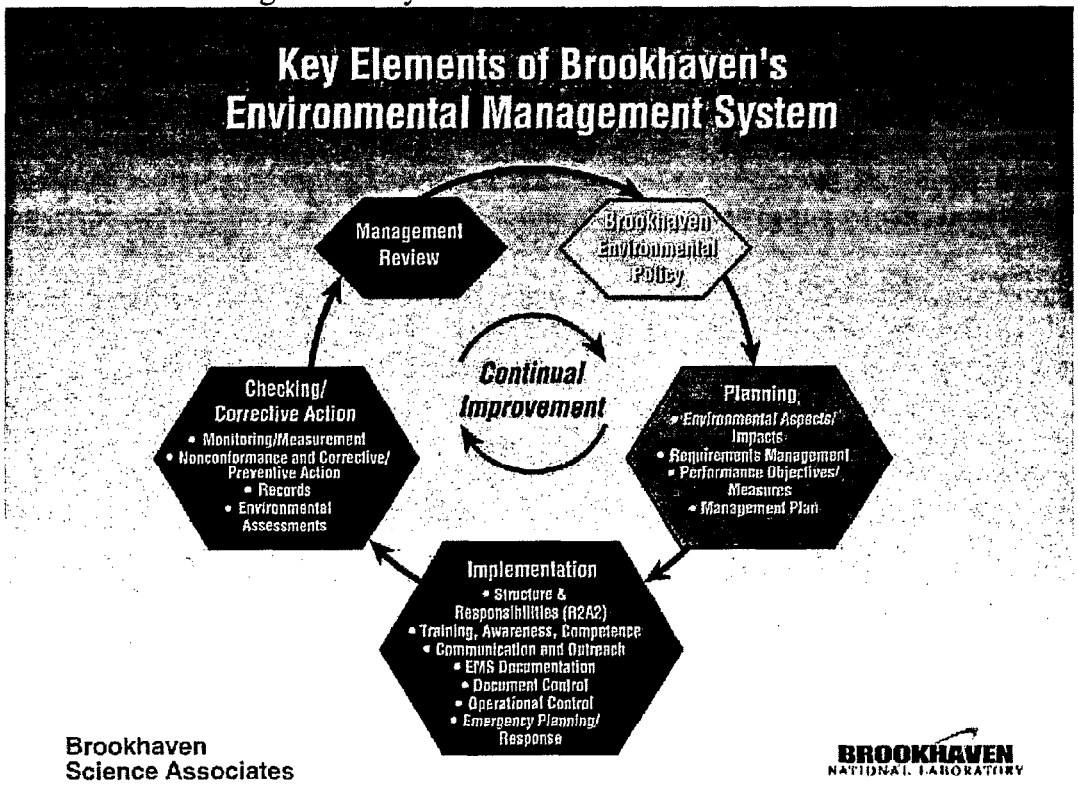
At this same time, a major new scientific facility, the Relativistic Heavy Ion Collider (RHIC), was nearing the end of construction and readying for commissioning. Although state of the art environmental considerations had been incorporated into the design and construction of the $600M facility, some stakeholders were skeptical that this new facility was not expected to cause significant environmental impacts. RHIC management recognized that the future of its operation was dependent on preventing pollution, allaying concerns of its stakeholders and working in a cooperative manner with the local community. Concurrently, a new ISO 14001 management program was in its design phase. To satisfy the contract requirements, initial planning for a pilot EMS implementation project and development of an ISO registration

strategy was just beginning. Plans were to first register six facilities that had a high potential to impact the environment in 2000, and then after one full improvement cycle register the entire organization. Although not initially identified as a facility that warranted ISO registration, RHIC management volunteered for the program, assisting in the design of the Laboratory-wide EMS[2], deploying it within their own facility on an extremely aggressive schedule, and piloting the registration process one year earlier to coincide with the commissioning of RHIC.

EMS IMPLEMENTATION

A project team was formed to design an EMS that conformed to the ISO 14001 International Standard. This program addressed each of the required elements of ISO 14001, and incorporated an enhanced emphasis on pollution prevention (P2), compliance assurance and community outreach. A graphical representation of Brookhaven's EMS incorporating the 17 ISO elements are shown in Figure 1. RHIC senior management established a core team representing the disciplines of environment, safety and health (ESH), operations, training, and quality management to evaluate the applicability of these program requirements to its facilities and operations and upgrade the existing RHIC management systems where necessary, to conform to the new requirements[3].

Figure 1: Key Elements of Brookhaven's EMS

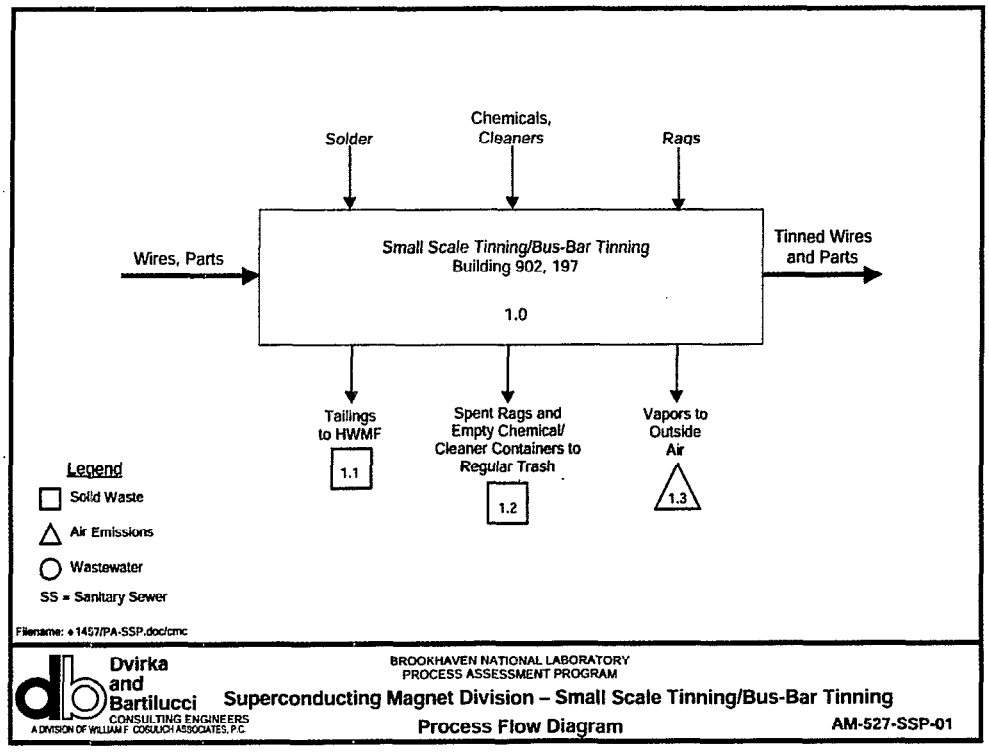


First and foremost, senior Laboratory management established their commitment and support to a comprehensive Pollution Prevention (P2) Program via the BNL Environmental Stewardship Policy. Specifically, management committed to "integrate pollution prevention/waste minimization, resource conservation, and compliance into all of our planning and decision

making" and to "adopt cost-effective practices that eliminate, minimize, or mitigate environmental impacts." The policy commitments also included regulatory compliance, cleanup of historical pollution, community outreach, and continual improvement. The Laboratory Director formally communicated this policy to all employees, and charged all managers with directly supporting implementation of the commitments.

As part of an agreement between the EPA and DOE, the Laboratory completed an extensive evaluation of all ongoing processes that generate wastes, effluents or emissions that are subject to Federal, State or County regulation. The regulatory requirements and compliance status for each process was determined, and opportunities for waste minimization/pollution prevention were identified. In addition, the evaluation made recommendations on best management practices for assessment, prevention, and control of environmental impacts. Each "Process Evaluation" used a mapping technique[4] that resulted in a mass-balance flow diagram and written analysis capturing a description of the process, existing controls, and required corrective actions and recommendations. An example of one of these diagrams from the RHIC Project, for Small Scale Tinning and Buss Bar Soldering in Magnet Fabrication, is shown in Figure 2.

Figure 2: Process Flow Diagram



A total of ten processes were identified and assessed within the scope of the RHIC Project. These analyses then formed the technical basis for the RHIC EMS and enabled the identification of significant environmental aspects, as required by the ISO 14001 Standard. Prior to the aspects identification, criteria for significance were developed for the Laboratory EMS. The basis of the significance criteria was regulatory requirements, groundwater protection, and management of radioactivity in any media. The specific criteria are shown in Table 1. As a result of the aspects evaluation, the following list shows the significant aspects that were identified for RHIC Project

Table 1: BNL Criteria For Significant Aspects

ASPECT	CRITERIA FOR SIGNIFICANT ASPECTS
Regulated Industrial Waste Generation	a) Any amount of regulated industrial waste generation
Hazardous Waste Generation	a) Any amount of hazardous waste generation
Radioactive Waste Generation	a) Any amount of radioactive waste generation
Mixed Waste Generation	a) Any amount of mixed waste generation
Regulated Medical Waste Generation	a) Any amount of regulated medical waste generation
Atmospheric Discharges	a) Any process that requires a point source air permit or inclusion in the Title V permit as an emission unit, or contributes to a regulated emission point b) Operations that use engineering controls to reduce hazardous air pollutant or radionuclide emissions c) Radioactive emissions that require monitoring by 40 CFR61 subpart H of the National Emission Standards for Hazardous Air Pollutants (NESHAPS)
Liquid Discharges	a) Radionuclides that are detectable at the point of discharge from the facility b) Discharges of any of the chemicals listed on the BNL State Pollutant Discharge Elimination System (SPDES) Permit c) Operations or activities that use engineering controls to reduce the quantity or concentration of pollutant d) Existence or use of underground injection control devices
Storage or Use of Hazardous Materials [Chemicals or Radioactive] (potential for accidental release or contamination)	a) Storage or use of hazardous materials requiring engineering controls b) Systems requiring back-flow prevention c) Transportation of chemicals or dispersible radioactive materials d) Storage or use of PCBs as specified in BNL Procedures e) Underground pipes or ducts that contain hazardous material/contamination f) Storage or use in quantities capable of resulting in a reportable spill
Water Consumption	a) Total organizational water consumption greater than 650,000 gallons per day. b) Continuous (24 hrs/day), permanent once-through water use greater than 4 gpm that discharges to the Sanitary Sewer System. c) Daily (8 hrs/day), permanent, once-through water use greater than 10 gpm that discharges to the Sanitary Sewer System. d) Continuous use greater than 10 gpm, or daily use greater than 15 gpm for a period greater than 60 days that discharges to the Sanitary Sewer System.
Power Consumption	a) Total Organizational Power Consumption Greater than 58 M KWh/yr.
Historical Monuments/Cultural Resources*	a) Any modification to a historically significant structure (BGRR, Cosmotron building, and WWI trenches) b) Proposed modification to known archaeologically significant area(s) or discovery of archaeologically significant material
Sensitive/Endangered Species And Sensitive Habitats (including Pine Barrens)	a) Potential for habitat destruction, harm or harassment within 850 feet of a critical habitat (*recharge basins, vernal pools, natural/manmade ponds/waters*) b) Disturbance within 100 feet of a regulated wetland c) Disturbance within ½ mile of the Peconic River d)Activity affecting five or more acres of undeveloped land
Environmental Noise	a) Exceed ordinance levels [7am-10pm: 55 dba; 10pm-7am: 50 dba (20 min. average)] at property boundary or off-site location.
Historical Contamination	a) Pre-existing contamination causing remediation with costs > $50,000.
Soil Activation	a) Any soil activation.
Transuranic Waste (TRU)	a) Generation or potential to generate any transuranic (TRU) waste
Other	a) Any other compliance requirement specific to an organization or aspect that could impact the environment. For example: asbestos research, odor. b) Any historical or legacy issue.

facilities and operations:

- Regulated Industrial Waste
- Hazardous Waste Generation
- Atmospheric Discharges
- Liquid Discharges
- Storage and Use of Chemicals
- Soil Activation

Once identified, any process/activity conducted in the RHIC Project that resulted in one or more of these aspects then fell within the scope of the EMS Program and was managed and controlled in accordance with the ISO 14001 requirements. Emphasis was placed on managing the compliance requirements associated with each activity and controlling the impacts by applying pollution prevention principles. Table 2 shows the processes/activities that contribute to these aspects. Although initially daunting, the EMS team found the implementation quite achievable. Table 3 gives a brief synopsis of the BNL approach to implementing the ISO 14001 requirements.

Table 2: RHIC Project Activities resulting in Significant Aspects

ACTIVITY DESCRIPTION	ENVIRONMENTAL ASPECTS					
	Regulated Industrial Waste	Hazardous Waste	Atmospheric Discharges	Liquid Discharges	Storage/Use of Chemical	Soil activation
RHIC Cooling Water Systems				X	X	
Electronic Assembly Operations		X	X			
Staff Shop Operations	X		X			
Mechanical assembly Operations	X	X				
Metal Cleaning Operations	X	X				
Small Scale Tinning-Buss Bar Tinning	X	X	X			
Cryogenic System Maintenance	X					
Vacuum System Maintenance	X					
Beam Stops/Beam Collimators			X			X
Diesel Generators	X				X	

Even before the Laboratory initiated ISO 14001 implementation, the RHIC Project environment, safety and health management systems incorporated many of the ISO 14001 requirements since it was based on DOE policy for Integrated Safety Management. Since RHIC was a new facility all systems and subsystems were subjected to independent ES&H reviews at the preliminary and final design stages. The quality management program had preexisting procedures for records management, nonconformance, corrective and preventive action, document control and internal audits. Formal training programs were successfully implemented at RHIC. Emergency preparedness and response was effectively established. In most cases, the underlying systems to support EMS requirements were firmly integrated into RHIC operations. What was required was

Table 3: **EMS ISO 14001 Implementation at Brookhaven National Laboratory**

Environmental Policy: BNL issued its environmental stewardship policy statement that describes BNL's commitment to the environment. This policy is used as a framework for planning and action.

Environmental Aspects: BNL has determined that the following environmental aspects of the Laboratory's operations have the potential to affect the environment: Waste generation; Atmospheric emissions; Liquid effluents; Storage or use of chemicals and radioactive materials (potential for accidental release or contamination); Natural resource usage (power and water consumption). In addition, each facility at BNL will determine if their operationshave other aspects that have the potential to impact the environment (soil activation, sensitive habitats, endangered species). The combined set of significant environmental aspects are used to identify training requirements, develop operational controls (including engineering controls, administrative control procedures, and pollution prevention opportunities), assess emergency planning issues, and/or determine applicable requirements.

Legal and Other Requirements: New or revised external regulations are analyzed to determine applicability to the Laboratory, and if additional actions are required to achieve compliance. This may involve developing or revising laboratory documents, developing specific work instructions, administering training, or installing engineered controls.

Objectives and Targets: BNL establishes environmental objectives and performance measures to drive improvements to the EMS and to measure progress in improving environmental performance. These objectives and measures focus on environmental aspects that can have a significant impact, reflect stakeholder concerns, and are aligned with commitments made in the environmental policy.

Environmental Management Program: Organizations within BNL develop an action plan showing how they contribute to achieving BNL's environmental objectives and mesures, and commit resources to successfully implement their plan. BNL also has a budgeting system designed to ensure that priorities are balanced, and that adequate resources are invested in environmental programs.

Structure and Responsibility: BNL established a program to define employee's role and responsibilities in key areas including environmental protection and established an Environmental Services Division of environmental professionals to assist the line organizations.

Training, Awareness and Competence: BNL enhanced their training programs for staff and visitors to ensure that they are capable of carrying out their environmental responsibilities.

Communication: BNL improved their processes for internal and external communications on environmental issues and enhanced community outreach activities such as the establishment of a Citizens Advisory Committee.

EMS Documentation: Procedures to ensure successful achievement of environmental goals are documented, maintained and implemented. A web-based system called the Standards Based Management System (SBMS) has been developed to improve the quality, usability of and access to Laboratory-level information. SBMS contains policies, regulatory requirements, Laboratory-wide procedures and documents that control the work performed at BNL.

Document Control: SBMS contains a comprehensive document control system to ensure effective management of procedures and other system records. When facilities require additional procedures to control their work, document control protocols are implemented to ensure that workers have access to the current versions of work instructions.

Operational Control: Systems are evaluated to identify administrative and engineered controls, and improvements.

Emergency Preparedness and Response: BNL has a program to provide time critical response to hazardous materials or other environmental emergencies. This program includes procedures for preventing and responding to emergencies.

Monitoring and Measurement: BNL has a comprehensive, site-wide environmental monitoring program, and environmental performance is summarized annually in the Site Environmental Report to ensure effective functioning of the EMS and timely identification and implementation of corrective measures.

Nonconformance, and Corrective and Preventive Actions: BNL has improved its processes to identify and correct problems. This includes development of a "lessons learned" program to prevent recurrences.

Records: EMS related records, including audit and training records, are maintained to ensure integrity, to protect them from loss and enable retrieval.

EMS Audit: To periodically verify that the EMS is operating as intended, audits are conducted. These audits, conducted as part of the site-wide self-assessment program, are designed to ensure that any nonconformance to the ISO 14001 standard is identified and addressed. In addition, BNL conducts regulatory compliance audits to assure operations comply with environmental requirements.

Management Review: Beyond audits, a management review process is being implemented to involve top management in the assessment of the EMS, to identify the need for changes and continual improvement.

a comprehensive review to verify that the scope of these programs specifically included environmental issues (such as environmental records, environmental audits, environmental training, etc), and in many cases a minor revision to increase the focus on these issues to ensure they were adequately addressed. The EMS initiative established a framework for institutionalizing the evaluation and mitigation of environmental issues in RHIC's design, construction and commissioning activities. One of its most valuable results was that the EMS Program elevated environmental management to the level of attention equivalent to that given to worker safety and health, a level previously not attained for environmental issues.

In fact, some new program elements were incorporated into the RHIC management systems in order to conform to ISO 14001 requirements. Operational Controls for environmental protection, both administrative and engineered controls, were systematically identified, evaluated for adequacy, and documented in an auditable manner. Operations were re-engineered where practical to implement the P2 principles of material substitution and waste minimization. A comprehensive community outreach program was developed to educate community members but also identify issues and address the concerns of interested parties. Training programs for staff and visiting scientists were expanded to include environmental issues associated with RHIC activities. A formal process to keep senior management apprised of the progress and status of the EMS, and involving them in determining its effectiveness, suitability and adequacy and areas for further improvement, was created. This process led directly to a new practice of establishing environmental goals, action plans to achieve those goals, and RHIC Project Manager approval of resources to ensure completion. In select cases where additional funds were needed to complete an improvement action, Laboratory resources, such as P2 funding, were sought and appropriated. It also dovetailed into the Laboratory-level EMS goals on Regulatory Compliance, Pollution Prevention, and Community Outreach and supported achievement of these higher-level organizational goals by applying them to the accelerator management and operations. These program enhancements ensured a holistic, systematic evaluation of RHIC activities to minimize any negative environmental impact, comply with regulatory requirements, and continually improve the environmental program.

Essential to successful implementation of an EMS is employee involvement. Each staff member has a direct role and responsibility for sound environmental practices, adherence to regulatory requirements and taking action to prevent a negative environmental impact. All employees were trained on their specific responsibility to "maintain awareness of environmental impact of work, and apply pollution prevention and waste minimization techniques" and "identify potential hazards, environmental concerns, and unsafe conditions or practices in work or at work site, and implement or suggest controls to minimize risk." These responsibilities are key to ensuring that work is conducted in an environmentally safe manner and that improvements to support P2 are identified and implemented.

To augment expertise of the staff, the Laboratory established a staff of Environmental Compliance Representatives (ECR) to provide field-deployed environmental expertise. These ECRs are highly qualified environmental experts who provide guidance on regulatory requirements, best management practices and pollution prevention opportunities. The ECR was appointed to the RHIC Experiment Safety and Accelerator Systems Safety Committees to review

the design of systems, facilities and operating procedures to ensure that environmental concerns are addressed up-front in the planning phase of work, and implemented in the day-to-day operations at the technician level. This effort results in elevating environmental issues to the same level of management and worker attention, as had been traditionally done for safety and health matters.

To ensure worker awareness of the EMS and requirements, an extensive effort to institutionalize sound environmental management practices, including P2, was undertaken through a variety of training programs targeted at key job functions. A computer-based Environmental Protection training program was administered to over 450 employees, visiting scientists and contractors. The training covered specific environmental issues at BNL, pollution prevention initiatives, employee responsibilities, and ISO 14001. Additional, targeted training was conducted for select personnel such as managers, ES&H staff, assessors, and employees whose work could have a direct impact on the environment. All managers were given training on the Environmental Stewardship Policy by the Laboratory Director himself, followed by an overview of EMS and ISO 14001 by a internationally recognized leading U.S. expert. Training on regulatory requirements was provided to all environmental support staff and select line personnel. Training was provided to members of the implementation team to assist them in the deployment of the EMS within RHIC. Select Quality and ES&H personnel were provided Internal EMS Auditor training to ensure qualified assessors conducted their assessment program. Lastly, employees whose work had the potential to significantly impact the environment were given job-specific training on requirements pertaining to that work, importance of controls to prevent an impact, and actions to take during an emergency.

Senior managers were kept apprised of progress and effectiveness of their EMS program. A self-evaluation program that includes a Management Review process looks holistically at the performance and results of the environmental program on an annual basis. It reviews the findings of both internal and external assessments, nonconformances, DOE reportable occurrences and compliance status, effectiveness of corrective actions, progress and return on investment of pollution prevention initiatives, and community member concerns. This review requires senior management evaluation of the adequacy, effectiveness, and suitability of the EMS and makes recommendations for improvements. These recommendations then formulate the improvement agenda for the coming year. This level of senior management involvement and support in the EMS Program is an important ingredient to EMS success.

Community outreach was an important factor for the RHIC Project. Some stakeholders were skeptical that this new facility was not expected to cause significant environmental impacts, especially in light of the recently discovered tritium leak at the Brookhaven reactor. Since RHIC was a major new scientific facility nearing the end of construction and readying for commissioning, a formal communications programs was launched. Senior RHIC managers were key participants and were provided support from the Community Involvement and Public Affairs support organizations. An communication campaign on the groundbreaking science that was expected from RHIC was developed. Regulators, elected officials, civic groups, schools and the community were invited to tour the facility and learn about the scientific program. Information on the safety and environmental protection programs in place, including ISO 14001, were included in the material presented. To allay concerns of special environmental interest

groups, several public roundtables were held to discuss issues and concerns. RHIC management recognized that the future of its operation was dependent on preventing pollution, maintaining compliance, allaying concerns of its stakeholders and working in a cooperative manner with the local community. ISO 14001 provided a management framework to balance and manage their diverse concerns. By applying the principles of ISO 14001, the concerns of the community and interested parties were addressed and resolved.

COSTS

The RHIC EMS project team spent one year designing and implementing the EMS Program. The core team was made up of four staff members, each working on the project on a part-time basis. Throughout the implementation phase, expenditures were tracked; both direct costs (purchased materials and services) and contributed resources (staff time). The RHIC team was provided guidance and assistance by the Laboratory EMS Project Team, however only those costs incurred directly for the RHIC implementation effort are provided. Purchased services included an ISO 14001 consultant to assist during implementation, environmental consultants to perform the process evaluations, procurement of training courses, and ISO registrar costs. Contributed resources included the cost of time existing staff spent on the implementation team, reviewing and revising existing programs, attending training, and assessing operations. Since RHIC was a new and state-of-the-art facility, no costs were incurred related to upgrades in engineered systems or controls. Total costs amounted to $152 K. Table 4 provides a breakdown of costs for this facility. As deployment of the EMS program progressed throughout the Laboratory the following year, the costs of implementation were further reduced by up-to 25%. This savings is attributed to sharing the tools, templates, and methodology developed by the pilot facilities with other facilities at the Laboratory. Registration costs also were reduced for facilities that followed RHIC because the registrar already had assessed the underlying Laboratory-level management systems and could focus their subsequent assessments on verifying implementation within the facilities. This observation attests to the benefits of implementing an EMS initially on a small scale in a pilot process and incorporating the lessons learned before deploying the program to the remaining facilities.

Table 4: EMS Costs

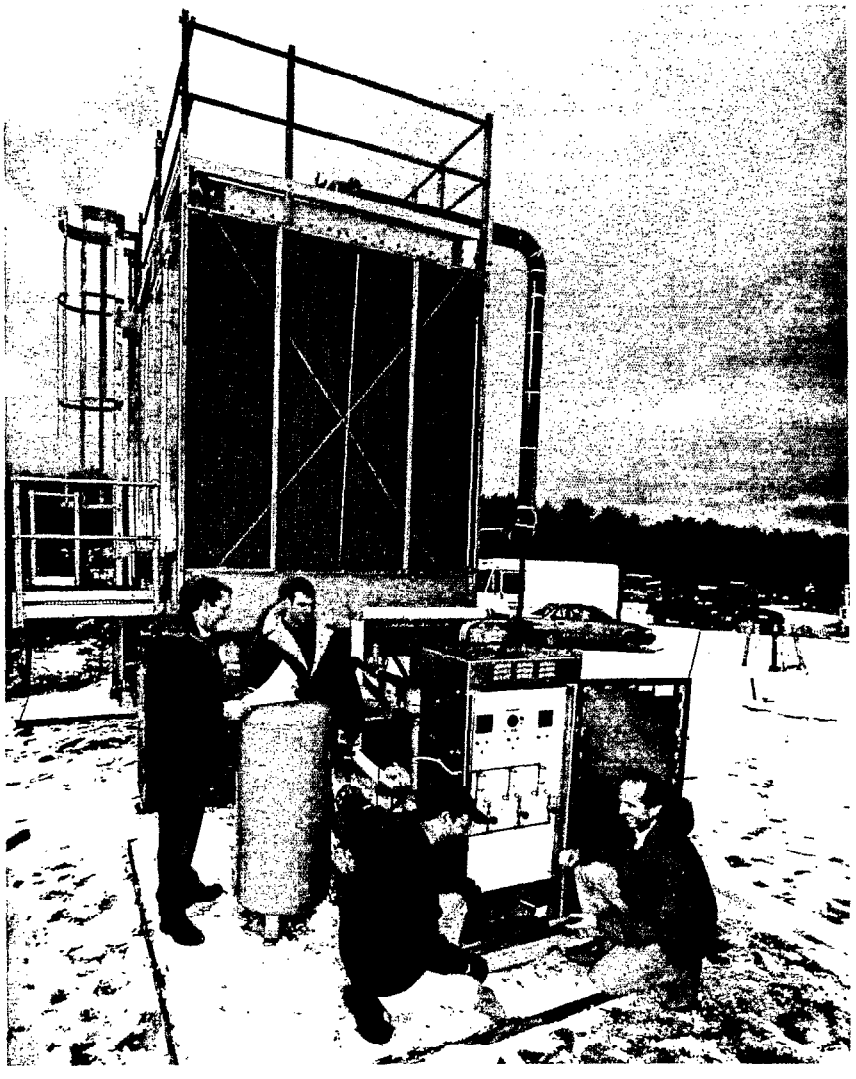
	Contributed	Direct	Total
Implementation	$89,850	$0	$89,850
Process Evaluations	$15,000	$27,680	$42,680
Registration	$1,600	$17,990	$19,590
TOTAL	**$106,450**	**$45,670**	**$152,120**

RESULTS AND BENEFITS

Using the EMS framework to provoke close scrutiny of ongoing activities, the RHIC team focused their efforts on eliminating regulatory requirements by reengineering processes and substituting non-hazardous materials. As an alternative to chemical water treatment to control bacterial fouling and prevent scale formation, ozone-magnetic field based water treatment systems were installed on cooling water towers for two of the RHIC experimental spectrometer magnets (see Figure 3). These systems eliminated the chemical treatment of cooling water with corrosion inhibitors and biocides. This change not only results in $15k savings/year, but also more importantly eliminates a chemically contaminated and regulated waste stream. The routine

blowdown and drainage effluents required to maintain the towers had entered a NPDES permitted recharge basin and eventually drained to the aquifer underlying BNL. Switching to this non-hazardous system also eliminates the applicability of costly and burdensome regulatory requirements such as monitoring and reporting. Out-year plans include expanded use of this system at other experimental detectors at RHIC as well as other cooling water systems at BNL.

Figure 3: Ozone-Magnetic Field Based Water Treatment System



In another case, a small metal cleaning operation implemented chemical substitution to eliminate the burden of regulatory requirements and waste disposal costs. Non-hazardous, citric-based solvents replaced methanol and acetone thereby eliminating the disposal costs associated with this waste stream, regulatory required training for those workers, and administrative requirements associated with maintaining a satellite waste accumulation area. Other opportunities are regularly being explored and prioritized now as part of the ongoing EMS because a system of establishing annual environmental goals, evaluating operations and implementing actions has institutionalized the concepts of P2.

Another example where pollution prevention principles were implemented and costs were avoided was the establishment of administrative controls to keep the facility free of any PCB-containing materials. Technical specifications requiring PCB-free equipment were established. The ESH Committee was assigned the responsibility to perform design reviews to ensure that all new equipment meets the specification. The most significant "costs avoided" relate to eliminating annual/quarterly inspections, maintaining accurate inventories, incurring equipment disposal costs, and most significantly, avoiding costs associated with spill cleanup.

The work of the implementation team over a thirteen-month period was independently assessed by the American National Standards Institute (ANSI), Registrar Accreditation Board and certified as conforming to the internationally recognized ISO 14001 standard. RHIC was the first Department of Energy Office of Science program and the first Long Island-based organization in New York State to achieve ISO 14001 registration. . This recognition by an independent body serves to assure community members, activist groups, politicians and regulators that sound and appropriate environmental management practices were put in place at RHIC. It also provided a successful case study for skeptical scientists who question the value and applicability of management systems to scientific research.

Additional benefits that have been realized at RHIC include the following:

- An extensive analysis of work processes, including a "mass balance" of the inputs and hazardous, radioactive, and regulated material outputs, which was above and beyond the DOE requirements for an accelerator/collider safety analysis.
- To augment the safety analysis, a comprehensive baseline of existing operating limits and controls required to prevent environmental impacts was created.
- Improved compliance status within the facility.
- Improved employee and visiting researcher awareness of environmental issues.
- Assignment of an environmental professional to the facility to augment the ES&H management infrastructure.
- Recognition as the first DOE National Laboratory to achieve ISO 14001 registration.
- Ongoing independent verification of conformance through ISO registration.
- Support of the RHIC mission by community members through outward commitment and demonstrated actions to addressing their concerns

CONCLUSION

It was a precarious time when the RHIC Project was nearing the end of construction and readying for commissioning. Based on historical releases and poor management practices in the past, local activists and community members were skeptical that this new facility would not cause additional and significant environmental impacts from its operations. Although environmental considerations had been incorporated into the design of the facility, RHIC management recognized that the future of its operation was dependent on preventing pollution

and allaying concerns of its stakeholders. These managers recognized the value of implementing an ISO 14001 conforming Environmental Management System to manage and control the operations that had a potential to impact the environment. They further recognized that undergoing an ISO registration process and requesting an evaluation of the EMS Program by an independent agency provided assurance to the community that environmental activities were effectively being managed.

Although RHIC had a firm basis to start from, enhancements to the existed program resulted in cost savings, reductions in regulatory requirements, and a heightened awareness of environmental issues associated with the work conducted within the facilities. This awareness translated directly to improved care in the management of operations and increased employee initiative on identifying and implementing pollution prevention opportunities. Most importantly, the principles of environmental stewardship and pollution prevention have been institutionalized through the Environmental Policy and implementation of key ISO 14001 system elements.

Acknowledgements

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