

Inspection of  
Environment, Safety,  
and Health Programs  
at the



# Brookhaven National Laboratory

November 2007



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Office of Environment, Safety, and Health Evaluations  
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## Abbreviations Used in This Report

BHSO	Brookhaven Site Office
BNL	Brookhaven National Laboratory
BSA	Brookhaven Science Associates
CFR	Code of Federal Regulations
DOE	U.S. Department of Energy
EMS	Environmental Management System
ES&H	Environment, Safety, and Health
HSS	DOE Office of Health, Safety and Security
ISM	Integrated Safety Management
ISO	International Standards Organization
NFPA	National Fire Protection Association
NSLS	National Synchrotron Light Source
PPE	Personal Protective Equipment
R&D	Research and Development
SBMS	Standards Based Management System
SC	Office of Science

The U.S. Department of Energy (DOE) Office of Independent Oversight, within the Office of Health, Safety and Security (HSS), inspected environment, safety, and health (ES&H) programs at the DOE Brookhaven Site Office (BHSO) and Brookhaven National Laboratory (BNL) during August and September 2007. HSS reports directly to the Secretary of Energy, and the ES&H inspection was performed by Independent Oversight's Office of Environment, Safety and Health Evaluations.

Within DOE, the Office of Science (SC), within the Office of the Under Secretary for Science, has line management responsibility for BNL. SC provides programmatic direction and funding for research and development (R&D), facility infrastructure activities, and ES&H implementation at BNL. At the site level, line management responsibility for BNL operations and emergency management falls under the BHSO Manager. Under contract to DOE, BNL is managed and operated by Brookhaven Science Associates (BSA), which is a partnership between Battelle Memorial Institute and Stony Brook University (a part of the State University of New York).

BNL is a multi-program R&D laboratory that operates various user-oriented facilities, performs basic research, develops technologies, and promotes technology applications and transfer. To support these activities, BNL operates numerous accelerators, laboratories, test facilities,



Aerial view of BNL

waste storage facilities, and support facilities. BNL activities involve various potential hazards that need to be effectively controlled, including exposure to external radiation, radiological contamination, lasers, hazardous chemicals, cryogenic materials, electromagnetic equipment, and various industrial hazards (e.g., electrical, noise, construction-like activities).

The purpose of this Independent Oversight inspection was to assess the effectiveness of ES&H programs at BNL as implemented by BSA under the direction of BHSO and SC. Independent Oversight evaluated a sample of activities, including:

- Implementation of the core functions of integrated safety management (ISM) for selected BNL facilities and activities, focusing on work planning and control systems at the activity and facility level. The Independent Oversight inspection evaluated:
  - R&D and operations at the National Synchrotron Light Source (NSLS), which is an accelerator designed specifically to produce synchrotron radiation that can be used to probe the fine structure of matter. The NSLS is a user facility (a large and complex machine that is used extensively by scientists from outside BNL and DOE), and is managed by BNL's Light Sources Directorate.
  - R&D and facility operations at selected "small science" activities (BNL refers to R&D projects performed at other than the major user facilities as small science). Independent Oversight examined activities performed by several BNL departments/divisions, including Energy Science and Technology, Environmental Science, Chemistry, Condensed Matter Physics Material Science Department, Physics, and Instrumentation Division.
  - Maintenance activities performed primarily by Plant Engineering and Staff Services.

- Construction activities, which are managed by the Plant Engineering Division, the Environmental and Waste Management Services Division, and the Environmental Restoration Projects, and performed by subcontractors.
- SC, BHSO, and BNL effectiveness in managing and implementing selected aspects of the ES&H program that Independent Oversight has identified as focus areas, including environmental management system (EMS) implementation, and injury and illness investigation and reporting. Although these topics are not individually rated, the results of focus-area reviews are integrated with or considered in the evaluation of other ISM elements. In examining these focus areas, Independent Oversight focused primarily on the application of institutional programs to BNL at the activity and facility level.
- SC, BHSO, and BNL feedback and continuous improvement systems, with a focus on their application to BNL facilities and activities. These were evaluated from the work planning and control perspective on this Independent Oversight inspection. The review of feedback and improvement systems also constitutes the Independent Oversight evaluation of the effectiveness of BNL and BHSO implementation of DOE Order 226.1, *Implementation of DOE Oversight Policy*, which is also one of Independent Oversight's current focus areas.

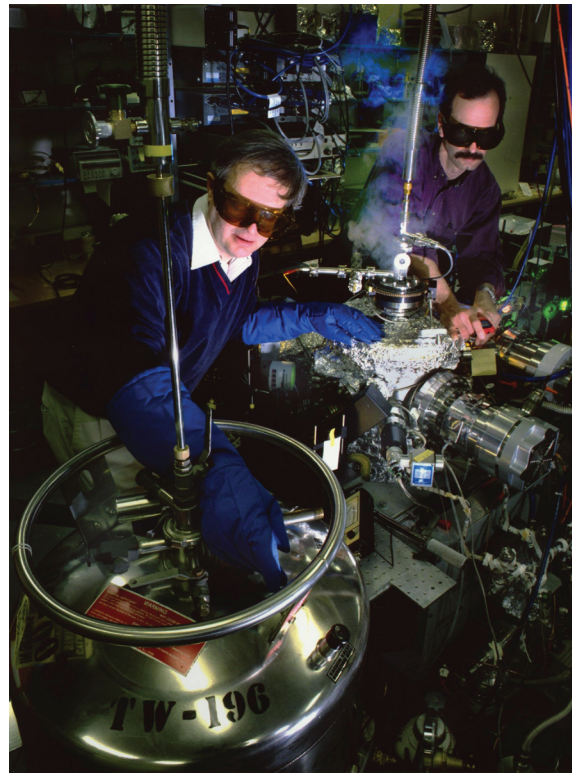
Sections 2 and 3 discuss the key positive attributes and weaknesses, respectively, identified during this inspection. Section 4 provides a summary assessment of the effectiveness of the major ISM elements that were reviewed. Section 5 provides Independent Oversight's conclusions regarding the overall effectiveness of SC, BHSO, and BNL management of ES&H programs, and Section 6 presents the ratings assigned during this inspection. Appendix A provides supplemental information, including team composition.

Appendix B presents the findings identified during this Independent Oversight inspection. In accordance with DOE Order 470.2B, *Independent Oversight and Performance Assurance Program*, SC must develop a corrective action plan that addresses each of the findings identified in Appendix B. In most cases, the findings listed in Appendix B were derived from multiple individual deficiencies that are described in the detailed results provided to the site. SC, BHSO, and BNL need to ensure that the corrective action plan for the Appendix B findings addresses these individual deficiencies and includes appropriate causal analysis, corrective actions, and recurrence controls. The findings are referenced in Sections 3 and 4 of this report. The weaknesses in Section 3 provide a management-level summary of the findings; the weaknesses do not need to be separately addressed in the SC corrective action plan because the findings encompass the scope of the weaknesses.

Positive attributes were identified in several ES&H programs in certain aspects of work control, environmental management, corrective action management, and SC initiatives.

**Office of Science senior management's leadership and direction to complete the Office of Science Management System are improving SC and BHSO oversight.** SC has made good progress in improving safety management systems since a January 2007 Independent Oversight inspection of ES&H programs at another SC site. SC has approved and issued (or updated) several important ES&H program documents, such as the *SC ISM System Description*, and several key management system descriptions that are important to ES&H management, such as quality assurance and oversight. SC Headquarters has established and implemented numerous mechanisms to ensure that Headquarters managers have sufficient knowledge of field office and contractor activities to support informed decisions and established mechanisms to hold field elements accountable for ES&H performance. SC's leadership, coupled with BHSO initiative, has maintained an effective Facility Representative program, and has recently made significant progress in developing and enhancing oversight processes and procedures.

**BNL senior management has effectively used a structured, project management approach to implement the corrective action plan addressing issues identified by the 2006 ISM readiness review.** In 2006, BNL management directed a comprehensive review and gap analysis of BNL's implementation of ISM. This focused review included an analysis of results from prior assessments of ISM at BNL to identify root and contributing causes and to establish corrective actions and recurrence controls to address these causes. To manage the large volume and variety of actions and initiatives resulting from this review, BNL management applied project management tools, established an integrated project team, appointed a project manager, developed a work breakdown structure, developed and updated an ISM/Safety Improvement Project Plan, and provided regular status briefings to senior



Work with cryogenics materials

management at BNL, BHSO, and HSS. This approach has ensured continued management focus on timely development and implementation of corrective actions to enhance ISM at BNL.

**BNL organizations have developed processes that, when implemented with sufficient rigor, are effective in defining the scope of work, analyzing hazards, and identifying needed controls, and have enhanced several ES&H programs.** At NSLS, processes, such as experimental reviews, are used effectively to define the work and to identify hazards and controls. For small science research activities, mature processes, such as experimental safety reviews, activity safety reviews, work permits, operating procedures, and job risk assessments, are used to define the scope of work and to identify hazards and controls. Phase hazard analyses, developed by Plant Engineering, provide an appropriate mechanism for identifying and linking activities, and hazards and controls for planned construction work. BNL has also been

effective in integrating environmental requirements and pollution prevention into experimental and operational processes. Although identified controls are not always effectively implemented, the existing processes provide the framework for an effective work control system in most cases. BNL organizations have also enhanced a number of aspects of ES&H programs. For example, Plant Engineering management has communicated that safety takes precedence over production and schedules; has responded positively to worker feedback on several occasions; closely monitors most aspects of subcontracted construction work; and is effectively implementing interim and long-term corrective actions generated during a Type B Investigation of a 2006 arc flash accident. BNL has also effectively used deployed environmental expertise to ensure environmental compliance and to support waste management and reduction efforts.

**BNL has established and implemented a noteworthy program for inspection of heavy equipment.** Plant Engineering inspects heavy equipment (i.e., cranes, earth-working equipment, aerial lifts, and rigging) to ensure proper working condition before use on site. Additionally, Plant Engineering ensures that operators are qualified to operate equipment safely. Construction contracts require that BNL be notified 48 hours before equipment is brought on site. This notification requirement is also included in the BNL Standards Based Management System (SBMS), which establishes BNL institutional requirements, and is reiterated in annual contractor vendor orientation training. BNL inspects the equipment and records inspection results in accordance with SBMS procedures. These inspections include assessment of equipment condition and verification that equipment operators are appropriately trained and qualified. BNL inspections of heavy equipment were thorough and properly documented, and equipment inspected by the Independent Oversight team was in good condition.

## 3.0 Weaknesses

Although some aspects of ES&H management are effective, there are weaknesses in ISM programs at BNL, most significantly in implementation of safety controls, compliance with requirements, and feedback and continuous improvement processes.

**BNL has not ensured that unambiguous ES&H requirements are established at the institution level and accurately communicated to BNL personnel through organizational implementing procedures that align with those requirements.** In some cases, external requirements are not properly identified or correctly reflected in organizational implementing procedures or in the BNL-wide requirements, which are delineated in SBMS documents. For example, BNL has not established effective mechanisms for implementing the lockout/tagout requirements of National Fire Protection Association (NFPA) 70E. In recent cases, some BNL-wide processes, as contained in SBMS, did not accurately identify gaps and needed actions. In addition, numerous institutional documents in SBMS describe requirements using incorrect/indefinite terminology that communicates optional compliance with the requirement (i.e., the use of “should” rather than “shall”). In some cases, the implementation of safety requirements has not been translated below the level of management system or program description documents into procedures/formal processes. Also, in many cases, requirements for a particular topic are located in many different documents, making it difficult for BNL personnel to identify all applicable requirements. Further, some SBMS documents have not been kept current and have not been subjected to review at the BNL-required frequency. In many cases, organizations have not established internal procedures for implementing BNL-wide requirements when necessary or have not updated their procedures to reflect changes in BNL-wide requirements. (See Finding #C-1.)

**BNL managers and supervisors have not always ensured that established safety controls are implemented by workers, particularly for activities in experimental and research facilities**

**and laboratories.** In several cases, appropriate controls were established in work documents but were not implemented by workers. For example, eating and drinking were observed in laboratory areas even though prohibited by requirements; workers did not always comply with posted signs and barricades; chemical and cryogen handling safety requirements were not followed; and flammable liquids were not stored in accordance with requirements. On several occasions, BNL personnel were allowed to continue to work when hazards and/or controls were not adequately defined. Facility managers and supervisors were often aware of the discrepancies between established controls and actual implementation, but did not take action to ensure full compliance with the safety control. The explicit or tacit acceptance of non-conformance to established safety controls creates a situation in which holding workers accountable for effectively implementing safety controls is problematic and can result in managers, supervisors, and workers ignoring important safety controls. (See Finding #C-2.)

**Some workplace and construction hazards have not been adequately analyzed.** BNL small science has not ensured that activity-level hazard assessments provide sufficient information about workplace hazards (e.g., lead solder, sharps) such that all appropriate hazard controls could be identified and effectively communicated to the workers. Plant Engineering has not implemented the work planning and control for experiments and operations subject area, as delineated in SBMS, sufficiently to ensure that health hazards associated with the work being performed are effectively identified, analyzed, and categorized during the work planning process. For example, Plant Engineering did not effectively apply the BNL work control process to analyze potential health hazards associated with exposures to welding fumes in confined spaces or exposure to asphalt fumes during roofing work. BNL ES&H representatives involved in the planning of this work were not aware of the potential exposure hazards associated with these fumes, and the Facilities and Operations industrial hygienist

was not aware that the construction work was to be performed. (See Findings #C-3 and #C-4.)

**BNL has not established and rigorously implemented effective contractor assurance systems in a manner that sufficiently communicates expectations and requirements, ensures effective implementation, and effectively drives continuous improvement in safety performance.** There are process and implementation weaknesses in BNL contractor assurance systems that are limiting BNL's progress towards reducing injuries and achieving performance excellence. Requirements and processes for these assurance system elements are often insufficiently and inconsistently defined in SBMS documents and organization implementing procedures. Line organizations conduct few self-assessments of work activities and safety processes. Self-assessment activities often lack sufficient depth and rigor; lack a focus on work observation, records reviews, and work documents; and often provide an inadequate evaluation of program implementation and effectiveness to provide management with an accurate understanding of safety program performance. Although an issues management tool (i.e., the assessment tracking system) has been developed and implemented, its use is primarily limited to issues identified by events, and external and internal independent assessments. The various other methods used by BNL organizations to manage issues are inconsistently implemented; often do not include essential elements of effective issues management, such as causal analysis and extent-of-condition reviews; and are not implemented in a manner that enables BNL-wide data analysis and performance evaluation. Similar weaknesses in processes and performance were identified in occupational injury and illness investigations, the lessons-learned program, accident and event investigations, and employee



**BNL's National Synchrotron Light Source**

concerns programs. Management has not adequately monitored assurance system implementation and ensured accountability for effective performance. (See Findings #C-1, #D-3, #D-4, and #D-5.)

**SC and BHSO oversight of BNL ES&H and assurance programs has not been consistently effective in ensuring continuous improvement.** Many of the current deficiencies in BNL ES&H programs are longstanding and have been identified previously by internal and external assessments. While SC and BHSO have maintained operational awareness and BHSO has performed a number of assessments, BHSO assessments and other oversight activities have not adequately evaluated and verified some BNL corrective actions to ensure that they were sufficient to address the issue, identify and address causal factors, and ensure that the extent-of-condition review was considered in the scope of corrective actions. (See Finding #D-2.)



## 4.0 Results

The following paragraphs provide a summary assessment of the SC, BHSO, and BNL activities that Independent Oversight evaluated during this inspection.

### 4.1 Work Planning and Control Processes

**NSLS.** The NSLS is used extensively by scientists and students from university, government laboratory, and industry institutions. Work activities at NSLS include: experiment review, basic setup, experiment performance, such activities as complex experiment setup or other unique operations, machine system operations, preventive maintenance, and other similar work. These work activities are covered by various sections of the BNL work planning and control subject area, as delineated in SBMS, which make provisions for activities deemed low risk to be performed as “skill of the worker” as defined in the current work planning and control subject area (“skill of the worker” was recently renamed as “worker planned work”). Because of the unique challenges of a large user facility, NSLS has developed its own work control procedures (including a facility-specific experiment review process) that tailor the BNL-wide work control requirements to the activities at NSLS.

In most cases, work is well defined and scheduled at NSLS through the experiment review process, job risk assessments and associated worker qualification matrices, job work permits, procedures, and other work and scheduling documents.

Experimental, operational, and maintenance hazards, along with hazards potentially introduced by facility modifications, are well analyzed at NSLS. Activity/task-level hazards for low risk skill-of-the-worker operations and maintenance activities are effectively identified and analyzed through the job risk assessment and job training assessment processes.

Although a few activity-level controls are not fully effective, NSLS has established the appropriate engineering and administrative

controls commensurate with the hazards for which these controls are intended for most types of experiments and work activities.

At NSLS, formal processes are in place to verify readiness, and in most cases, work is performed safely and in accordance with established controls. However, NSLS monitoring of activities is insufficient, and processes for BNL line management to control and monitor activities in the laboratories and other chemical handling areas have not been established. Further, there were a number of instances in which facility management observed situations in which established requirements were not fully implemented but did not take action to stop work to enforce the requirements or, alternatively, to take actions to modify requirements that were perceived as unnecessary. (See Finding #C-2.)

Overall, NSLS work is well defined through the experiment review process, job risk assessments and associated worker qualification matrices, job work permits, procedures, and other work documents. Hazards are adequately analyzed and controls are adequately defined. However, processes for BNL line management observations and control of activities have not been adequate to ensure worker compliance with all safety requirements. These deficiencies can be attributed to a lack of a process to provide facility line management monitoring of these activities and management’s tacit acceptance of failure of workers, supervisors, and management to follow requirements when perceived as not necessary. (See Findings #C-1 and #C-2.)

**Small Science.** Small science encompasses a wide variety of activities and hazards, and uses a variety of different work control processes. To evaluate work planning and control, Independent Oversight evaluated a wide range of R&D, operations, and maintenance activities in several small science departments and divisions, including observations of ongoing work in a number of laboratories.

The experiment safety review and activity safety review work control processes are mature and provide effective mechanisms for defining the conduct of research, operations, and research

support activities. In some cases, these processes did not provide sufficient information about work activities to ensure that appropriate hazard controls could be identified and effectively communicated to the workers. (See Finding #C-3.)

Many hazards are sufficiently analyzed through application of the experiment safety review and activity safety review, job risk assessment, and work permit processes. However, in several cases hazards (e.g., lead solder, sharps) were not adequately identified or analyzed to ensure that appropriate hazard controls could be identified and effectively communicated to the workers. In addition, BNL recognizes that their industrial hygiene exposure monitoring program is not compliant with 10 CFR 851 requirements. Consequently, BNL is taking action to perform more exposure monitoring, but has not provided sufficient direction for interim measures or processes to ensure that exposure hazards are sufficiently analyzed before work is performed. (See Findings #C-1 and #C-3.)

The experiment safety review and activity safety review processes have, for the most part, been effective in identifying and documenting many hazard controls through forms, job risk assessment procedures, and work instructions. For example, interlocks and remote systems are routinely used to restrict access and limit exposures at both accelerator and laser facilities, and engineering controls are effective in controlling many hazards. However, in several cases, the processes have not been adequately implemented, and controls for worker safety hazards have not been adequately identified or communicated to workers. Some controls lack specificity, especially with respect to some administrative controls and personal protective equipment usage. In at least two cases, when hazards changed, the hazard controls were not reanalyzed. (See Findings #C-1, #C-2, and #C-3.)

Workers followed controls when expectations were clearly established. However, on several occasions, BNL personnel were allowed to continue to work when hazards and/or controls were ambiguous or unclear, and in some cases, work was performed outside of established controls. (See Finding #C-2.)

Overall, the work control processes applied by small science organizations provide an effective framework for implementing the core functions of ISM. R&D activities and operations are, with few exceptions, well defined. Some hazards are sufficiently analyzed, and controls, where identified, are appropriate. With few exceptions, workers followed controls when expectations were unambiguously established. However, in several cases, workplace hazards have

not been adequately identified or analyzed, and controls lack specificity, especially with respect to some administrative controls and personal protective equipment (PPE) use. Additionally, on several occasions, BNL staff performed work outside of established controls. (See Findings #C-1 and #C-2.)

**Maintenance.** The Plant Engineering Division, within the Facilities and Operations Directorate, is responsible for designing, constructing, operating, and maintaining BNL facilities and infrastructure. The Independent Oversight team evaluated a variety of maintenance work, such as roofing, electrical work, hoisting and rigging, and craft work in various maintenance shops and machine shops.

The Plant Engineering Division has established adequate processes for defining work. Skill-of-the-craft work is adequately defined and assigned through work orders, preventive maintenance, or work permits. For the work activities observed by Independent Oversight, the work scopes were defined in sufficient detail to support hazard identification and analysis.

Plant Engineering has well-defined processes to identify and analyze hazards during the early stages of their work control and planning process. This process has, with some exceptions, been effective in identifying and analyzing hazards associated with the work being performed. For example, hazards associated with elevated work and asbestos sampling were adequately identified and controlled through work permits and other work control processes. Although the process is effective in identifying hazards in most cases, the processes have not always been implemented with sufficient rigor. The insufficient rigor resulted in some hazards not being sufficiently analyzed, as evidenced by examples in observed work activities involving potential electrical shock hazards, automotive lifts, beryllium hazards in circuit breakers, environmental concerns from solvent use, and noise. (See Finding #C-4.)

The Plant Engineering process for defining and implementing controls is well defined and mature. Plant Engineering effectively uses engineered controls where feasible. In most cases, administrative controls, PPE, and safety training are effective. Plant Engineering has implemented an aggressive safety equipment inspection program that, in some cases, is more stringent than Occupational Safety and Health Administration requirements. However, in several cases, controls were not adequately defined to provide adequate protection from industrial hazards and environmental elements, or were not implemented as required. Specific concerns were identified with

controls for managing halogenated oils as hazardous waste and ensuring that belts and pulleys on machine tools are adequately guarded, electrical outlets are protected by ground fault circuit interrupters, aerosol cans containing flammables are properly stored, controls for proper management of waste from the use of solvents are communicated to workers, and repairs of large truck tires are performed in accordance with Occupational Safety and Health Administration requirements. (See Finding #C-1.)

Most work evolutions were performed safely in accordance with established controls. Supervisors conducted comprehensive and effective pre-job briefings or daily shop meetings for the work observed during the inspection. Maintenance workers also wore the appropriate PPE in most/many cases. However, Independent Oversight observed several instances in which workers did not fully conform to required controls (e.g., crossing safety barricades), did not wear the specified PPE (arc flash protective clothing, hearing protection), and used or staged PPE that was past the reinspection date. (See Finding #C-2.)

Overall, the Plant Engineering Division's processes for implementing BNL's work planning and control process are comprehensive and well defined. Plant Engineering has provided adequate resources for work planning and work execution, and expects work to be performed safely. In most cases, the workforce demonstrated a high level of safety awareness and care when performing work. Many of the controls established for recognized hazards were appropriate, and with some exceptions, the workforce followed the controls. However, some hazards had not been identified during the work planning process. Industrial safety hazards and environmental concerns were observed in a number of work places such as machine and craft shops. Additionally, several workers were observed not wearing the prescribed PPE or not following established controls. The number of easily recognized industrial safety-type hazards observed during the inspection suggests that management attention is needed to ensure that appropriate rigor is applied to the work planning process. (See Findings #C-1, #C-2, and #C-4.)

**Construction.** Most construction at BNL is performed by subcontractors to BNL. The work is managed by various BNL organizations in accordance with the work control process delineated in the BNL SBMS and the implementing procedures prepared by the managing organizations. Independent Oversight evaluated contracted construction work managed by the Plant Engineering Division, Environmental and Waste

Management Services Division, and Environmental Restoration Projects.

The scope of construction work was adequately defined in contracts, drawings, and specifications, and was broken down into phases by construction contractors in phase hazard analyses. Tasks were described in job risk assessments for work managed by the Environmental and Waste Management Services Division and Environment Restoration Projects, and were discussed routinely in tailgate meetings. The work was defined in sufficient detail to support the hazard identification and analysis required by 10 CFR 851.

BNL institutional work control requirements are adequate to ensure preparation of activity hazard analyses for all construction work as required by 10 CFR 851 and are effectively implemented for most of the construction work observed by the Independent Oversight team. Most environmental and safety hazards were adequately identified and analyzed in work control documents, or were adequately addressed in pre-job briefings and tailgate meetings. However, some potential health hazards associated with asphalt and welding fumes were not identified for previously performed work, and workers were not adequately informed about them. Insufficient review by the BNL industrial hygiene organization contributed to this situation. (See Finding #C-1.)

In most cases, the BNL work control process is adequate to ensure that appropriate controls are established for identified hazards and to ensure that these controls are understood by workers. However, this process has not been implemented effectively for construction work in a number of instances. Required controls are not always adequately described on phase hazard analyses and area or job risk assessments. Controls specified on work permits are not always well understood, and lockout/tagout procedures do not meet NFPA requirements. BNL has partially compensated for these shortcomings with effective use of meetings, briefings, and the monitoring of work activities to ensure that construction workers understand and follow applicable ES&H requirements. (See Finding #C-4.)

Appropriate processes for authorizing work have been established and implemented. Workers understand that management expects them to work safely and most work was performed safely and in compliance with required controls.

Overall, construction work is adequately defined, analyzed, and controlled in many cases. BNL has effectively used meetings, training, and review-of-work activities to provide construction workers with

safety expectations and an understanding of required controls; consequently, most construction work was performed safely and within required controls. However, there are some process and performance weaknesses. Some potential health hazards were not fully analyzed, and electrical lockout/tagouts do not meet NFPA requirements. In addition, controls specified on work permits are not always clear or consistently understood, and those on phase hazard analyses and area or job risk assessments are not always tailored for specific tasks to be performed. The quality of these documents is important because they are used by contractor supervisors in conducting pre-job briefings and tailgate meetings; these meetings are a principal source of hazard and control information for construction workers. (See Findings #C-1 and #C-2.)

## 4.2 Focus Areas

### **EMS and Pollution Prevention Program.**

BHSO approved the EMS for BNL in 2005 based on a desk assessment for conformance with DOE Order 450.1, *Environmental Protection System*, and on BNL longstanding International Standards Organization (ISO) 14001 certification. The EMS is routinely audited by a third party to ensure that ISO 14001 requirements are maintained and improved as needed. BHSO provides oversight for the EMS by participation in joint assessments and in regular meetings with BNL environmental organizations and has used EMS contract performance measures to drive improvements in BNL environmental programs. BNL has effectively implemented EMS within the ISM system for most work activities, with the exception of skill-of-the-craft work performed in the Facility and Operations shop areas. BNL has established significant environmental aspects that are being implemented within line organizations and that are effectively supported by deployment of environmental compliance representatives and, for some organizations, waste services support. Pollution prevention has been effective for sitewide initiatives, and BNL has received numerous pollution prevention awards, including a Close the Circle award in 2007. With BHSO providing incentives, BNL is taking action to increase funding for pollution prevention opportunity assessments to identify mechanisms to reduce the generation of waste for individual activities within line organizations. (See Finding #C-1.)

### **Injury and Illness Investigation and Reporting.**

BNL has established and implemented an adequate

process for identifying, categorizing, responding to, investigating, and reporting incidents and events, and for taking corrective/preventive actions to address associated issues. However, in some cases, fact-finding, critique, and investigation reports lacked sufficient rigor to address all elements of the event and identify effective recurrence controls. In addition, there are weaknesses in processes, injury investigations, and recordkeeping for the Computerized Accident/ Incident Reporting System. Many injury and illness investigations lack sufficient completeness and rigor to address work control/ISM elements and accurately identify causes. Corrective actions sometimes do not adequately address causes, extent-of-condition reviews, or recurrence controls. (See Finding #D-5.)

## 4.3 Feedback and Improvement Systems

**SC.** SC senior management leadership and direction to complete the Office of Science Management System products are improving SC feedback and improvement. Important SC program documents have been recently approved, issued, or updated (i.e., *Quality Assurance Program Description*; the *SC Functions, Responsibilities, and Authorities Manual*; and the *SC ISM System Description*). Three key management system descriptions (*Environment, Safety and Health; Management & Operating Contracting*; and *Quality Assurance & Oversight*) have been issued. However, most subject area supporting documents (procedures) have not been developed. Many aspects of the SC oversight program are under development and currently are not governed by documented processes/procedures, including Operating Experience/Lessons Learned, Employee Concern Program, Federal Employee Occupational Safety and Health, Startup and Re-start of facilities, Assessment and Self-Assessment, Technical Training & Qualification, Issues Management, and Corrective Action Tracking. However, progress is being made in most of these program areas in response to previous findings and corrective action plans.

SC is maintaining adequate operational awareness of BNL ES&H issues and status. There are numerous examples of the SC personnel being engaged in operational awareness and actively supporting evaluations of site and contractor ES&H performance, and SC is making progress in improving the oversight of contracts. Increased management attention, however, is needed to ensure timely establishment of a training and qualification program and the development of a formal process for delegating safety management

responsibilities, as directed by the Deputy Secretary of Energy in December 2005. (See Finding #D-1.)

**BHSO.** Over the last year, BHSO has worked aggressively to develop and issue program documents and procedures relevant to ES&H programs and oversight. Program documents that have been issued in the past few months include: the *BHSO Functions, Responsibilities, and Authorities Manual; Environment, Safety, and Health Management Plan; ISM System Program Description; and Quality Management Plan*. Most BHSO implementing procedures have been revised as part of a BHSO procedure improvement initiative. However, several BHSO procedures and their subsequent implementation do not fully conform to the requirements of DOE Order 226.1A, *Implementation of DOE Oversight Policy* (i.e., assessments, self-assessments, issues management, corrective action tracking, and operational awareness).

Several aspects of the BHSO oversight program are adequate. The BHSO procedures for regularly evaluating BNL performance against contract objectives are adequate. The BHSO Facility Representative program is satisfactory, with a few exceptions. There are numerous mechanisms for effective communications between SC headquarters and BHSO. The BHSO employee concerns program meets requirements, with some exceptions; the exceptions were, in large part, identified by a 2007 BHSO self-assessment, and corrective actions are ongoing. The Federal Employee Occupational Safety and Health program is adequate. The BHSO *Quality Management Plan*, in most cases, meets the requirements of DOE directives.

While a number of recent BHSO actions and initiatives are appropriate, the BHSO oversight program does not meet some important aspects of DOE expectations (as defined in DOE Order 226.1A and other applicable orders), and much work remains to effectively implement adequate oversight and feedback and improvement processes at BHSO. BHSO has not developed all elements of an adequate baseline assessment program in accordance with DOE Order 226.1A. The technical quality of BHSO assessment reports varies significantly. BHSO does not have a corrective action tracking system or procedure in place to effectively track self-assessment corrective actions to closure. In addition, BHSO does not have an effective issues management process and efforts to develop one have been unsuccessful. The BHSO Operational Awareness database has not been fully implemented and is not currently an effective tool in shaping the BHSO oversight program. BHSO has not collected adequate data to perform formal trend analysis. BHSO recently

approved and issued a lessons-learned procedure, but it is not fully implemented and not adequate to implement some of the DOE lessons-learned requirements. (See Finding #D-2.)

**BNL.** BNL has established and implemented the safety assurance elements defined in DOE Order 226.1 that are contributing to safer conditions, work performance, and environmental protection. Worker feedback is solicited, assessment activities are performed, injuries and events are analyzed and reported, issues are identified, employee concerns are investigated, deficiencies are corrected, and lessons learned are identified and applied. BNL has established and implemented a comprehensive, tiered self-assessment program and conducts many ES&H-related assessment activities. BNL has established a process and tool for managing and tracking corrective actions for events and institutional safety issues identified by external parties or the BNL independent oversight organization. Various means are being used by line and support organizations to document and track the resolution of ES&H deficiencies and opportunities for improvement. Workers at BNL have many ways to express and obtain resolution of safety concerns, and the few formal concerns being reported are generally adequately dispositioned. BNL management and organizations use other effective mechanisms (e.g., safety committees) to provide feedback between employees and management, communicate expectations, and promote continuous improvement in safety performance. External lessons learned are being screened and distributed; internal lessons learned are being generated, disseminated, and posted to the BNL website; and lessons are being incorporated into work activities. BNL management has also recently embraced the use of human performance



Aerial view of NSLS

improvement concepts and methods for evaluating incidents and identifying precursors and weaknesses in institutional management systems in an effort to prevent occupational injuries. Much attention has recently been directed at developing and strengthening institutional-level goal setting, causal analysis, and performance analysis rolling up evaluation of data and line management reviews. These process improvements can improve the understanding and communication of performance, if based on sufficient and accurate data.

However, weaknesses in assessment programs and issues management processes are limiting BNL's effectiveness in driving substantial and continuous improvement in safety performance. Management expectations and institutional processes for assessment programs are not sufficiently defined, and there are deficiencies in program implementation by line and support organizations. There has been too little focus on overseeing and ensuring effective processes, safe conditions, compliant performance, and continuous improvement at the activity level. Independent Oversight identified weaknesses in line and support organization feedback and improvement processes and implementation. Institutional-level contractor assurance activities at all levels have been insufficient to ensure fully effective implementation of safety programs and accountability for performance. Line

organizations are performing few self-assessments of safety-related activities and assurance system processes and performance. The line and support organization self-assessments that are performed often lack sufficient rigor and are inadequately documented. In some cases, assessments are identified as completed when they were not performed, and in some cases, assessments are performed but reports are not issued and findings are not input to the issues management system. Some assessments mandated by external standards are not being performed. In addition, the requirements for managing issues identified by line and support organizations are not adequately detailed, and management of those issues is inconsistent. Issues management actions often are not performed with sufficient rigor, are not adequately documented, do not include analysis for causes and extent-of-condition reviews, and do not identify recurrence controls. Processes and requirements delineated in SBMS do not provide sufficient detail for effective management of all identified safety issues at BNL. Formal collective trending or analysis of issues data to identify adverse trends and areas to focus management attention and resources is insufficient. BNL permits individual organizations to limit access to organization issues management data; this longstanding practice continues to hamper effective BNL-wide data analysis and program performance evaluation. (See Findings #D-3 and #D-4.)

Although significant effort remains, SC is demonstrating progress in development of the Office of Science Management System. Some key milestones are the development of site management plans, risk-based assessment plans, and issuance of the laboratory performance appraisal process. SC management has established effective communications mechanisms with the site to maintain cognizance of operations.

BHSO has established mechanisms to gather performance data and provide feedback to laboratory management, which is resulting in improvements (e.g., projectized ISM improvement initiative). Significant effort has been applied to establish and upgrade processes and procedures, and to maintain an experienced cadre of technical staff. However, some site office processes and procedures are not fully compliant with Department directives. In addition, BHSO's efforts have not been fully effective in ensuring effective BNL processes and performance in several key areas, including BNL self-assessments and corrective action management, implementation of controls, and injury/illness investigations.

BNL has established management systems consistent with ISM and is managing a significant improvement effort utilizing a structured project management approach. This approach has ensured timely implementation and good communication of status to DOE and senior laboratory management. Senior laboratory management also demonstrated significant attention to safety during this inspection and initiated several actions in response to the Independent Oversight team's observations during the inspection. The SBMS provides a sound framework for management of requirements, and work control processes are generally mature with several enhancements in progress. Senior management's attention to maintaining an awareness of safety performance and continuous improvement is evident in the recent efforts on institutional-level goal setting and performance analysis.

While management systems were adequate, several areas of weakness were identified by the inspection team that present obstacles to

improving performance. While work control processes are mature, implementation of these processes has not been sufficiently effective to ensure that all hazards and controls were identified and implemented. In addition, there were a number of individuals observed not following requirements (including not wearing prescribed PPE) and inadequacies in SBMS documents. Ambiguous communication of expectations and requirements is a contributing cause to many of the identified performance deficiencies. In other cases, however, the attitude of individuals, including supervisors, is not always conducive to following established safety requirements.

Institutional efforts to maintain cognizance of safety performance and to facilitate continuous improvement rely on a sound foundation that includes organizational self-assessment, investigation, and corrective action management. The decentralized approach to certain functions, such as issues management, also contributes to a situation where managers at the institutional level do not have sufficient information to evaluate ES&H performance and focus on areas needing improvement.

During the Independent Oversight inspection, BNL management initiated some actions to enhance implementation of safety controls, including a senior management memorandum that clarifies management expectations for full compliance with safety controls. These actions are appropriate first steps, but additional actions, effective monitoring, and continued management attention will be needed to address longstanding weaknesses in the clarity of management expectations and facility-level enforcement of safety controls.

SC, BHSO, and BNL need to place a high priority on additional actions to foster a culture of acceptance of and compliance with a minimum set of safety standards. In a number of cases, facility managers and supervisors were aware of the discrepancies between established controls and actual implementation, but did not take action to ensure full compliance with the safety controls. The explicit or tacit acceptance of non-conformance to established safety controls creates a situation in

which workers, supervisors, and managers ignore important safety controls. Further, inadequacies in SBMS documents and ambiguous communication of expectations and requirements are contributing causes to many of the performance deficiencies and findings identified by Independent Oversight. The weaknesses in institutional programs and processes also contribute

to a culture where compliance with requirements is problematic and hinder efforts to hold individuals accountable for ES&H performance. Addressing the safety culture issue is essential to achieving effective implementation of ES&H programs and meeting DOE expectations for continuous improvement in ISM and ES&H performance.



## 6.0 Ratings

The ratings reflect the current status of the reviewed elements of BNL ISM programs.

### Work Planning and Control

ACTIVITY	CORE FUNCTION RATINGS			
	Core Function #1 – Define the Scope of Work	Core Function #2 – Analyze the Hazards	Core Function #3 – Develop and Implement Controls	Core Function #4 – Perform Work Within Controls
<b>NLSLS</b>	Effective Performance	Effective Performance	Effective Performance	Needs Improvement
<b>Small Science</b>	Effective Performance	Needs Improvement	Needs Improvement	Needs Improvement
<b>Maintenance</b>	Effective Performance	Needs Improvement	Needs Improvement	Needs Improvement
<b>Construction</b>	Effective Performance	Needs Improvement	Needs Improvement	Effective Performance

### Feedback and Continuous Improvement - Core Function #5

SC and BHSO Feedback and Continuous Improvement Processes..... Needs Improvement  
 BNL Feedback and Continuous Improvement Processes ..... Needs Improvement

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# APPENDIX A

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## SUPPLEMENTAL INFORMATION

### A.1 Dates of Review

Planning Visit	August 6-9, 2007
Onsite Inspection Visit	August 20-30, 2007
Report Validation and Closeout	September 26-28, 2007

### A.2 Management

Glenn S. Podonsky, Chief Health, Safety and Security Officer  
Michael A. Kilpatrick, Deputy Chief for Operations, Office of Health, Safety and Security  
Bradley Peterson, Director, Office of Independent Oversight  
Thomas Staker, Director, Office of Environment, Safety and Health Evaluations

#### A.2.1 Quality Review Board

Michael Kilpatrick	Bradley Peterson	Thomas Staker
Dean Hickman	Robert Nelson	Bill Sanders

#### A.2.2 Review Team

Thomas Staker, Team Leader			
Phil Aiken	Vic Crawford	Larry Denicola	Janet Macon
Jim Brown	Bob Compton	Al Gibson	Ed Greenman
Joe Lischinsky	Ed Stafford		

#### A.2.3 Administrative Support

Mary Anne Sirk	Tom Davis
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### A.3 Ratings

The Office of Independent Oversight uses a three-tier rating system that is intended to provide line management with a tool for determining where resources might be applied toward improving environment, safety, and health. It is not intended to provide a relative rating between specific facilities or programs at different sites because of the many differences in missions, hazards, and facility life cycles, and the fact that these reviews use a sampling technique to evaluate management systems and programs. The rating system helps to communicate performance information quickly and simply. The three ratings and the associated management responses are:

- **Significant Weakness (Red):** Indicates that senior management needs to immediately focus attention and resources necessary to resolve management system or programmatic weaknesses identified. A Significant Weakness rating normally reflects a number of significant findings identified within a management system or program that degrade its overall effectiveness and/or that are longstanding deficiencies that have not been adequately addressed. In most cases, a Significant Weakness rating warrants immediate action and compensatory measures as appropriate.
- **Needs Improvement (Yellow):** Indicates a need for improvement and a significant increase in attention to a management system or program. This rating is anticipatory and provides an opportunity for line management to correct and improve performance before it results in a significant weakness.
- **Effective Performance (Green):** Indicates effective overall performance in a management system or program. There may be specific findings or deficiencies that require attention and resolution, but that do not degrade the overall effectiveness of the system or program.

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## APPENDIX B

### SITE-SPECIFIC FINDINGS

**Table B-1. Site-Specific Findings Requiring Corrective Action**

FINDING STATEMENTS	
C-1	BNL institutional-level and facility/functional area-level management has not ensured that some ES&H and assurance requirements/controls are adequately defined and communicated to workers through SBMS and supporting facility/functional level documents in a manner that ensures workers are adequately protected from all hazards, as required by DOE Manual 450.4-1, <i>Integrated Safety Management System Manual</i> , DOE Order 414.1C, <i>Quality Assurance</i> , and 10 CFR 851, <i>Worker Safety and Health Program</i> .
C-2	BNL institutional-level and facility/functional area-level management and supervisors have not ensured that workers implement established safety controls, as required by DOE Manual 450.4-1, <i>Integrated Safety Management System Manual</i> , and 10 CFR 851, <i>Worker Safety and Health Program</i> .
C-3	BNL small science has not ensured that activity-level experiment safety reviews and job risk assessments provide sufficient information about workplace hazards such that all appropriate hazard controls could be identified and effectively communicated to the workers in accordance with DOE Manual 450.4-1, <i>Integrated Safety Management System Manual</i> .
C-4	Plant Engineering has not sufficiently implemented the requirements in the BNL-wide work planning and control subject area of SBMS to ensure that all hazards associated with the work being performed are effectively identified, analyzed, and categorized during the work planning process.
D-1	SC has not established a formal process or procedure for delegations of safety management responsibilities and authorities (consistent with process criteria and attributes) as directed by the Deputy Secretary of Energy in the memorandum <i>Delegations of Safety Authorities</i> , dated December 27, 2005.
D-2	BHSO management and quality processes have not ensured that procedures and their subsequent implementation fully comply with all of the requirements in DOE Order 226.1A, <i>Implementation of DOE Oversight Policy</i> , in such areas as assessments, self-assessments, issues management, corrective action tracking, and operational awareness, and with requirements of DOE Order 210.2, <i>DOE Corporate Lessons Learned Program</i> , in the areas of required roles and responsibilities, and annual self-assessments.
D-3	BNL has not implemented an effective and compliant self-assessment program that appropriately identifies, prioritizes, plans, and conducts rigorous evaluations of the adequacy of safety programs and implementation by line organizations as required by DOE Order 414.1C, <i>Quality Assurance</i> , and DOE Order 226.1, <i>Implementation of DOE Oversight Policy</i> .
D-4	BNL has not established and implemented an effective issues management program that appropriately describes safety deficiencies, determines their causes and the extent-of-condition reviews, and ensures development and implementation of effective corrective and preventive actions as required by DOE Order 414.1C, <i>Quality Assurance</i> , and DOE Order 226.1, <i>Implementation of DOE Oversight Policy</i> .
D-5	BNL has not implemented a rigorous and effective program of injury and illness investigations that consistently documents and evaluates conditions and causes, and establishes appropriate corrective and preventive actions as required by BNL SBMS procedures and DOE Order 414.1C, <i>Quality Assurance</i> , and DOE Order 226.1, <i>Implementation of DOE Oversight Policy</i> .

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