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VALIDATION APPENDICES
FOR

INDEPENDENT OVERSIGHT
INSPECTION OF
ENVIRONMENT, SAFETY, AND HEALTH
PROGRAMS
AT
BROOKHAVEN NATIONAL LABORATORY

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INTRODUCTION

These validation appendices are provided to the Office of Science (SC), Brookhaven Site Office (BHSO), and the Brookhaven National Laboratory site contractor – Brookhaven Science Associates (BSA) – to provide additional technical details regarding the July-August 2007 environment, safety, and health inspection by the Office of Health, Safety and Security's Office of Independent Oversight.

Three technical appendices (C through E) contain detailed results developed during the Independent Oversight inspection. Appendix C provides the results of the review of the application of the first four core functions of ISM for work activities. Appendix D presents the results of the review of feedback and continuous improvement processes and management systems, and addresses the related focus areas (implementation of DOE Order 226.1, *Implementation of DOE Oversight Policy,* and injury and illness investigation and reporting. Appendix E presents the results of the review of safety management of the other selected focus area (i.e., implementation of the environmental management system). For each of these areas, Independent Oversight identified opportunities for improvement for consideration by SC, BHSO, and BSA. The opportunities for improvement are listed at the end of each appendix so that they can be considered in context of the status of the areas reviewed.

SC, BHSO, and BSA need to address the individual deficiencies and specific examples contained in these appendices in their corrective action plan for the findings identified in Appendix B of the inspection report. The individual deficiencies and specific examples in these appendices are referenced to the specific findings in Appendix B. The causal analysis, corrective actions, and recurrence controls developed in response to the findings in Appendix B need to fully consider the specific deficiencies and specific examples in these appendices.

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APPENDIX C
Work Planning and Control

C.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight evaluated work planning and control processes and implementation of the core functions of integrated safety management (ISM) at the DOE Brookhaven National Laboratory (BNL).

The Independent Oversight review of the ISM core functions focused on environment, safety, and health (ES&H) programs and work planning and control systems as applied to various BNL facilities and organizations including:

- National Synchrotron Light Source (NSLS), managed by the Light Source Directorate (see Section C.2.1)
- Various research and development (R&D) and facility operation and maintenance activities, managed by various "small science" departments including Energy Science and Technology, Environmental Science, Chemistry, Condensed Matter Physics Material Science Department (CMPMSD), Physics, and Instrumentation Division. (See Section C.2.2)
- Maintenance, managed by Plant Engineering and Staff Services (See Section C.2.3)
- Construction managed by the Plant Engineering Division, the Environmental and Waste Management Services Division, and the Environmental Restoration Project and performed by subcontractors (See Section C.2.4)

Independent Oversight reviewed implementation of the core functions of ISM, observed ongoing operations, toured work areas, observed equipment operations, conducted technical discussions and interviews with managers and technical staff, reviewed interfaces with ES&H staff, and reviewed ES&H documentation (e.g., plant standards, permits, safety analyses). Work activities that were observed at BNL included various R&D experiments, laboratory operations, clean room operations, facility operations, maintenance work, machine shop operations, subcontracted construction, and waste/environmental management activities.

C.2 RESULTS

In addition to evaluating the selected four BNL activities, Independent Oversight also evaluated the collective results of the application of the core functions in the selected areas to identify commonalities. As discussed below, the evaluation of the collective results provides perspectives on the site-wide work control processes.

For many work activities observed by the Independent Oversight team, hazards were adequately identified, controls were established, and workers were aware of most hazards and required controls. A graded approach to work planning and control provided a level of pre-job planning that was commensurate with ES&H risks in most cases. The Work Planning and Control for Experiments and Operations Subject Areas, as delineated in SBMS, and implementing procedures prepared by user organizations, contained requirements and guidance which, when implemented, provided adequate control for most work activities. The knowledge and experience of the BNL workforce contributed to safe work performance. In some cases, where the work control process was deficient, work was performed safely because of the expertise of the workers.

The foundation of an effective ISM system includes a structured means to identify the external and internal requirements that apply to the facilities, conditions, and activities involved and

communicating those requirements through training, departmental procedures, and activity-level documents that ensure effective and compliant implementation. BNL has established the SBMS as the process for setting laboratory standards; for managing requirements from contractual obligations, standards, and regulations from the federal, state, local, and industry entities; and for conveying this information to employees. Institution-level training on a variety of ES&H topics has been developed and provided to staff. In many cases, BNL organizations developed internal operating and administrative procedures to implement the BNL-wide requirements delineated in SBMS.

Evaluation of the collective results identified systemic deficiencies in implementation of the work control processes and assurance systems across a wide range of BNL facilities and organizations. While there are exceptions, the problems discussed below and the associated findings were sufficiently prevalent across the areas reviewed by Independent Oversight to warrant attention at the institutional level and corrective actions on a site-wide basis, to include facilities and activities not reviewed by Independent Oversight on this inspection. These institutional-level concerns are discussed below and reference two findings. Additional observations leading to these findings are addressed in more than one of the areas reviewed. The results section for each of the areas discussed in this Appendix (Subsections C.2.1-4) and the results sections of Appendices D and E include references to the findings, where applicable.

Although many aspects of the processes for establishing and implementing safety controls are well defined and implemented, there are process and performance deficiencies at all levels of the BNL organization (institutional, department, facility/functional area, and supervisor) that contribute to the observed deficiencies in implementation of safety controls and assurance systems at the activity level. At the institutional level, external requirements, management direction and expectations are not always sufficiently defined in the SBMS and other institutional directives. External requirements in 10 CFR 851 for construction hazard analyses and in NFPA70E for lockout/tagout were not clearly identified in SBMS or translated into implementing procedures. Further, some SBMS documents have not been maintained current and have not been subjected to review on the BNL required frequency. Content changes in SBMS documents are not always reflected in linked documents. For example, SBMS contains a number of references to the Chemical Hygiene Plan even though the Plan was rescinded in November 2001. In addition, in some cases organizations have not established internal procedures that describe the roles, responsibilities, and authorities, and provide tailored internal processes for implementing BNL-wide requirements. Additionally where organizational procedures have been developed, they have not always been maintained current with SBMS or subjected to configuration management controls. (See Finding #C-1)

External requirements have not always been properly identified and translated for implementation in SBMS documents and organizational implementing procedures. In some recent cases, Records of Decision (the BNL-wide process and documentation for how new requirements are being implemented by existing BNL documents and identifying needed changes) did not accurately identify gaps and needed actions. In addition, many SBMS documents 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 document into procedures/formal processes. As discussed throughout this Appendix and in Appendices D and E there were deficiencies in the implementation of safety controls for various hazards including cryogens, lasers, lead solder, carcinogens, other hazardous chemicals, high voltage (electrical rated) insulation equipment, and work at elevated heights, as well as deficiencies in implementing assurance systems. (See Finding #C-1)

Many important portions of SBMS are included as non-mandatory guidance. For example, the criteria for categorizing work according to risk and the guidance for establishing appropriate PPE for various hazards are not mandated by the SBMS procedure. Although the Independent Oversight review indicates that the guidance is being followed in most cases, line managers and work planners chose to not follow the guidance in several cases, and the use of guidance in lieu of requirements for important safety controls makes it problematic to enforce line management accountability. Non-mandatory guidance can be an appropriate supplement to a process if accompanied by adequate direction about its use (e.g., requiring a documented demonstration of comparable protection for alternative measures) and the level of management approval for deviation from established guidance (e.g., work planner, facility manager); however, the BNL processes do not include well defined expectations for use and approval of alternative measures when line managers and work planners choose not to follow established guidance. As another example, BNL recognizes that requirements for workplace monitoring and exposure assessments are not fully met and is developing a corrective action plan; however, BNL has not established adequate direction about compensatory actions at the facility level when workplace monitoring and exposure assessments are not yet sufficient for an ongoing or planned activity (e.g., use of a carcinogen such as chloroform or benzene in an operation). (See Finding #C-1)

Also, to accomplish some activities, employees must apply requirements and processes that are contained in numerous SBMS documents, including various exhibits which may contain either guidance or additional requirements. For example, the Work Planning and Control for Experiments and Operations Subject Area contains 20 exhibits and 5 forms and references 67 subject areas. While the use of links to provide additional supporting information or guidance is appropriate in some situations, dispersing requirements throughout multiple links on a particular topic increases the difficulty for employees to identify all applicable requirements. (See Finding #C-1)

Some institutional and facility-functional area-level processes provide insufficient or conflicting direction about required safety controls. As one example, requirements for personal protective equipment for cryogenic hazards are defined and/or communicated to workers through several different mechanisms (including SBMS, institutional training, and facility-level hazard analyses, work packages, and procedures) but these mechanisms sometimes provide conflicting direction (e.g., expectations provided through the training classes are more stringent than other mechanisms). The conflicting requirements can contribute to non-conservative application of controls and hinders line management and worker accountability for implementation of controls. (See Finding #C-1)

At the facility level, particularly for R&D activities, managers and supervisors have not always ensured that established safety controls are implemented by workers. In several cases, appropriate controls were established in ESRs or other work documents but were not being 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. (See Finding #C-2)

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 control. In some cases, the managers/supervisors believed that the controls that

were being implemented were sufficient to ensure worker safety but did not initiate action to reevaluate the hazards analysis and controls and modify the work documents to reflect the "accepted" practices. 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 workers ignoring important safety controls. Additionally, a part of BNL's strategic mission is "to educate new generations of scientists and engineers," and thus it is important to set a good example for visiting students and the scientific community. (See Finding #C-2)

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 contribute to a culture where compliance with requirements is problematic and hinder efforts to hold individuals accountable for ES&H performance. (See Finding #C-1, #D-3, and #D-4)

During the Independent Oversight inspection, BNL management initiated some actions to enhance implementation of safety controls, including a senior management memorandum that clarifies management expectation 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.

C.2.1 NSLS

The National Synchrotron Light Source (NSLS) is a large user facility dedicated to the production and utilization of synchrotron radiation. The synchrotron consists of two electron storage rings, the X-ray ring and the vacuum ultraviolet (VUV) ring, with each ring providing light in different areas of the spectrum (including both ultraviolet and infrared spectrums in the VUV ring). The NSLS operates an extensive user program built around facility and Participating Research Team photon beam lines on the VUV and X-ray storage rings. In a typical year, the NSLS supports 2300 users from approximately 400 university, government laboratory, and industry institutions conducting over 1100 experiments. The NSLS is operated by the NSLS Department within the Light Sources Directorate.

During this inspection, observed work included control room activities, operations coordinator activities and interfaces with users including beam line authorizations, beam line hutch assembly, amplifier preventative maintenance, lockout/tagouts, and beam line experimental activities. The Independent Oversight team also reviewed the NSLS experiment review process including implementation of the safety approval form process; walked down chemical laboratories, shops, material storage areas, and waste storage areas; attended routine operations and users status meetings, and participated in NSLS user training.

Within the BNL-wide Work Planning and Control Management System, control of work at NSLS falls primarily under three "categories" addressed or referenced in the *Work Planning and Control for Experiments and Operations* subject area of SBMS. Experiment review, basic setup, and experiment performance are governed by the *Experimental Safety Review* procedure of this subject area. For other activities, such as complex experiment setup or other unique operations, the *Work Planning and Control for Operations* procedure of this subject area is used, which includes use of work permits. Finally, for control of repetitive or safety significant machine system operations, preventive maintenance, or other similar work, NSLS develops and implements operating procedures in accordance with the *Internally Controlled Documents* subject

area along with associated facility project plans and work schedules. In all categories, the work control process makes provisions for activities deemed low risk to be performed as "skill of the worker" as defined in the current SBMS, or more recently renamed "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, as delineated in SBMS, to the activities at NSLS.

Core Function 1: Define Scope of Work

At NSLS, the scope of work is defined by several methods and depends on the type of work being performed. Experimental work is well defined through the experiment submittal process. Experimental Safety Reviews (ESRs) are required for all users, including NSLS staff as well as visiting users. Initial inputs are provided by the principal investigators in the electronic Proposal Allocation Safety Scheduling system using safety approval forms. The principal investigator inputs to the safety approval forms adequately describe the experiments including identification of materials and expected operations. The safety approval form system requires adequate information and detail to permit effective hazard identification and analysis. The system requires users to include potentially hazardous materials, processes, and equipment, thereby giving an advance notice of potential hazards to NSLS. In practice, safety approval forms for experiments observed during this inspection contained the appropriate user inputs.

The scopes of work for maintenance, complex experiment setup, and machine operations are well defined in work permit requests or approved procedures. The scopes of work for complex experimental setups, such as reconfiguring beam lines or large diagnostic equipment installations, are well documented in drawings, proposals, and descriptions. These documents are subsequently used in the initial planning stages for work permits and provide adequate descriptions of work activities that can be used in subsequent hazard analysis. Machine operations, safety interlock checks, and preventive maintenance on high hazard equipment such as high voltage equipment are adequately described in established procedures.

Scopes of work for most observed "skill of the worker" activities were adequately described in the basic job steps contained in job risk assessments (JRAs) and associated worker qualification matrices, and facility work control coordinators had appropriately screened the work to ensure the jobs did not exceed the triggers for more extensive work planning (work permits or procedures). At NSLS, job risk assessments were comprehensive and provided a base job task analysis by individual job positions and tasks that, along with the appropriate training requirements, are documented in a worker qualification matrix for each worker. The qualification matrices enable supervisors and work control coordinators to adequately define which tasks can be performed as skill of the worker without further documented work planning. Although a recent reorganization has resulted in the computerized worker qualification matrices not being up to date for some positions, supervisors were maintaining written documentation of worker qualifications in those cases, and the matrices were already being updated to reflect the new organizational alignment.

NSLS effectively uses a comprehensive scheduling system for scheduling all work. Because beam time is critical to a user facility, maintenance, project, and beam line schedules are tightly controlled to ensure beam time is available when scheduled.

Core Function 2: Analyze Hazards

Hazards at NSLS are adequately identified and analyzed. NSLS has a formal, documented, stringent experiment review process that effectively integrates safety throughout the process. The

process applies to all users of the beam and is an interactive computer process, making access simple for remote review submitters and safety approval form reviewers. The experiment review process effectively defines the scope of experiments and requires users to include descriptions of all hazardous materials, equipment, or processes being proposed. The NSLS Safety Officer, acting as the safety review committee, reviews each experiment proposal and when necessary, convenes a broader, multi-disciplinary safety review committee for other-than-routine experiments. On the more complex experiments requiring committee review, documentation and hazard analysis are extensive, involving subject matter experts from across the BNL site, supplemented by offsite expertise when needed.

For NSLS work activities meeting the initial screening criteria for potentially moderate or high risk, hazards were effectively analyzed through the work permit process or the procedure review process. Work packages for activities such as beam hutch construction and lead removal were adequately documented, and the associated hazards were effectively analyzed and mitigated. Based on a review of selected operations procedures, operational hazards were effectively analyzed and controlled during procedure development.

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. These processes effectively analyze task risks, determine appropriate training and qualification requirements, and subsequently determine whether the risk following mitigation by existing engineering controls, training, and specific administrative controls (such as lockout/tagout) is acceptable to allow the task to be performed without additional formal work planning. These processes also meet the guidance provided in the *Work Planning and Control for Operations* procedure table, *Screening Guidelines for Work Permit Determination,* specifying pre-analyzed Risk Level determinations (for which activities not exceeding criteria for the low risk category can be performed as skill of the worker). As required by BNL-wide Work Planning and Control Subject Area, work control coordinators are assigned for each NSLS group, and the coordinators were effective in screening work to determine whether work could be performed as skill of the worker or as moderate or high risk work needing additional formal work planning. Overall, the depth of analysis and documentation for skill of the worker activities at NSLS met or exceeded the minimum requirements of the *Work Planning and Control for Operations* procedure and was effective for analyzing the hazards associated with observed operations.

Core Function 3: Develop and Implement Controls

For most radiological (x-ray) and hazardous light (ultraviolet and infrared) activities, NSLS has developed and implemented extensive engineering and administrative controls. Beam hazards are controlled through engineered components and systems such as shield walls, personnel protection interlock systems, and hutch interlock systems. To ensure the engineering controls remain valid, administrative controls, such as work authorization forms for work potentially affecting interlocks and safety approval forms, are used to verify appropriate configuration control of the engineered safety systems. For users, safety requirements are developed as part of the experiment review process, training specific to the beam line is developed, and operations coordinator oversight is established to ensure appropriate controls are implemented before users are allowed access to the beam.

Task-specific controls were adequately implemented in most cases through the qualification process for skill of the worker activities. NSLS staff personnel are experienced, well trained, and knowledgeable of NSLS systems and hazard controls. Staff ES&H training requirements were appropriate for observed work activities. In the sample of activities reviewed by Independent

Oversight, workers had completed required training and were knowledgeable of the systems, activities, and associated requirements.

For higher risk activities, controls were adequately identified and implemented through safety approval forms, procedures, postings, and other related controls. For example, administrative controls for a nitrogen gas powered gun used in an experiment were extensively analyzed in the experiment review and documented on the associated safety review form. In other examples, required electrical personal protective equipment (PPE) for breaker operations and work inside breaker compartments are explicitly listed on each individual breaker. Approved procedures contain step-by-step lockout/tagout instructions for routine maintenance on high voltage equipment.

NSLS provides an effective training program to ensure outside users are adequately trained on facility hazards. As part of user access to the NSLS facility, users must first go through several phases of training directly related to safety. The training consists of computer-based site general employee radiological training (GERT) and facility specific classroom training from an ES&H representative prior to gaining access to the controlled area. In addition, users must complete beam line specific training prior to performing experiments at a beam line, as well as other specific training if warranted by the hazard analysis. For example, several processes are used to ensure facility users and services personnel have had the appropriate training on hazardous waste requirements. The NSLS training required for all users has a section on hazardous waste management. Safety approval forms include a requirement for at least one experimenter within a team to have BNL hazardous waste training when the potential exists to generate hazardous waste. The Beam Line Operations and Safety Awareness Checklist is used to discuss specific requirements with beam users and includes topics on waste removal, satellite accumulation areas (SAAs), and 90-day accumulation areas. Job-specific environmental awareness training read and sign sheets have been developed for the SAA managers and vacuum system maintenance functions.

Several work areas of NSLS are common to all workers, and in some cases, controls for these areas are extensive. For example, controls for user access to the User Machine Shop include a 3-tier training and qualification process for user machine shop activities. The first level of training and qualification is hazard awareness and only allows access to the machine shop. The second level of training is machine specific and provides machine specific operating instructions, hazards, and controls. Qualification at this level only allows machine operation with continuous oversight of a dedicated NSLS machine shop worker. The final qualification is also machine-specific and involves demonstrated competency with machine operations including hazards and controls. All machines in the shop are key controlled, and only users with the highest qualification on a specific machine can have access to the key for that machine.

Although adequate controls have been developed for most operations and hazard control processes are generally effective, a few hazardous activities were not as well controlled. As further discussed in Core Function 4, the Independent Oversight team identified several cases of failure to follow chemical and cryogen handling safety requirements. These instances can be attributed in part to inadequacies in controlling and monitoring some activities in the laboratories and other chemical handling areas in NSLS, including NSLS management and supervisor's tacit acceptance of non-conformance in a few cases. Examples of inadequate or insufficiently defined controls include: (See Finding #C-1)

- A chemical spill event July 2006 resulted in corrective actions to limit or control glass containers larger than one liter within laboratories. The corrective actions from this event were reported as closed in the occurrence report to DOE; however, the Independent Oversight

team found several instances of glass containers larger than one liter without the prescribed controls (plastic sleeves). When questioned, workers, supervisors, and safety professionals had non-conservatively interpreted the controls to be inventory limits for the contents instead of container size as stated in the event analysis and associated corrective actions.

- NSLS management recognized poor performance in the chemistry laboratories in a December 1, 2006 science advisory committee meeting presentation and issued some corrective actions in the *NSLS FY 2007 ESH&Q Improvement Plan*, including development of a roles, responsibilities, authorities, and accountability (R2A2) document for laboratory stewards by February 2007. However, progress in implementing these actions has been slow (action dates have moved several times and the R2A2 document was still marked draft during the data collection phase of this inspection), a process for implementing the roles and responsibilities has not been developed, and non-compliance with chemistry controls is still evident in the laboratories as further discussed in Core Function 4.
- NSLS cryogen controls are conflicting in some cases. For example, the posting at the small dewar filling station and cryogen PPE requirements in the NSLS procedure are less conservative than SBMS recommendations, BNL Cryogen Training requirements, and liquid nitrogen MSDS protective clothing requirements in the BNL MSDS database.
- The NSLS Experiment Safety Review procedure assigns operations coordinators the responsibility for assuring that only approved experiments are allowed to proceed, but only requires the users to contact the operations coordinators when they are ready for enabling of the beam line. Only then does the operations coordinator have a formal process to verify that controls are in place. The experiment review process requires appropriate review of experiment setup hazards and appropriate controls to be in place, but the primary mechanism for line management monitoring of these controls is linked to beam access. While this mechanism is appropriate for the vast majority of the experiments at NSLS, it does not provide a mechanism to ensure that operations coordinators verify controls are in place in for those cases where significant hazards may be present in the experiment set up or in sample preparations.

Core Function 4: Perform Work within Controls

NSLS has implemented adequate systems to ensure appropriate hazard controls are in place before work authorization. For example, readiness and authorization to perform experiments by visiting users is rigorously controlled using the safety approval form and associated approval processes. Final readiness to perform the experiment includes required safety training for users, and final formal authorization by a NSLS operations coordinator (issuance of a key to access the beam) after verifying the controls on the safety approval form have been completed and implemented. (However, see the exception discussed under Core Function 3 in the process for experiment activities not linked to beam access). For work permits, NSLS adequately implements the BNL-wide work control authorization process through the facility-specific work control procedure. Work permits must receive approval from a work permit review committee, be coordinated through the work control manager and responsible work control coordinator, and the workers must participate in a pre-job brief prior to proceeding with the work.

With some exceptions as further described below, workers and users at NSLS performed work safely and in accordance with controls. For most observed work, workers and users followed established controls, requirements, and procedures; used the correct PPE; and prepared the appropriate documentation as required. For example, a Booster Ring 3kW Amplifier isolation, cleaning, and inspection activity was performed safely and in accordance with comprehensive procedures and lockout/tagout requirements. The technician performed the safe work procedure as written, appropriately inspected and donned the required PPE, and performed and documented

the electrical lockout/tagout in accordance with BNL-wide requirements, as delineated in SBMS, and NSLS requirements. In other examples, carpenters assembling a new beam hutch effectively followed controls established in the work permit and in BNL subject areas for specific tasks performed as skill of the worker. NSLS Control Room shift turnovers and operations such as beam line fills were performed professionally and in accordance with established operational limits and administrative requirements. In the beam and vacuum shop areas, the containers in the SAAs were closed and properly labeled; however, some satellite areas contained unprotected multi-liter glass containers, which was not in accordance with NSLS chemical storage requirements (see discussion below). The RCRA-required weekly inspections were being logged and an adequate contingency plan was available for the 90-day area. The required supplies (i.e., spill kit, PPE, and eye wash bottle) were located in the 90-day dedicated storage container.

Although workers and users at NSLS performed work safely and in accordance with controls in many cases, deficiencies in some activities were observed. In several cases, chemical use and storage at NSLS was not in accordance with NSLS and BNL-wide requirements (see CF3 for a discussion on process deficiencies). (See Finding #C-2)

- NSLS has a requirement that glass bottles larger than one liter are not permitted unless enclosed with a protective plastic sleeve or with specific permission from ES&H. Several cases were observed including flammable storage cabinets and satellite accumulation areas where glass chemical containers larger than one liter did not have the required protective sleeves (including 4 liter hazardous waste accumulation glass jugs for flammable materials).
- In one case, NSLS management unofficially allowed users to establish an eating and drinking area within a user laboratory that according to interviews, allowed users to use the area for eating if they stayed on one side of the lab, and kept the chemicals on the other side of the lab. NSLS requirements, BNL-wide requirements, and the postings on the laboratory door do not allow this practice.
- According to interviews, users bringing chemicals onsite to NSLS and using them only for short periods (a few days) are tacitly allowed to not enter those chemicals into the BNL Chemical Management System (CMS) if the users take the unused chemicals with them when they leave. NSLS and BNL-wide requirements state that all chemicals must be entered into the CMS and does not include provisions for transient use of chemicals.
- In several cases observed by the BHSO Facility Representative and the Oversight team, chemical containers were not labeled with a National Fire Protection Association label as required by NSLS procedures.
- In one case, a plastic unlabeled beaker in a hood was observed with a large amount of dried residue in the bottom of the beaker. The residue had flaked up and appeared to have been a result of evaporation of solution over a long period, but was not labeled or readily identifiable.
- In several cases, coffee pots and eating areas were established in close proximity to areas where hazardous chemicals were being used. For example, several soldering stations using lead solder were immediately adjacent to coffee and food areas. In another example, a dirty coffee mug was sitting on the drain area of a chemical sink and in the immediate vicinity of hazardous solvent squeeze bottles.
- In several cases, gas cylinders on the loading dock were improperly secured. When notified by the Oversight team, facility management immediately secured the cylinders.
- Use of required PPE while transferring or using liquid nitrogen was not adequate in all cases. Several researchers were observed working with liquid nitrogen with varying degrees of cryogen PPE, none of which met the most conservative of the varying PPE requirements at BNL. For example, a researcher was observed filling a dewar at the small dewar filling station using only work gloves (partial leather and cotton) and glasses without side shields.

The NSLS cryogen procedure requires a face shield and either cryogen gloves or mid forearm length leather gloves (which is also less stringent than the recommendations delineated in a BNL-wide document that is included in SBMS). In other cases, workers did not follow the BNL training requirements for cryogen handling. According to interviews, NSLS staff perceives the hazard to be similar to boiling water and not requiring extensive PPE. This perception has led to an attitude of acceptance of deviation from established PPE requirements. Independent Oversight also notes that in November 2005, a researcher in NSLS was injured while handling liquid nitrogen without proper PPE, and NSLS issued a lessons learned about this accident.

C.2.2 Small Science

BNL refers to R&D projects performed at other than the major user facilities as small science. To evaluate work planning and control for small science, Independent Oversight sampled a wide range of R&D, operations, and maintenance-like activities in several BNL small science departments/divisions including Energy Science and Technology, Environmental Science, Chemistry, Condensed Matter Physics Material Science Department (CMPMSD), Physics and Instrumentation.

Within the SBMS framework, various work control processes are used to plan and control work for small science activities. The Experiment Safety Review (ESR) and Activity Safety Review (ASR) processes establish the expectations and mechanisms at BNL for defining the work, identifying and analyzing the hazards, developing and implementing controls, performing work safely within controls, and feedback and improvement, in accordance with the Experimental Safety Review procedure of the BNL-wide Work Planning and Control for Experiments and Operations subject area. The ESR/ASR processes are required of all R&D activities and are also being implemented to varying extent for shop like work, such as machine shop and fabrication operations. Operations activities, such as Accelerator Test Facility (ATF) and activities associated with Class IIIb and Class IV laser operations, are performed in accordance with procedures that identify safety controls. Maintenance activities are governed by the BNL institutional work control processes, and are primarily implemented through work permits and JRAs. Within these processes, some routine and low hazard work activities are performed as skill of the worker (now also referred to at BNL as worker planned work).

Core Function 1 - Define the Work

With few exceptions, the ESR and ASR processes have resulted in research and support activity work descriptions that are well defined. R&D activities are well defined in ESRs, work permits, and procedures where applicable. R&D support activities such as instrumentation development are managed through a set of ASRs that are equivalent to ESRs in format. Most ESRs and ASRs have been tailored to the work activity, such that the work activity is adequately described. BNL Small Science currently has hundreds of ESRs and a lesser number of ASRs to describe a wide variety of research and work activities. Scopes of work for "skill of the worker" activities often are rolled into ESRs or ASRs and/or are described in the basic job steps contained in job risk assessments and associated job task analyses for individual workers. Most BNL Small Science operations and laser activities are well defined in BNL procedures.

A few research support activities have limited work definitions in the ESR for the larger activity they support. For example, several of the BNL Small Science laboratory spaces and shops perform occasional ancillary work activities, such as soldering, without a work description

contained in the ESR for the actual research activity. In another example, *Environmental Analysis for Mercury to Assess Deposition from Coal-Fired Electric Generating Plants, ESR 15603 rev. 2, Building 830*, the ESR, makes no mention of work with acidic calibration solutions (some containing levels of mercury greater than normally expected in environmental sample analysis under the experiment). In these few cases, a more rigorous implementation of the ESR process is needed to ensure that work descriptions provide sufficient information to ensure that all hazards and associated controls are adequately identified in the ESRs.

Core Function 2 - Identify and Analyze the Hazards

At the facility level, BNL analyzes facility-level hazards in authorization basis documents. For example, R&D, operations, and maintenance activities conducted in Building 820 Accelerator Test Facility (ATF), which is an Accelerator facility are analyzed with a Safety Assessment Document (10/01/04) and approved Accelerator Safety Envelope document (10/31/04). Facility hazards in other BNL buildings are analyzed or bounded by Facility Risk Assessments, Facility Use Agreements or comparable documents.

With several exceptions, the ESR/ASR processes are effective mechanisms for identifying, analyzing and documenting hazards associated with BNL Small Science research and development work activities. Most ESRs/ASRs reviewed were comprehensive, and were often supported by task specific JRAs. ESRs/ASRs require committee approval before conduct of research, including appropriate ES&H subject matter expert (SME) review and signoff. Scopes of work for skill-of-the-worker activities often are rolled into ESRs or ASRs and/or are described in the basic job steps contained in job risk assessments and associated job task analyses for individual workers.

BNL Small Science research personnel are knowledgeable of the hazards within their BNL small science laboratories and associated research activities. For example, researchers were knowledgeable of the hazards described in ESR CO-MA-1 for laboratories conducting Structure and Function in Electrochemistry & Electro Catalysis research in Building 555. Additionally, a summer intern was knowledgeable of the laboratory safety requirements for applicable tasks (involving working with soil samples potentially containing mercury).

Many BNL research and operational hazards are identified and adequately analyzed in ESRs/ASRs prepared at the division level. For example, under Thermal and Photo-induced Chemistry on Surfaces, ESR CO-7-2, Building 555, lab 127, the applicable ESR includes the major sources of risk in the experiment, identifies hazards, and establishes requisite controls for those hazards identified. Additionally, the chemistry directorate has developed an activity level JRA (JRA18) for this process, which provides additional detail and has been used to validate and augment the existing ESR. Another example includes the Infrared and Optical Studies of the Electronic Properties of Solids, ESR PO2006-045, Building 510, room 1-130, which includes the major sources of risk in the experiment and identifies hazards and establishes requisite controls for those hazards identified. The BNL-wide requirements in the Laser Safety Subject Area for laser operations have been tailored to small science activities; as an example, a comprehensive Standard Operating Procedure (SOP) has been developed by BNL for the Laser Controlled Area specifically tailored to address the Laser Spectroscopy on Surfaces in Building 555, lab 127.

Environmental elements have also been effectively integrated into work planning and controls in most cases. For example, the Chemistry Department uses Facility Risk Assessments (FRAs) and JRAs for service work in shop areas and waste management areas. These FRAs and JRAs included environmental elements along with detailed controls. ESRs typically consider

environmental aspects by including a section on pollution prevention and waste management. All personnel observed in Chemistry that were involved with hazardous waste were required to have the BNL Hazardous Waste Generator Training as part of their annual training. In Printed Circuit Fabrication operations in Building 535, rooms B-114, 116 and 118, ASR 10 includes the major sources of risk in the experiment and identifies most hazards and establishes requisite controls for those hazards identified; however, it does not contain a complete listing of materials in use in the required section (i.e., wastes generated and/or chemicals), which are referenced as hazards elsewhere in the document.

At the research activity level, in some cases, the ESR hazard assessment did not provide sufficient information about workplace hazards such that the appropriate hazard controls could be identified and effectively communicate to the workers. Examples include: (See Finding #C-3)

- *Synthesis of Alanes for Automotive Applications ESR 15403N rev.2* does not analyze some conditions that may result in release of hazardous materials or direct impacts on workers. One such hazard is the potential for loss of inert atmosphere in the glove box where flammable gases/liquids/solids are stored in the presence of pyrophoric materials. The fire safety SME was not included in the review and approval of the ESR.
- *A Novel Approach for Biofuel Generation ESR 18507E rev.1* does not identify the physical hazard of a soldering iron routinely used to prepare copper electrodes. Furthermore, the ESR makes no mention of soldering or the use of lead containing solder and does not differentiate between chemical PPE and that needed while conducting work with a hot soldering iron, (i.e. the worker still wearing their nitrile gloves from chemical preparation activities, was observed conducting soldering potentially increasing skin burn potential).
- *Soft - Matter Chemical Procedures and Instrumentation, ESR PM 2007-74*, includes preparing syringes in a chemical hood using a chloroform solution. The ESR however does not address the injection hazard for these sharps, or provide an analysis of the range of materials that could be contained in syringes.
- *Environmental Analysis for Mercury to Assess Deposition from Coal-Fired Electric Generating Plants, ESR 15603 rev. 2, Building 830*, does not identify hazards and controls associated with vehicular traffic during field sample collection in the ESR, however, based on worker interview, although undocumented, traffic considerations were verbally discussed during sample collection field activities.
- Some lead soldering activities and stations in Building 510, (Rooms 2-81, 3-175, 2-80, and 2-106), have evidence of eating/drinking (e.g., cups, food wrappers) in close proximity to soldering stations creating an additional potential exposure pathway by ingestion. In one location, the technician reportedly occasionally solders for up to 4-6 hours at a time. Only limited airborne exposure samples for lead during soldering have been conducted, additionally the existing sampling data does not have a sufficient description to determine its applicability. ESRs reviewed across BNL Small Science departments do not address: 1) the direct potential for both inhalation and ingestion of lead from soldering and 2) the potential synergistic affects of lead as one of multiple sources of exposure for some individuals. As a result of these observations BNL IH management has issued interim controls in a laboratory wide memorandum designated "High" Importance, which requires the cessation of work with these materials pending substitution of lead free materials and/or appropriate exposure assessment. Furthermore, proposed actions include assessment of work areas for contamination and a requirement to develop a sampling plan and exposure assessment for any replacement materials.

Current BNL small science hazard analysis is impacted negatively by an existing BNL deficiency involving industrial hygiene exposure monitoring. An open Noncompliance Report (NC ID

2744) has indicates that baseline exposure monitoring is still not complete (approximately 25% complete). Although hazard analysis in some areas has not been conducted by direct sampling or through exposure assessment, work with these materials has been allowed to continue with no interim compensatory measures, and management has not provided sufficient direction on compensatory measure or controls. Examples of such activities include: work with benzene and chloroform in Soft - Matter Chemical Procedures and Instrumentation, ESR PM 2007-74, Building 510, room 2, and work with lead solder across all Small Science organizations. (See above examples and Findings #C-1 and #C-3).

Core Function 3 - Define and Implement Controls

With some exceptions, the ESR/ASR processes being implemented within BNL small science have been effective in identifying and documenting many hazard controls using ESR/ASR forms, JRAs, procedures, and work instructions. Engineering controls in most BNL small science research laboratories and facilities are effective in controlling hazards, are well maintained, and are being used as designed. Most laboratory fume hoods ventilation systems were calibrated as required, and posted documentation included photographs of the hood set-up required to meet rated flow. Doors for some BNL small science labs have keycard locks to restrict entry to workers who are not authorized. In a few cases, glove boxes with inert atmospheres were used for handling of more hazardous chemicals. Interlocks and remote systems are routinely used to restrict access and limit exposures at both accelerator and laser facilities. Additionally, hazard communication postings on most BNL small science laboratory doors adequately reflect hazards and points of contacts for research experiments.

In a number of examples, hazard controls have not been adequately identified and/or implemented through ESRs/ASRs associated with BNL Small Science R&D activities: (See Finding #C-1)

- In *Building 815, lab C-2, Synthesis of Alanes for Automotive Applications ESR 15403N rev.2*, the ESR has not established engineering or administrative controls to ensure the glove box remains inert. The ESR establishes hazard controls (administrative, engineered, protective equipment) against flammable gases/liquids/solids and pyrophoric materials including use of an inert atmosphere in the glove box, although no measures are provided to ensure this is adequately monitored and maintained. The ESR also includes a requirement to "keep proper Class D Dry Powder fire extinguisher at hand." The actual location of two of these extinguishers was outside of the laboratory, one located outside of an emergency exit door and the other outside of the laboratory within the corridor, (although approved by fire protection, the exact definition of "at hand" was not apparent at either location). Workers when questioned indicate a call would go to the local fire department, and one individual was not trained on how to introduce the dry powder into the glove box, in the case of a fire while another individual thought a port could be opened. The glove box although relatively new had no existing engineered fire suppression input location. Following these observations, subsequent evaluation by BNL Fire Protection was requested and is currently ongoing, this review has identified some combustible loading not previously considered by line management and division level ES&H support.
- In a few instances, hazard controls contained in ESRs were generically defined (e.g., "consult MSDS," or "use appropriate PPE") and not tailored to the activity as required by ISM. Additionally, some ESRs cross-reference other departmental procedures, BNL-wide subject areas, other ESRs, or industry references (e.g., MSDSs), again without specifically tailoring the controls to the activity.
- For *Soft - Matter Chemical Procedures and Instrumentation, ESR PM 2007-74, Building 510, room 2-106*, the only PPE in use was nitrile gloves and safety glasses. Section III of the ESR

(develop and implement hazard controls) part B (chemical hazards and controls) lists chloroform, a carcinogen, and sets requirements for waste management and handling in a fume hood, but provides no requirements for PPE such as laboratory coats or chemical protective gloves as required by BNL-wide Personal Protective Experiment Subject Area.

- The ESR for *Environmental Analysis for Mercury to Assess Deposition from Coal-Fired Electric Generating Plants, ESR 15603 rev. 2, Building 830*, the effluent vent path for the detector was directed through a tygon tube into an adjacent high bay area; any potential hazard to co-located workers has not been controlled. Additionally, no analysis was available to demonstrate that an evaluation of potential off–gassing was conducted for mercury and/or other hazardous materials/metals, which may be present in roadside soil samples. Additionally, the ESR for this activity references corrosives in Section II (identify hazards); however no controls were listed and section III did not list any chemical hazards.
- In the Instrumentation Division, Machine Shop: ASR-11, Building 535, Independent Oversight identified some equipment with inadequate guarding and, although most small machines were bolted to the floor, a belt sander was not properly secured. Containers of flammable materials (i.e., spray cans of surface lubricants or cleaning compounds) at many locations were not properly stored, including several containers of flammable materials being stored on top of a flammable storage cabinet. No industrial hygiene review of cleanout and maintenance of dust collection systems has been performed although these systems are being used, and access to a fire extinguisher and several electrical shut-offs were blocked by carts and equipment.
- *Soft - Matter Chemical Procedures and Instrumentation, ESR PM 2007-74, Building 510, room 2, Review/Approval Comments,* states "There needs to be surveys of the microwave & RF heater. Also baseline monitoring of benzene & chloroform" and is dated May 30, 2007. Even though work with chloroform was ongoing and based on interview of researcher is a routine activity, this exposure assessment has not yet been conducted, and there is no mechanism to ensure an industrial hygienist will be notified when this work occurs and/or work with these materials was not prohibited pending conduct of the surveys. (See Finding #C-1)
- The BNL-wide Handbook on Chemical Use in Laboratories in the Working with Chemicals Subject Area discourages operations from stocking calcium gluconate, and the BNL Occupational Medical Clinic stocks calcium gluconate and zephiran for onsite treatment of hydrofluoric acid exposure before transport to a hospital. In addition, the documentation from the Manager of the Occupational Medicine Clinic discourages operations from stocking hydrofluoric acid burn kits because employees may think that self treatment is sufficient and calcium gluconate is not the initial recommended treatment. However, several locations using hydrofluoric acid have instituted exposure response plans that may delay adequate treatment. For example, the Instrumentation Division maintains a stock of calcium gluconate for first aid treatment but the current inventory has a manufacturer's expiration date of March 2004. The Chemistry ES&H coordinator informed Independent Oversight that their response would be to ensure an exposed employee is transported to a hospital as quickly as possible based on their understanding that only a hospital can administer calcium gluconate. This position conflicts with information provided through training course slides for CO-Safety-1 dated April 18, 2007, which was excerpted from approved laboratory-wide training materials. Neither approach (i.e., the Chemistry ES&H Coordinator or the training course slides) conform to the initial treatment recommended in SBMS.

In at least two cases, when hazards have changed, the hazard controls have not been re-analyzed. One example was noted at Building 510, Room 1-130, Infrared and Optical Studies of the Electronic Properties of Solids under ESR PO2006-045, where the oxygen deficiency analysis

was based on 50 liters of liquid helium. The analysis indicated catastrophic failure of the dewar will result in a laboratory breathing air concentration barely above 19.5% oxygen. However this calculation and/or Oxygen Deficiency Hazard (ODH) controls were not revised when the amount of liquid helium in the storage dewar was increased to 62 liters. A subsequent re-evaluation/calculation of ODH value following the Independent Oversight teams observation, required the laboratory to be posted and controlled as an "ODH 0" location and requires the researcher to complete ODH requirements that include completion of ODH training prior to being allowed to conduct work in the laboratory with these materials present. In another example; in Building 815, lab C-2, Synthesis of Alanes for Automotive Applications ESR 15403N rev. 2, the ESR does not place upper limits on loading or introduction of new flammable gases/liquids/solids, which are stored in the glove box in the presence of pyrophoric materials. (See Finding #C-1 and #C-3)

Core Function 4 - Perform Work within Controls

Many BNL small science R&D and operations work activities were conducted safely and with the controls specific in work documents. In a number of examples, controls identified in ESRs/ASRs were adequately implemented. Satellite Accumulation Areas, less than 90-day hazardous waste storage areas, and treatment storage and disposal facilities are being operated within RCRA requirements.

On several occasions, BNL personnel were allowed to continue to work when hazards and/or controls were not adequately defined and, in some cases, work was performed outside of established controls. As an example, for work under the Thermal and Photo-induced Chemistry on Surfaces, Building 555, lab 127, workers transferred cryogenic materials, (liquid nitrogen) from a dewar to a detector vessel fill location at or above eye level without the PPE required by the BNL-wide Cryogenic Safety Subject Area, thereby placing workers at risk of potential thermal injury. Workers used a three-foot high stepstool to reach a vessel pour location located at head height with a five liter dewar of liquid nitrogen. The individual was wearing a short-sleeved shirt, and wore only cryogenic gloves and laser safety polycarbonate glasses with side shields as PPE. The SBMS subject area requires the use of a face shield in addition to safety glasses with side shields when transferring cryogens. Additionally, the Cryogenic Safety Subject Area states that "all parts of the body must be protected from uninsulated pipes or vessels containing cryogenic liquids" and would preclude the wearing of a short-sleeved shirt. However, the JRA for this activity only listed safety glasses as the required PPE for this activity. Workers and supervision, when questioned about the lack of additional PPE such as splash aprons or face shields, stated that additional PPE could make the transfer more cumbersome potentially resulting on dropping items which would damage experimental apparatus; however this analysis was not documented. The BNL cryogenic safety committee has been requested by some BNL individuals to relax BNL-wide PPE requirements for certain activities considered as lower level risks; however, no action has been taken to date, and no justification for it being a lower risk has been documented. Such an evaluation is currently underway. Additionally, managers and supervisors appear to tacitly accept existing practices, allowing these individuals to work with less PPE than required by SBMS and work control documents. Line supervision and ES&H support had either observed this activity previously or during this observation and did not stop work or correct the condition. There were no interim compensatory measures to protect worker, such as requiring them to wear long sleeves and long pants (as others in the immediate area were dressed in short pants), to not tuck in shirts where cryogens may become trapped at the waistband, or to implement other face protection. (See Finding #C-2)

In the same location, researchers routinely align a class IV laser by hand during experimental start up each day and as needed during the test runs. The alignments at start up include curtain removal and visual matching of the UV laser source with a visible laser source. During this process, the researcher only used their laser-safety-required polycarbonate glasses with side shields for PPE. One of these individuals wore shorts and both wore short-sleeved shirts. However, the SOP states under the topic of skin protection, "Operators will minimize risk of skin exposure by wearing long sleeves and other skin protection during alignment procedures or when in the vicinity of the UV beams." Additionally, the researcher was wearing a watch and ring on the hand used to focus and or align the beam, contrary to the SOP which states under General Considerations "to reduce accidental reflections, watches, rings, dangling badges, necklaces, reflective jewelry are taken off before any alignment activities." When workers were questioned about these work practices, they were unaware of the provisions in the SOP, potentially exposing them to an unknown increased risk of exposure. (See Finding #C-2)

In another situation, during Infrared and Optical Studies of the Electronic Properties of Solids under ESR PO2006-045, Building 510, room 1-130 the researcher added small amounts of liquid nitrogen to research equipment and conducted liquid helium transfer operations while wearing only safety glasses for PPE and was dressed in a manner that provided potential areas for pooling spilled material (street clothes with tucked-in shirt and the shirt cuffed at the wrist/forearm) and without additional PPE as required by the ESR and/or BNL-wide subject area (including cryogenic gloves, face shield, lab coat). (See Finding #C-2)

During a mercury cleanup in Chemistry, Building 555, hazard controls were not adequately implemented. The work permit was ranked as ES&H Risk level moderate and the walkdown was checked as being required. The walkdown was not adequate to address specific steps. The work was performed using controls from Plant Engineering procedure EP-ES&H-216, *Mercury,* however, the procedure was not included on the work permit as required. One worker was dressed out in the required PPE, which included gloves, chemical suit, and shoe covers; however, the IH monitoring the work wore only a lab coat and gloves. As the work progressed the IH person began conducting more hands on work such as holding the waste bags and then closing them, requiring more protective PPE (such as that required by the work permit and procedure). (See Finding #C-2)

Additional examples of PPE deficiencies include observations at the ATF, Building 820, where a researcher transferred liquid nitrogen in requisite PPE with the exception of safety glasses with side shields under his face shield as required by the BNL-wide subject area. In another observation, in the Soft - Matter Chemical Procedures and Instrumentation experiment conducted in Building 510, room 2-106 under ESR PM 2007-74, a researcher was working at a hood with chloroform (a carcinogen) with only street clothes, safety glasses, and chemical protective gloves, which is not in accordance with BNL SBMS subject area "Working with Chemicals" which also requires lab coats). (See Finding #C-2)

C.2.3 Maintenance

The Plant Engineering Division (EP), within the Facilities and Operations Directorate, is responsible for designing, constructing, operating and maintaining BNL facilities and infrastructure. Key functions within the Division are Operations and Maintenance, Engineering and Construction Services, Infrastructure Management and Energy Management. The Division employees approximately 335 FTEs and has an FY 2006 operating budget of $47.6M.

Maintenance work observed during this Independent Oversight inspection included a re-roofing job on Building 1005S, the de-energizing and lock-out/tag-out of the 1008A substation to gather arc flash data, hoisting and rigging operations to lift and move heavy industrial equipment, craft work in various maintenance shops and machine shops, planning and execution of the replacement of an underground steam line, and a planning walk-down for electrical work in a Dormitory.

Core Function 1 – Define the Work

The Plant Engineering Division requires all work to be governed by the SBMS Work Planning and Control for Experiments and Operations and has established adequate implementing procedures and processes for defining work. Some maintenance activities are defined in operational procedures. Most (Plant Engineering managers estimated about 75 percent) maintenance activities are performed through the skill-of-the-craft provision, which is defined as "the level of proficiency required by the worker to successfully perform the work using existing knowledge, experience, or procedures without direct supervision."

Skill-of-the-craft work is adequately defined and assigned through work orders, preventative maintenance, or work permits. The bulk of skill-of-the-craft work is assigned by work order, described in procedure O&M-MMC-003, *Work Order System.* Procedures are in place to require that skill-of-the-craft work is properly screened to determine the risk level/work permit required before work assignments are made. Work reviewers, work control coordinators, and supervisors use a "Craft Screening Criteria for Work Permit" form to facilitate this process. The form lists typical work functions performed by all crafts and categorizes the work as low, moderate, or high risk. Most work orders defined the work requested in sufficient detail to ensure that supervisors and workers could determine the hazards and establish controls. Most preventative maintenance work is considered skill-of-the-craft. Preventive maintenance work documents contain detailed equipment specific steps required to complete the task including safety related steps such as when lockout/tagout or confined space entry permits are required, per PM procedure O&M-MMC-006. Work Permits are used to ensure proper planning and control for jobs that are rated moderate or high on ES&H risk, complexity, or work coordination. Work Permits are used by requesting organizations and by Plant Engineering as a tool for hazard screening using the checklist on the Permit. The rigor of the planning and control process is commensurate with the level of risk. The project engineer, planner, or craft supervisor are responsible for interfacing with requesters of the work to ensure that all the work elements and field conditions are well defined. A "Screening Guidelines for Work Permit Determination" form is used to facilitate this process. Work permits are not required for use on low-risk skill-of-the-craft work, routine work, or on jobs covered by established work procedures; however, Plant Engineering workers can request work permits or re-screening of tasks categorized as low risk if they believe that there are location hazards, changes at the jobsite, hazards not previously identified, or changes in job complexity issues.

For work observed by the Independent Oversight team, work scope was defined in sufficient detail to support hazard identification and analysis. The Plant Engineering work planning and control process, defined in procedure EP-ES&H-006, *Work Planning and Control System,* provides adequate instructions for defining work. Most work observed during this inspection was adequately defined in work control documents. Walk-downs of the jobs were conducted by supervisors, workers, and facility management to validate the adequacy of work definitions and to participate in identifying hazards. For example, the re-roofing job on Building 1005S was clearly defined in the work package. Following a walk down of the job site, the job was categorized as "Permit Required" because of its complexity and level of ES&H risks. In another example, the

scope of work for material handling activities involving large, heavy uniquely shaped industrial equipment conducted by master riggers was clearly defined on the Work-Order. The work package to de-energize and lock-out/tag-out substation 1008A contained a detailed switching procedure and a one-line electrical schematic showing feed and supply lines. Planning to isolate and replace the leaking underground steam line at Building 830 was well done and well coordinated, and adequately defined by the Supervisor. Subject matter experts from environmental, electrical, radcon, facility management, and Communications participated in the planning to identify hazards and to develop controls.

Core Function 2 – Analyze the Hazards

Plant Engineering has well defined processes to identify and analyze hazards during the early stages of the work control and planning process. For skill-of-the-craft work assigned by work order or by preventive maintenance, work control coordinators, work reviewers and supervisors use a "Craft Screening Criteria for Work Permit" form, based on training and qualification, to determine if the craft can perform the work safety. Work permits contain a hazard analysis checklist, and additional reference information on the checklist items is available in the Plant Engineering work control procedure, including a listing of procedures and subject matter expert contact information for radiation, safety, and environmental concerns that can be used to develop controls for hazard mitigation. For work permits generated by Plant Engineering, the work control coordinator authorizing the permit has the responsibility to ensure a thorough hazard analysis is conducted. The work control coordinator screens the work and determines who is needed for a team review of the work and a walk down of the job site. If environmental issues are possible, the Environmental Compliance Representative is also involved.

BNL organizations issue work requests to Plant Engineering that require work permits as determined by their work control coordinator based on location hazards. On these work permits, the Plant Engineering person assigned to manage the work request (e.g., craft supervisor, project engineer) ensures that the task hazards are properly analyzed and interfaces with the requester on location hazards. The requester or area work control coordinator is responsible for assembling a job site walk down team. Job Risk Assessments (JRA) and Facility Risk Assessments (FRA) are used to quantify risks associated with the work being performed, and to identify hazards and controls for the work. JRAs and FRAs are developed by teams consisting of workers, supervision, and, in some cases, subject matter experts. Building Key Plans are floor plans used to identify and show the location of possible hazards during work planning.

This process was, with some exceptions, effective in identifying and analyzing hazards associated with the work being performed. For example, hazards associated with elevated work on the roof at Building 1005S were adequately identified on the work permit. The supervisor for the project conducted work site reviews and walk-downs to pre-identify the hazards associated with access to and work to be performed on elevated surfaces, and coordinated with facility management to identify facility specific hazards, such as when the weekly test of the roof-mounted site evacuation siren is conducted, and if the roof-mounted exhaust fans were exhausting chemicals or fumes. In other examples, asbestos sampling was conducted in the Heavy Equipment Machine Operator (HEMO) shop to determine the level of exposure during work on asbestos containing brake and clutch components; a comprehensive noise monitoring survey was completed in the Building 555 Satellite Machine Shop and motor pool; and skill-of-the-craft training and qualifications were used by master riggers to identify hazards when lifting and moving two heavy objects.

Although the process was effective in identifying hazards in most cases, the processes were not always implemented with sufficient rigor, resulting in some hazards not being sufficiently analyzed. Examples include: (See Finding #C-4)

- The electrical shock hazard potential has not been evaluated for circuit breaker testing in the 528 circuit breaker test trailer. The tester operates at 50 volts direct current (vdc) or less, at currents exceeding 3000 amps. The contacts connecting the circuit breaker to the tester are not guarded when energized, and the worker is not required by JRA to wear PPE. The JRA identifies arc-flash as a potential hazard and the control simply states that an isolation transformer is installed. A BNL Electrical Engineer and two sub-contractor arc flash calculation subject-matter-experts interviewed during the Independent Oversight inspection indicated that the IEEE Guide (#1584) for Performing Arc-Flash Calculations excludes single-phase ac systems and dc systems. Previous calculations made by an Plant Engineering electrical engineer using the Guide showed the arc flash potential during the testing to be zero. However, the potential for shock hazard at the test voltage and current levels employed during testing has not been analyzed.
- The hazard potential associated with the inadvertent lowering of the #2 and #3 in-ground automotive lifts in the motor pool has not been adequately analyzed. The motor pool Supervisor confirmed that the lifts (two of the five in use in the motor pool) are older and do not have positive stops or locks installed.
- Exposure monitoring has not been conducted to determine if circuit breaker contacts contain Beryllium or if the work areas are contaminated with Beryllium residue. However, the contact fingers on circuit breakers are cleaned in the 528 trailer using gloves, solvent and abrasive cloth; according to the Industrial Hygienist, this practice is acceptable for preventing worker exposure to Beryllium if it were present in the contacts. Also, the manufacturer of most of the circuit breakers used at BNL was contacted during the Independent Oversight inspection and stated that 99% of the breakers they provide to BNL did not contain Beryllium.
- Environmental and health concerns from solvent use in craft shops for work performed as skill of the craft have not been sufficiently analyzed. For example the JRA for pump maintenance identifies solvent usage but does not analyze the health hazards and there is no process for addressing environmental elements for specific work activities so that environmental hazards can be analyzed. (See Appendix E)
- Noise hazards associated with the emergency generator located adjacent to substation 1008A had not been analyzed during job planning. The diesel started as expected when the substation was de-energized, and the resulting noise at the substation made it difficult to hear normal speech. Because of a concern voiced by the Independent Oversight inspector, a subsequent noise survey by an Industrial Hygienist showed noise levels to be over 90 dBA, which exceeds the OSHA standard.

Existing exposure monitoring records were comprehensive in nature and were effective in identifying hazards and controls. However, workplace exposure monitoring, self-identified by BNL as an NTS non-compliance, has historically been reactive, and in most cases was being accomplished on a request only basis.

Core Function 3 – Define and Implement Controls

The Plant Engineering process for defining and implementing controls is established in ES&H procedure EP-ES&H-006, *Work Planning and Control Systems.* Except for low hazard work conducted by skill-of-the-craft, controls developed to mitigate hazards are specified in specific

procedures and work permits. Controls are also specified in JRAs and FRAs, in most cases even for craft work considered low hazard.

Plant Engineering effectively used engineered controls where feasible. For example, engineered controls were used to protect workers from fall hazards and to provide access to elevated work surfaces on the Building 1005S re-roofing job. In other examples, local exhaust ventilation systems installed in the motor pool and HEMO shop meet ACGIH requirements for automotive exhaust applications, are evaluated for proper air flow every three years, and are on an annual preventive maintenance schedule. However, none of the local exhaust ventilation systems observed during the Independent Oversight inspection were labeled or marked to indicate to employees in the work-place or to inspection personnel that the systems had been tested to verify proper operation.

Supervisors, craft lead men acting for the supervisors, and workers effectively applied administrative controls at job sites. Because a previous IH survey showed the two local exhaust ventilation systems installed in the carpenter shop did not meet ACGIH recommendations (1,000 fpm) for escape velocity, administrative controls were implemented to keep unused gate blocks closed and to limit the number of wood-working machines operating simultaneously to keep airborne wood dust exposures below ACGIH recommended levels. Temporary barricades are placed across door and work bay entrances on a daily basis to restrict entrance to the motor pool by unauthorized employees.

Plant Engineering has implemented an aggressive safety equipment inspection program that, in some cases, is more stringent than OSHA requirements. Plant Engineering conducts annual inspections on fall protection equipment and attaches color-coded clips annotated with the date the inspection expires. Specific colors (for example Blue for 2007, orange for 2008) are used to indicate the year the inspection expires. Voltage rated rubber insulated equipment is marked with the date the test was conducted. However, there was some confusion among the workers at the re-roofing job and at the 1008S substation concerning the dates on the harnesses and voltage rated equipment, and they were not certain if the dates were the test date or the expiration date, since the equipment was not annotated to indicate what the date meant. Several of the maintenance supervisors at the job sites voiced a similar concern and indicated that they had observed similar confusion among workers on previous jobs.

Appropriate PPE requirements were specified in most work control documents. For example, appropriate fall protection equipment was identified in work control documents on the 1005S re-roofing job, and voltage-rated rubber insulating equipment were appropriately specified at the 1008A substation. Electrical panels and disconnects, including electrical panels on machine tools, were marked with a generic label indicating that an arc flash hazard is present. BNL is in the process of implementing corrective actions generated during a Type B Investigation of an arc flash accident (April 2006) and in the interim has implemented the posting of panels with generic labels and the use of conservative arc flash PPE for work on or near energized conductors pending the completion of arc flash calculations and proper labeling of the panels.

In most cases, controls were adequate to ensure workers had received required safety training before they were assigned work. Training is based on Job Task Analyses conducted for each craft, and training records for all crafts are on a database readily accessible to supervisors and workers. The Training Coordinator sends e-mail notifications, followed by reminders, to the workers and their supervisors when training is required. A selected sample of training records for mechanics in the motor pool and HEMO shop showed they have completed training in CFC-12 refrigerant recycling and service procedures as required by Section 609 of the Clean Air Act. The

training records of a motor pool mechanic were current (except for fire extinguisher-practical, which is scheduled infrequently during the year).

In several cases, controls were not adequately defined to provide adequate protection from industrial hazards and environmental elements or were not implemented as required. Examples include: (See Finding #C-1)

- Plant Engineering O&M-MMC-003 procedure for Collection and Disposal of Waste Oil does not specifically address requirements for managing halogenated oils as hazardous waste. This procedure requires that the halogenated oil be stored separately but does not reference controls or the procedure for hazardous waste management. The shop has assigned waste service support for assisting in compliance with waste requirements and this person was knowledgeable on the requirements for hazardous waste management. However, the craft worker following the procedure would not know this halogenated oil was considered hazardous thus increasing the potential for mismanaging this specific oil from other oils covered by the procedure. The waste service deployed individual is not required to evaluate O&M procedures.
- Belts and pulleys were not adequately guarded on some machine tools in Building 423 motor pool, Building 422 carpenter shop and Building 555 machine shop as required by OSHA 1910.219, and some of the machine tools in the same facilities designed for fixed location were not lagged down to prevent walking or moving as required by OSHA 1910.212(b).
- The floor accessible electrical outlets in the HEMO shop are not GFCI protected as required by the National Electrical Code and portable GFCIs were not observed being used. However, GFCIs are provided in the motor pool, a similar work environment in the same building.
- The FRA for *Facilities Used for Automotive Repair and Maintenance* does not list flammable materials as a hazard yet aerosol cans containing flammables are stored on an open shelf in the motor pool.
- Specific controls for proper waste management from the use of solvents have not been provided to the shop workers. For example, although the manager responsible for a craft shop had completed the required Hazardous Waste Generator Training, there was no evidence that the manager had provided required waste management training to the craft workers using the aerosol can puncture device. The cap on the aerosol can puncture device in a craft shop was not in place, which is not in accordance with regulatory requirements.
- A tire inflation cage has not been provided in the HEMO shop for repair of medium and large split rim truck tires used on heavy equipment as required by OSHA 1910.177. A 3-bar, heavy gauge steel tire inflation cage installed in the motor pool meets OSHA 1910.177 requirements; however, the JRA for tire changing/repair does not contain a step requiring the use of the tire inflation cage.

Core Function 4 – Perform Work within the Controls

Supervisors and lead craft men acting for the supervisor, conducted comprehensive and effective pre-job briefings or daily shop meetings for the work observed during the inspection. All work observed was assigned by work permit, work order, or preventive maintenance. Workers understood that they could not perform work that was not properly authorized. Supervisors and lead craftsmen were knowledgeable of the hazards associated with the work and the controls that had been established. Supervisors encouraged and workers actively participated in discussing hazards and controls. Supervisors use JRAs at Toolbox meetings, and copies of JRAs were available in the shops or in workers' safety bags.

Most work evolutions were performed safely in accordance with established controls. Workers demonstrated effective procedure compliance, and safety requirements specified in work control documents were followed. Management conveyed an expectation that safety was a higher priority than schedule, and no scheduling pressure was evident. Workers demonstrated appropriate hoisting and rigging practices during the lifting and moving of heavy, uniquely shaped industrial objects, and standard hand signals were used effectively to communicate with the forklift, truck and truck-mounted crane operators. The master riggers inspected rigging accessories as required prior to work being performed to ensure it was properly load rated and in good repair. Multiple controls were established and followed to ensure pedestrian and traffic safety during the off-loading and movement of the laser table into Building 480. An exclusion boundary was established around the re-roofing job at Building 1005S to keep people out of the work area, and compensatory measures were implemented for emergency egress by building employees because it was necessary to barricade the front door to prevent routine or emergency egress into the work area. A review of records showed that a preventive maintenance on an elevator was conducted in accordance with procedures; an electrical lock-out/tag-out was performed by the electrical shop, and the elevator pit (confined space, Class 2A) was sampled by the HEMO craftsman for four gases prior to entry. The pre-job briefing for the Building 830 steam line replacement job was adequate to inform workers on the expected hazards and the required controls before work was authorized to begin, including the change that an electrical outage would not be required as originally expected.

Maintenance workers also wore the appropriate PPE in most cases. Category 4 arc flash PPE was used when de-energizing and performing lockout/tagout at the 1008A 13.8KV substation, mechanics in the motor pool and HEMO shop wore appropriate PPE for the work being performed, appropriate fall protection equipment was worn as specified on the 1005S re-roofing job, and voltage-rated rubber insulating equipment was worn as specified at the 1008A substation.

Although most work was performed within established controls, a few exceptions to the above good work practices were observed, as discussed in the following examples: (See Finding #C-2)

- The master rigger at the laser table work site became engrossed with signaling the truck-mounted crane operator and stepped within fall down distance of the table as it was being raised from horizontal to vertical.
- The synthetic load strap used to secure the laser table as it was being secured to the forklift backrest was not padded to protect it from the sharp radius of the forklift tine as required by procedure.
- Two employees visiting the motor pool violated a highly visible yellow barricade, posted with a "Do Not Enter" sign, to enter the motor pool work area.
- The backhoe operator at the steam line replacement job and the master rigger operating a forklift in central shops and at Building 480 did not wear seat belts as required by the manufacturer. A supervisor incorrectly stated that seat belts were only required when the backhoe was being driven on roadways when in fact the operator's manual for the equipment requires them to be fastened before the machine is started and worn at all times.
- A flammable storage container is not provided in the motor pool for storage of aerosol cans containing flammables in accordance with OSHA standards.

In addition, workers did not always wear specified PPE as required and did not ensure that staged PPE was within test/inspection dates. Examples include: (See Finding #C-2)

- The lead Tower Line man did not wear the specified Category 4 arc-flash protective clothing inside the arc flash boundary established at the 1008A substation when observing the zero voltage check and application of grounding cables.
- The Tower Line workers de-energizing substation 1008A did not wear hearing protection under the arc flash hoods as required.
- A Master Rigger did not wear hearing protection while operating a forklift. Earlier surveys indicated the forklift being used generated noise as high as 91 dBA in some operating modes, and "hearing protection required" signs were posted on all forklifts.
- The Independent Oversight team found a full-body fall protection harness worn by a worker to attach to the Grove aerial lift at Building 1005S to be past its annual inspection date, a full-body fall protection harness stored on the Tower Line crew truck at the 1008A substation to be past its annual inspection date, and four voltage-rated insulated rubber line hoses on the Tower Line crew truck at the 1008A substation to be past their required six month test date. They were last inspected in 2004.

In one case, workers did not work within established electrical safety controls in part because of an incorrect interpretation of an electrical safety code. At the 1008A substation, the Tower Line workers used a hand held proximity tester that was not attached to a hot stick (electrically insulated live line tool) to verify zero voltage at the 480 VAC secondary. The protective grounding cables were attached to the ground buss wearing voltage-rated gloves and then hand tightened using a hot stick. Voltage-rated gloves and category 4 arc flash protective clothing were worn as required. However, the use of the proximity tester was not permitted by procedure. Work specific interpretations for the Tower Line crew have been made by the Laboratory Electrical Safety Committee, the Authority Having Jurisdiction in electrical matters at BNL. The interpretations were issued in the form of a "Record of Decision" but the LESC was reluctant to change the BNL electrical safety standards because of its concern that doing so could lead to misinterpretation by the unique workforce, with the possible result of unqualified persons performing unsafe acts. The Committee views certain work of the BNL Line Crew as similar to that of a utility and subject to the National Electrical Safety Code. The remainder of the work is considered subject to the National Electrical Code and NFPA 70E. One of the interpretations of the Committee is that a zero voltage condition for high-voltage systems (600 volts and above) may be confirmed using a proximity tester on the end of a hot stick, followed by using a hot stick for application of protective grounding before work is permitted. The rationale for using these techniques is that the power levels are often so high that no amount of personal protective gear will permit a worker to safely get close enough to apply meter leads directly to line conductors. However, the Tower Line crew used the proximity tester to verify zero voltage on the 480 volt secondary in violation of procedure, and inconsistent with LESC interpretation. The Tower Line crew supervisor notified the Line crew following this observation that use of the proximity tester was not permitted for work evolutions of this nature. (See Finding #C-2)

C.2.4 Construction

Most construction at BNL is performed by subcontractors managed by various BNL organizations in accordance with the work control process in the Standards Based Management System (SBMS) and in implementing procedures prepared by the managing organizations. Independent Oversight evaluated the following subcontracted construction work managed by the Plant Engineering Division: replacement of an HVAC control and a ground-fault detection panel in Building 463, removal of raised floor tiles in Building 515, Repair and painting the exterior of Building 624, installation of motion detectors in Building 815, installation of cable trays in

Building 928, and construction of an addition to Building 930. Independent Oversight also examined two projects managed by the Long Term Response Action (LTRA) Group within the Environmental and Waste Management Services (EWMS) Division, installation of pipe supports in Building 670 and well drilling at the Brookhaven Airport, and one project managed by the Environmental Restoration Project, refurbishment of an overhead crane in Building 701.

Core Function 1-Define the Work

Most construction activities are adequately defined in work control documents. The scope of construction work is defined in plans and specifications and is broken down into phases or activities in Phase Hazard Analyses and Job Risk Assessments, in which associated hazards and applicable controls are linked to each phase or activity. This breakdown is required by procedures for work managed by the Plant Engineering Division and Environmental Restoration Project. Plant Engineering work was adequately defined work on Phase Hazard Analyses. The Phase Hazard Analyses were required by contract, prepared by contractors, and reviewed by BNL for each inspected construction job managed by that division.

Environmental Restoration Project work to restore the overhead crane in Building 701 was defined in a work procedure, a Job Risk Assessment and the Facility Waste Management Plan. With the few exceptions noted below, this crane work was defined in sufficient detail to support analyzing hazards and establishing controls.

- Neither the Job Risk Assessment (JRA) nor the work procedure described the use of an electric bearing heater that was used on the job. Thus, hazards and controls from the vendor manual for an electric bearing heater were not incorporated into the Job Risk Assessment or work procedure for the job on which it was used and a worker handled the hot heater without heavy gloves as specified by the manual.
- The work control documents for this crane refurbishment did not describe all of the work activities required to perform crane refurbishment in that the removal of asbestos brake shoes and thus the potential health hazards and controls associated with this activity were not identified.

The scope of work managed by the LTRA Group was adequately defined in contracts, drawings, and specifications and was broken down into phases by the construction contractor in a Phase Hazard Analysis. Tasks were described on a JRA and were discussed in daily tailgate meetings.

Core Function 2 - Analyze the Hazards

The work control process in SBMS provides a graded approach for the planning and control of construction activities that enables BNL organizations managing construction work to tailor programs to meet their needs and to apply a level of planning commensurate with risks involved in the work. Most of the construction work reviewed during this inspection was categorized as low risk for which subject area requires a minimum of documentation and requires no Work Permit. Nonetheless, each of the organizations managing this work routinely prepares Work Permits for all construction work. In addition, Plant Engineering procedures require contractors to prepare Phase Hazard Analyses and Environmental Restoration Project procedures require Job Risk Assessments as well as written procedures or instructions for all construction work.

BNL-wide requirements and guidance for application of a graded approach to work planning and control, as delineated in SBMS documents, are not sufficiently rigorous to ensure an appropriate level of planning and control. The BNL-wide Subject Area requires that planned work be assigned a hazard category of low, moderate or high and requires a level of planning and control

commensurate with the assigned hazard category. The subject area requires consideration of three risk factors (ES&H issues, complexity, and work coordination) in assigning hazard categories but provides rating criteria for only one of the three (ES&H issues). Further, the use of the criteria is not mandatory, and the subject area does not explain how each of the three risk factors contributes to an overall rating. The rating criteria were not conservatively applied to the One of the two inspected jobs managed by the LTRA Group. Specifically, well drilling was judged to involve a minimum risk for injury and was classified as low hazard even though a lesson learned discussed at the pre-job briefing involved a severe injury during well drilling which met the criteria for a high hazard classification. (See Finding #C-1)

Industrial safety hazards associated with work managed by Plant Engineering and the Environmental Restoration Project are adequately documented on Phase Hazard Analyses or Job Risk Assessments and these work control documents are used by supervisors conducting pre-job briefings and tailgate meetings. Workers at all inspected construction sites demonstrated an adequate level of knowledge of the industrial safety hazards associated with their work.

Environmental hazards are also adequately identified and analyzed and are integrated into construction work planning. Applicable environmental concerns were identified in Work Permits prepared for each construction job inspected. For example, the Work Permit for refurbishment of the overhead crane in Building 701 appropriately identified environmental concerns for "Oil/PCB Management, Spill Potential and Waste-Radioactive" and the Work Permit was supplemented with a work procedure that specified waste management requirements.

Environmental and industrial safety hazards are adequately addressed in pre-job briefings and tailgate meetings. The BNL work control process as applied to construction relies primarily upon pre-job briefings and tailgate meetings for informing construction workers of hazards. Hazards are described on Work Permits, Phase Hazard Analyses, and Job Risk Assessments, and these documents are used as a source of information by supervisors when conducting pre-job briefings and tailgate meetings. Additionally, hazards are described in work procedures and instructions for Environmental Restoration Projects. In most cases, workers demonstrated an awareness of hazards. This awareness was especially evident for electrical work observed by the Independent Oversight team.

The BNL work control process was not applied effectively to ensure identification and analysis of some potential health hazards. During this Independent Oversight inspection, Plant Engineering work involving potential exposure to welding fumes in manholes, and potential exposure to asphalt fumes during roofing work, was delayed pending further assessment of the health hazards associated with these exposures. This delay was appropriate and conservative but these exposure hazards had not been identified or fully assessed during the planning of this work or before performing similar work in the past. (See Finding #C-1)

Construction contracts assign responsibility for workplace monitoring to construction subcontractors and BNL has relied on its subcontractors to monitor exposures to hazardous materials. However, construction subcontractors have not always adequately understood the requirements for monitoring and monitoring of potential exposure hazards has not always been adequate. BNL did not identify the potential exposure hazards during early planning (before soliciting bids), during review of Phase Hazard Analyses prepared by subcontractors, or during development of Work Permits issued to authorize the work. BNL ES&H representatives involved in the planning of this work were not aware of the potential health hazards associated with welding or asphalt fumes. BSA has not provided sufficient oversight or assessment of subcontractor compliance in this area. The Facility and Operations industrial hygienist

understood the hazards associated with these materials, and the need for monitoring, but was not aware that construction work involving such hazards was to be performed. BNL has assigned primary responsibility for reviewing ES&H at construction sites to the construction subcontractors and BNL Facilities and Operations industrial hygienists do not normally review or inspect construction work activities. Further, these hazards were not identified before performing similar work in the past. (See Finding #C-1)

Core Function 3 – Define and Implement Controls

BNL has included appropriate ES&H requirements in construction contracts. Contracts require construction subcontractors to comply with applicable BNL-wide requirements (e.g., the Construction Safety Subject Area as delineated in SBMS), submit their safety plans to BNL for approval, designate safety representatives, and conduct daily or weekly tailgate meetings. BNL explains these requirements during Pre-Construction meetings and annual Contractor/Vendor Orientation Training and monitors construction work to ensure compliance.

As previously discussed, Work Permits are supplemented with Phase Hazard Analyses and Job Risk Assessments for construction work performed by the Plant Engineering Division and Environmental Restoration Project. The Phase Hazard Analyses and Job Risk Assessments provide adequate mechanisms for defining controls for construction work.

The LTRA Group uses Phase Hazard Analysis, Job Risk Assessments, tailgate meetings, and onsite review of construction activities to ensure that workers understand the hazard controls applicable to their work. Work control documents do not always detail applicable controls when knowledge of these controls is assumed to be within the skill of the craft. However, the LTRA Group had not justified and documented worker skills, as as required by the Work Planning and Control for Experiments and Operations Subject Area within SBMS. (See Finding #C-1)

BNL has effectively used permits for specific hazardous work such as excavations, penetrations and hot work. Digging Permits are adequate to ensure identification of buried utilities prior to ground excavation. Penetration permits adequately control concrete and masonry penetrations to avoid striking embedded utilities. Cutting and welding permits contain appropriate controls and are used when required. However, controls have not been established for other blind penetrations such as drywall, trailer/modular or sheetmetal walls. Such penetrations to avoid striking utilities that may be inside these walls.

Barricades and signs were used effectively to control access to construction sites. All inspected construction areas were properly barricaded to control access. Open excavations were also adequately barricaded. Fire extinguishers are located at construction sites and first aid kits were maintained at construction jobsites as required by contracts. However, emergency vehicle access to the Building 930 construction site was sometimes restricted by parked cars and trucks, and there is no established process to ensure emergency vehicle access to construction sites.

Adequate controls have been established to manage waste. For example, the Environmental Restoration Project has established an overall waste management plan and a lower level specific waste management plan for Building 701 modifications (removal of graphite reactor) that addresses controls necessary for effective waste management. The plan assigns waste management responsibilities to individuals with appropriate waste management expertise.

Controls specified by Work Permits are not always clear and the expectation for compliance was not well understood. For example, when "Lockout/Tagout" is specified as a control, the work

permit typically does not indicate what is required to be locked and tagged or when it must be under this control. Further, this control was described as, "Lockout/tagout procedures and PPE as necessary," on Phase Hazard Analysis forms for three jobs reviewed, indicating that the lockout/tagout was not mandatory. Further discussions with BNL and contractor employees revealed that some regarded controls specified on work permits as mandatory and some did not. The Phase Hazard Analysis forms also did not identify where or when the LOTO was needed. (See Finding #C-1)

Controls specified on Phase Hazard Analyses and Area or Job Risk Assessments are not always sufficiently complete and specific. (See Finding #C-1) For example:

- Electrical hazards are described on Phase Hazard Analyses as "shocks, electrocution, burns" without identifying the location of the hazard, specifying the voltage, or specifying the PPE to be worn for electrical work in Buildings 912, 928, and 914.
- Phase Hazard Analyses and Job Risk Analyses do not normally include specific training required by OSHA, or training required by construction contracts such as NFPA 70E Certification Training and NFPA 70E Briefings, or Building Crane Training.
- Excavation controls such as sloping of sides, hand digging, shoring, and barricading were not specified or referenced in sufficient detail in the Phase Hazard Analysis for installation of a water main to ensure compliance with BNL-wide and OSHA requirements.
- For elevated work on ladders, most Phase Hazard Analyses require "Three points of contact with the ladder at all times." This is not always possible when performing work while standing on a ladder and was not always followed. OSHA requires three points of contact only when ascending or descending.

Lockout/tagout programs in SBMS and in BNL-approved health and safety plans are not fully compliant with NFPA 70E. For example, neither the lockout/tagout procedure in SBMS, nor the Environmental Restoration Project (ERP) lockout/tagout procedure, requires each person who could be exposed directly or indirectly to a source of electrical energy to be involved in the lockout/tagout process as specified by Section 120.2(B)(1) of NFPA70E, Section 120.2(B)(1). These deficiencies contributed to an inadequate lockout/tagout during refurbishment of the overhead crane in Building 701. In this case, a member of the facility staff installed his tag and lock on a circuit breaker in another building and briefed the crane service contract workers who disconnected electrical leads from the crane's power control panel. Although the crane service contractor observed that the locks and tags were in place, and witnessed the "zero voltage" verification, he did not install his own lock and tag. This lockout/tagout was not in accordance with any of the three procedures permitted by NFPA. The "Individual Qualified Employee Control Procedure" permitted by NFPA 70E, Section 120.2(D)(1), was not applicable in this case because the disconnecting means was not adjacent to the equipment on which work was performed. The requirements of a "Simple Lockout/Tagout Procedure" permitted by Section 120.2(D)(2) were not met because the crane workers did not install their locks on the disconnecting device. The requirements of a "Complex Lockout/Tagout Procedure" permitted by Section 120.2(D)(3) were not met because no written plan of execution was established. No other lockout/tagout procedures are allowed by NFPA 70E. (See Finding #C-1)

Further, some BNL-approved, contractor lockout/tagout procedures do not comply with NFPA 70E. Plant Engineering construction contracts (Special Condition 21D) require lockout/tagout programs that meet OSHA but not NFPA requirements. The contractor lockout/tagout procedure for work observed in Buildings 815, 928, 463 and 930 met OSHA requirements but did not meet NFPA 70E in that it did not address the three types of lockout/tagout procedures specified by Section 120.2(D) of NFPA 70E or the elements of planning and control specified by Section

120.2(F). A contractor used a "tic-tracer" to verify the absence of voltage following a lockout/tagout in Building 928 instead of using a "properly-rated and listed voltmeter," which was the approved voltage testing device required by NFPA 70E and specified by BNL-requirements. Use of the tic-tracer was permitted by the contractor's BNL-approved lockout/tagout procedure. (See Finding #C-1)

Annual audits of lockout/tagout programs were performed as required by NFPA 70E and OSHA. However, as discussed in Appendix D, these audits did not fully comply with OSHA requirements and were not effective in identifying the above problems. (See Finding #D-3)

Some construction contractors have not yet established an occupational medical examination program as required by 10 CFR 851. BNL is aware of this issue and is working with contractors to resolve it. (See Finding #C-1)

Core Function 4 - Perform Work within Controls

BNL has established adequate processes for authorizing the start of construction work. ES&H subject matter experts are appropriately involved in issuing initial authorizations to proceed. The BNL Work Permit serves effectively as a work authorization control document.

With a few exceptions, BNL has effectively used meetings, training, and review/inspection of work activities to provide construction workers an understanding of required controls:

- BNL emphasizes the importance of complying with ES&H requirements during pre-bid and pre-construction meetings to ensure construction contractors understand ES&H requirements and expectations.
- BNL has closely monitored construction activities and has provided appropriate guidance and direction to ensure that contract workers understand and follow ES&H requirements. Knowledgeable representatives from the Plant Engineering Division, the Environmental and Waste Management Services Division, and the Environmental Restoration Project are effectively reviewing and inspecting construction activities managed by these organizations. A specialist from Plant Engineering inspects heavy construction equipment before it is used on site and effectively reviews and evaluates rigging activities.
- Pre-job briefings and tailgate meetings are conducted as required. Controls were adequately addressed during briefings and meetings attended by the Independent Oversight team.
- Most ES&H training requirements have been effectively implemented. Construction contracts require that workers read health and safety plans, attend BNL orientation training, and attend weekly tailgate meetings. In general, these requirements have been met by BNL contractors with a few exceptions (one subcontractor manager acknowledged that his employees had not read the entire health and safety plan, employees of another subcontractor were not aware of a BNL-wide requirement to test GFCI receptacles before use, and one worker who had attended BNL orientation training did not remember the phone number to call in an emergency).

Although most industrial hazards are addressed, some ES&H requirements from 10 CFR 851 that are applicable only at DOE sites are not adequately addressed. These include requirements to comply with ACGIH Threshold Limit Values to control exposure hazards, electrical safety requirements in NFPA70E, and the occupational medical requirements of 10 CFR 851. (See Finding #C-1)

Appropriate PPE was worn for most work observed by the Independent Oversight team. Fall protection requirements were met for work on the bridge of the Building 701 overhead crane and areas below the bridge were properly barricaded to protect people from falling objects. Hard hats, safety glasses, and safety shoes were consistently worn by workers at all sites visited. Electricians wore PPE that was more conservative than required by NFPA 70E while performing a lockout/tagout in Building 815. Conservative PPE was also worn during replacement of a control panel in Building 463.

In some cases, workers properly performed tasks even though work control documents did not provide adequate direction. For example, a construction subcontractor plumber installing pipe supports in Building 670 performed this work safely using proper PPE and controlling the depth of drilling to less than three inches to reduce the risk of striking embedded utilities even though work control documents for this work did not identify the tasks, hazards, or controls for drilling holes in concrete. In another example, contractor electricians properly performed an electrical lockout/tagout for installation of motion detectors in Building 815. Work practices and PPE met or exceeded NFPA requirements even though work control procedures did not specifically describe these controls. Workers were instructed on applicable ES&H controls by their supervisors during performance of the work.

However, a few examples of unsafe work practices were observed. Workers removing the elevated floor tiles in Building 510 were standing on the concrete floor beneath the tiles and were stepping on wires. The wires were insulated but their electrical status was unknown. The workers understood that the work could be accomplished more safely by standing on the raised tiles instead of the floor below, but they elected to stand on the floor below to expedite the work. The wires included power cables and two open junction boxes contained power cable connections. The electrical hazards beneath the floor tiles were not characterized. Work practices were changed when potential hazards were identified by the Independent Oversight team. Another unsafe condition involved the storage of tools and loose parts on a make-shift shelf on a scissor lift at the Building 930 construction site. This practice increased the risk of dropping objects onto people below the lift. The condition was promptly corrected. In one case, two sheet metal workers handled sheet metal with sharp edges without wearing gloves. These unsafe practices are at least partly attributable to weaknesses in management efforts to ensure that safety controls are followed. (See Finding #C-2)

C.3 OPPORTUNITIES FOR IMPROVEMENT

This Independent Oversight inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management organizations, and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

Institutional

1. **Revise BNL-wide subject areas, as delineated in SBMS, to ensure minimum requirements are easily identified**. Specific actions to consider include:
   - Develop and revise subject areas using a method to easily distinguish between information, guidelines, and minimum requirements.

- Standardize requirements within subject areas. Consider use of a limited set of action verbs similar to those used in technical procedures. Reference DOE-STD-1029-92, "*Writer's Guide for Technical Procedures*" for further information.

2. **Continue improvements in the Work Control subject area**. Specific actions to consider include:
   - Ensure requirements are established for documenting the level of worker-planned work within each directorate.
   - Ensure use of the terms "hazard" and "risk" are in accordance with standard industry definitions.
   - Establish a set of requirements (not guidelines) that provide the minimum set of ES&H criteria for each risk level of work planning.
   - Ensure the concept of "worker-planned work" tasks is addressed within higher risk jobs or complex activities.

3. **Develop and implement a BNL-wide program to ensure strict compliance with requirements**. Specific actions to consider include:
   - Communicate management expectation for strict compliance with procedures and other safety requirements (i.e., "follow or fix")
   - Enforce the use of PPE and ensure that PPE is within its inspection/test date.
   - Improve the work-place inspection process to ensure that industrial safety type hazards are identified and mitigated.

NSLS

1. **At NSLS, increase management attention and enforcement of a minimum set of safety standards for chemical use**. Specific actions to consider include:
   - Supplement the R2A2 for chemistry laboratory stewards with a process to qualify users of chemical laboratories. Consider use of similar qualification and access control mechanisms already established in the user machine shop.
   - Define a specific minimum distance from areas where chemicals are used for eating or drinking areas. Increase enforcement and oversight of user eating and drinking policies.
   - Define and enforce minimum PPE requirements for the various activities using cryogen. Ensure PPE postings match minimum requirements.

Small Science

1. **Revise the BNL Experiment Safety Review (ESR) and Activity Safety Review (ASR) processes as necessary to improve the quality and comprehensiveness of the reviews.** Specific actions to consider include:
   - Improve the quality of some ESRs and documentation of actual controls, to include more tailoring to the specific activity and avoiding boilerplate statements such as "see MSDS" or "use appropriate PPE".
   - For work performed by procedures, ensure that hazards and requisite controls have been identified in either the procedure or an accompanying JRA and are consistent with subject area requirements in SBMS.
   - Establish specific hazard controls in lieu of requiring only "good practices." Verify that hazard controls are clearly linked to the hazard for which the control is intended to

mitigate. Avoid listing hazards by entire class (e.g., chemicals or acids) if only specific conditions (e.g., hydrofluoric acid) exist.

- Document the requirements for ES&H subject matter expert involvement, the extent of their involvement, and the conclusions and recommendations provided.
- Review hazard checklists in "equivalent versions" to ensure potential hazards are not missed.
- As part of initial development and the annual review cycle, compare hazard controls outlined in ESRs/ASRs to BNL-wide requirements and update the ESRs/ASRs to reflect BNL-wide requirements at a minimum.

2. **Re-assess the hazards, and controls associated with BNL machine shops, and shop-like activities within Small Science.** Specific actions to consider include:
   - Review the work activities within each shop to verify that the hazards are identified, controls are appropriate and documented, and good housekeeping is practiced.
   - With the assistance of ES&H subject matter experts, identify, quantify, and document the potential exposures of workers to the variety of hazards presented during routine shop work.
   - Consider issuing work hold points to ensure appropriate monitoring for activities identified without a current and adequate exposure assessment.
   - Establish a mechanism for researchers to notify the Industrial Hygiene Office in advance of conducting activities where initial or additional exposure monitoring is needed.

3. **Conduct a review of all ESR/ASRs in use for research and operational activities to identify situations where skill of the worker tasks and activity associated hazards and controls are not documented in ESRs/ASRs and/or associated JRAs.** Identify activities where work practices (i.e., work considered as skill of the worker or procedures unidentified in ESRs, ASRs or JRAs), do not contain sufficient identification of hazards and requisite controls to meet BNL-wide and DOE work control expectations.

4. **Revisit options to provide treatment for dermal exposure to hydrofluoric acid to ensure they are adequate to protect employee health.** Specific actions to consider include:
   - Establish procedures to ensure inventories of calcium gluconate and zephiran (at any/all locations maintaining an inventory of these materials) are replaced before the manufacturer's expiration date.
   - Ensure employees working with, or in close proximity to, hydrofluoric acid are provided with unambiguous instruction on the unique first aid requirements for exposure as specified in the MSDS and how and when to seek treatment if exposed.

5. **Implement a process to periodically capture and share lessons learned or other feedback from long term activities performed under ESRs and ASRs.** Specific actions to consider include:
   - Enhance requirements to request feedback/lessons learned on ongoing research projects on a periodic basis (e.g., quarterly), with a focus on adequacy of hazard identification and associated controls.
   - Document informal feedback/lessons learned received verbally or by other means.
   - Establish consistent procedures to evaluate feedback/lessons learned to determine applicability to other projects, departments, and/or directorates and share information as appropriate.

Maintenance

1. **Continue to improve the quality of the JRAs and FRAs to effectively quantify the relative level of risk associated with work at the activity level, and to adequately identify hazards and to establish controls**. Consideration should be given to placing the documents in a required reading file when issued initially and when revised.

2. **Label local exhaust ventilation systems to readily indicate to workers and inspection teams that they had been tested at regular intervals and determined to meet appropriate exhaust velocity requirements**.

3. **Proceduralize the interpretations of electrical safety codes made by the Laboratory Electrical Safety Committee to define the work practices and personal protective equipment that is required for specific work activities to provide clear, concise and consistent directions for the Tower Line crew.**

4. **Annotate the inspection/test expiration date on personal protective equipment such as fall protection harnesses and voltage rated rubber insulated equipment to readily indicate to workers if the PPE they are using is within the current inspection/test date.**

Construction

1. **Improve the flowdown of ES&H requirements in 10 CFR 851, Appendix A to construction contractors**. Specific actions to consider include:
   - Revise SBMS subject areas and implementing procedures to require preparation of activity hazard analyses as required by 10 CFR 851, Appendix A, for all construction work, regardless of hazard category.
   - Establish a schedule and milestones to ensure that contractors establish occupational medical programs as required by 10 CFR 851 in a timely manner.
   - Add conditions to construction contracts that specify how the worker safety and health requirements in 10 CFR 851, Appendix A, are to be met. Tailor the contract requirements to the work to be performed.
   - Ensure that construction safety requirements in SBMS subject areas and 10 CFR 851 that may be unique to DOE work, such as ACGIH Threshold Limit Values and NFPA PPE and lockout/tagout requirements are emphasized during pre-construction meetings and Contractor/Vendor Orientation Training.

2. **Revise lockout/tagout procedures.** Specific actions to consider include:
   - Consider revising lockout/tagout requirements in the SBMS subject area to use terminology and procedures similar to the terminology and sample procedure in NFPA 70E.
   - Involve electrical SMEs in the review and approval of contractor lockout/tagout programs.

3. **Strengthen BNL review of potential health hazards associated with subcontracted construction.** Train BNL ES&H representatives on potential health hazards associated with construction and provide guidance on when they should request IH support.

4. **Strengthen the work control process for construction.** Specific actions to consider include:
   - Develop an institutional procedure to specify appropriate precautions and controls for performing blind wall penetrations other than concrete.
   - Revise BNL procedures as necessary to require consideration of hazards and controls listed in tool vendor manuals in the development of Phase Hazard Analyses and Job Risk Assessments.
   - Clarify expectations for complying with controls specified on Work Permits. Consider changing work permits to better link tasks, hazards and controls.
   - Revise construction contracts and procedures to better describe the level of detail and specificity expected in the documentation of required controls on Phase Hazard Analyses and Job Risk Assessments. Specify the PPE and training required (including that required by NFPA 70E) for performing specific tasks.
   - Develop a process for ensuring accessibility of emergency vehicles to construction job sites.
   - Consider changes to policies, procedures and staffing to provide a more proactive review of planned and ongoing construction by BNL industrial hygienists.

DRAFT

APPENDIX D
Core Function #5 – Feedback and Continuous Improvement

D.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight evaluated DOE Federal and contractor feedback and improvement processes at Brookhaven National Laboratory (BNL). The Independent Oversight Team examined the following areas:

1. The DOE Headquarters Office of Science (SC) feedback and improvement processes, including issues management, corrective action tracking, headquarters oversight/assessments, technical qualifications, and lessons learned. (See Section D.2.1.)
2. The Brookhaven Site Office (BHSO) feedback and improvement processes, including assessments, issues management, corrective action tracking, technical qualifications, Facility Representative (FR) Program, and Employee Concerns Program (ECP). (See Section D.2.2.)
3. BNL contractor – Brookhaven Science Associates (BSA) – feedback and improvement processes, such as assessments, corrective actions and issues management, injury and illness investigation and prevention, lessons learned, ECP, and activity level feedback processes. (See Sections D.2.3)

For each of the organizations above, Independent Oversight examined applicable institutional, facility-level, and activity level feedback and improvement programs and processes, with primary emphasis on their application to BNL facilities and organizations reviewed on this inspection (See Appendix C). Independent Oversight interviewed SC, BHSO, and BSA personnel, and reviewed various program documents and assessment reports.

D.2 RESULTS

D.2.1 Office of Science Headquarters Feedback and Improvement

SC is in the process of developing and implementing the *Office of Science Management System (SCMS),* which is web based communication tool that provides SC personnel with ready access to SC reengineered processes and procedures. Modeled after the Standards Based Management System (SBMS) used at BNL and some other national laboratories, SCMS is designed to flow down from 18 management system descriptions (currently 11 are approved and issued, 5 are in draft, and 2 are not yet drafted). Three management system descriptions that are important to BHSO oversight (e.g., Environment, Safety and Health; M&O Contracting; and, Quality Assurance & Oversight) have been issued. However, most of the implementing procedures (that support the management system descriptions) are not yet developed.

SC has issued a Functions, Responsibilities, and Authorities Manual (FRAM), which closes a (CATS# SLAC-01/17/07-I0007-0001-A) corrective action item from a previous (January 2007) Independent Oversight inspection of an SC site – the Stanford Linear Accelerator Center (SLAC). As part of other corrective actions associated with that inspection (CATS# SLAC-01/17/07-I0007-0002-A), SC has committed to fully implement an SC oversight process with a planned closure date of April 1, 2008).

As indicated in the SLAC inspection, SC does not currently have documented processes in place at Headquarters to adequately implement a number of important ES&H-related functions

including Operating Experience/Lessons Learned, ECP, 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. The SC Chief Operating Officer (COO) advises that these procedures are being developed by SC Teams with the participation of the Integrated Support Center (ISC) and membership from around the SC complex and are scheduled for completion by the end of CY07). Independent Oversight's review indicates that significant progress has been made in developing the needed procedures since the January 2007 review of SLAC.

SC has ensured that there are several mechanisms and frequent opportunities for the SC senior managers to maintain operational awareness of BHSO and BNL contractor activities to support informed decisions at headquarters. There are numerous examples of the SC COO and some Headquarters personnel being engaged in operational awareness and actively supporting evaluations of site and contractor ES&H performance (i.e., telephone conference calls, document reviews, quarterly safety reviews, program/project reviews, and official travel). Communications between the SC COO and the BHSO Manager are generally robust and effective.

SC is making progress in improving the oversight of contracts. SC issued its SC Laboratory Performance Appraisal Process on June 16, 2007. SC also issued specific direction/guidance on the development, review and approval of Performance Evaluation and Measurement Plans (PEMPs), Annual Assessment Plans, Annual Assessment Reports, and Annual Contract Performance Evaluations, as well as guidance for the joint annual SC Performance Evaluation Meeting with the responsible Site Office Manager, appropriate SC Program Associate Directors, other DOE Headquarters representatives, major customers, and the Director of the Office of Science. Key deliverables (e.g., PEMP, Performance Report, Fee Determination) of these processes are reviewed (both at the site office and at Headquarters) and are approved by SC-1.

SC does not have a Training and Qualification Program (TQP) in place to ensure that SC Headquarters personnel are trained and qualified commensurate with responsibilities (in accordance with DOE O 226.1A, DOE M 360.1-1B, and DOE M 426.1-1B). In an April 2, 2007 memorandum to the ISC and Site Office Mangers, the SC COO issued the *Technical Qualification Program Manual* and directed its formal implementation at SC sites having Hazard Category 1, 2, and 3 nuclear facilities. The Manual lists scope as follows:

> "This TQP applies to Federal technical employees whose positions require them to provide management direction and oversight that could impact the safe operations of a nuclear facility. In addition, Site Managers have the discretion to use this program to meet the requirements of DOE Order 226.1, *Implementation of DOE Oversight Policy,* to establish and maintain qualification standards for personnel with oversight responsibilities."

The SC COO advised that the TQP Manual would be implemented in the field first, and Headquarters would be addressed at a later date. The manual addresses most directive training requirements. The implementation of the manual (in the field) is a good first step, however, headquarters training and qualification also needs management attention.

The SC FRAM is the mechanism by which SC-1 delegates safety functions, responsibilities, and authorities to subordinate headquarters and field organization personnel. Contrary to Deputy Secretary of Energy direction provided in a memorandum entitled, *Delegations of Safety Authorities*, dated December 27, 2005, SC does not have a formal process that details how safety management responsibilities are delegated. The Deputy Secretary directed that "Delegating officials shall establish a documented process or procedure to ensure that delegations are made carefully and accurately, consistent with the process criteria and attributes defined here." A

response to the Deputy Secretary's memorandum was expected by January 31, 2006, but SC did not provide the required response. SC did, however, take action to remove safety management responsibilities from SC Site Office Managers (due to the lack of required training) and re-delegated these responsibilities to the SC COO. (See Finding #D-1)

D.2.2 Brookhaven Site Office Feedback and Improvement

In the past year, BHSO has worked aggressively to develop and implement the: 1) BHSO Functions, Responsibilities, and Authorities Manual, dated August 2007; 2) Environment, Safety and Health Management Plan, dated July 2007; 3) Integrated Safety Management System Program Description, dated July 13, 2007; and 4) Quality Management Plan, dated July 18, 2007. These documents form a foundation for an adequate oversight program and when fully implemented should satisfy most feedback and improvement expectations.

There are numerous mechanisms for effective communications between SC headquarters and BHSO. These include regularly scheduled weekly and monthly telephone calls between BHSO managers and their headquarters counterparts, Quarterly Safety Reports, the Contractor Performance and a Fee Determination Presentation, the Annual Performance Plan, the Annual Performance Report, and other such mechanisms.

While a number of recent BHSO actions and initiatives are appropriate, as discussed in this section, 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.

Contract oversight. BHSO procedures (BHSO-ADM-10, *Contractor Performance Based Management Procedure*; BHSO-ADM-22, *Performance Assurance Procedure*; and, BHSO-ADM-08, *DOE Directives Process*) are sufficiently detailed and adequately describe the roles and responsibilities for implementing the process. PEMPs are prepared, reviewed (at both BHSO and SC Headquarters), and approved in accordance with the listed procedures. The PEMP includes satisfactory ES&H criteria (objectives and performance measures) and appropriate weighting for ES&H elements. BSA provides annual performance input to BHSO which is forwarded with the BHSO annual performance evaluation to SC Headquarters. The BHSO Site Office Manager (SOM) presents the annual laboratory evaluation to SC-1. SC-1 is the Fee Determining Official. On a tri-annual basis BHSO reviews BNL input, and prepares/presents tri-annual "stoplight" and brief narrative feedback to BNL.

New requirements are managed in accordance with the applicable procedure and are being included, as required, during next contract modifications. For example, DOE Order 210.2, *Corporate Operating Experience Program* contractor requirements document was issued in June 2006, and was included in the next BSA contract modification.

Although generally an adequate process, a few areas needing improvement were observed in the implementation of the contract performance evaluation process. The second tri-annual feedback report to BSA (February – May 2007) has not yet been completed and is currently about two months late in part because BNL was three weeks late providing input (which fell into time reserved for the preparation of the FY08 PEMP). That annual report was subsequently transmitted to the contractor on September 12, 2007. During the first tri-annual feedback, a non-technical individual evaluated BNL input and provided feedback on the Occupational Medicine functional area. BHSO plans to correct this situation (i.e., use a safety and health professional to evaluate the area) for subsequent tri-annual feedback reviews. The basis for the "green"

evaluation of contractor training and qualification is not based on a BHSO assessment or series of operational awareness entries, and a review of the BSA self-assessments of the area was not documented by the evaluator.

Assessments. BHSO has prepared a risk based multi-year assessment schedule, and has determined the required periodicity for most assessments based on either the risk model or, if applicable, a directive driver. Directive drivers have been identified in some cases. BHSO has recognized a need for and requested assistance in preparing for and conducting assessments. Accordingly, the ISC has provided assessment support and performed some third party reviews for BHSO.

BHSO has not developed all elements of an adequate baseline assessment program in accordance with DOE Order 226.1A. The spreadsheet block identifying the last time BHSO conducted an assessment (for a given functional area) is often blank (the assessments may not have been performed or were not located). Some weaknesses in the assessment area were self-identified by BHSO and are being resolved. Some others include that BHSO missed two directive required assessments, specifically:

- Periodic configuration management assessment (for Category 1, 2, and 3 nuclear facilities) in accordance with DOE Order 420.1B.
- Periodic contractor training assessment (using DOE-STD-107O-94) in accordance with DOE Order 5480.24A.

The technical quality of BHSO assessment reports varied significantly. In some cases, there was insufficient report detail (i.e., BNL Offsite Response Interfaces, EMS Desk Assessment, and Program Administration & Emergency Response Organization). Another report (Fire Protection Program) took over three months to be issued and sent to the contractor. In other cases, documentation of required correspondence (delivering assessment, or delivery or approval of the corrective action plan (CAP) was incomplete (i.e., 2006 Radiological Protection, BNL Offsite Response Interfaces, EMS Desk Assessment, Program Administration & Emergency Response Organization, and Contractor Assurance System). Some letters delivering assessments to BSA requested performance of causal analysis, but extent of condition determinations were rarely requested. (See Finding #D-2)

Self-Assessment. BHSO has prepared a risk based, multi-year self-assessment schedule. An annual Program/Oversight self-assessment is conducted, and results in numerous corrective actions that are improving BHSO processes and oversight.

Procedure BHSO-ADM-14, *Self-Assessment,* is limited to the description of the Operations Management Division (OMD) annual year-long self-assessment. No direction is provided for the accomplishment of "topical" self-assessments (i.e., FR program, ECP, Emergency Management, etc.). BHSO has not determined the required periodicity for self-assessments based on either the risk model, or if applicable, a directive driver. As a result, self-assessments have been missed in the past (i.e., FR Program annual, and ECP program annual). Directive drivers for self-assessments have not been identified. None of the "last performed" blanks have been filled in and out-year scheduling has not been accomplished. BHSO self-assessment planning missed two directive required self-assessments, specifically:

- Integrated Safety Management/Operating Experience annual self-assessment in accordance with DOE Order 210.2.
- Federal training periodic self-assessment in accordance with DOE Manual 360.1-1B.

BHSO does not have a corrective action tracking system or procedure in place to effectively track self-assessment corrective actions to closure. Assessments Leads are responsible for tracking findings and concerns to closure, but have not always done so (i.e., BHSO ES&H Oversight Program Self-Assessment, and the BHSO ISM self-assessment). The periodic self-assessment of the FR program did not result in a corrective action plan (CAP) being developed. The BHSO Integrated Safety Management self-assessment resulted in a less than adequate CAP (corrective actions were not specific, are not likely to adequately address the identified deficiencies, and do not specify required completion dates). (See Finding #D-2)

Issues Management/Corrective Action Tracking. Most BHSO Lead Reviewers interviewed demonstrated an adequate knowledge of corrective action status for contractor assessments.

Although the Office of Science never required its use, some issues management, some corrective action tracking, and some closure validations were captured in the Office of Science Management Actions and Tracking (SMART) database. Due to frustrations associated with the use of the SMART database, BHSO decided to establish most of the SMART database capabilities (other than the integrated assessment scheduling portion) in a local database. BHSO has developed and has just begun to implement (direction to begin populating the module was given on August 29, 2007) an assessments and corrective action tracking module as part of its OMD database. The Independent Oversight team observed informal training on the new assessments/corrective action tracking module (content not formalized in a BHSO procedure).

BHSO has decided to curtail entries into the SMART database for everything other than populating the Integrated Assessment Schedule. Several BHSO personnel stated that they no longer make entries into the SMART database as it is not user friendly, training has been limited, support from the ISC has not been adequate, and it does not support trending. Because of such concerns, BHSO decided to transition from the SMART database; however, they transitioned from SMART before developing and implementing equivalent capabilities at BHSO. Also, BHSO decided to begin using the new assessments/corrective action tracking module before developing and approving a procedure for its use. Closure validation of BNL corrective actions are not adequately documented in the SMART database, and the new capability is just beginning. Therefore, closure validation (the documentation of objective evidence reviewed supporting closure) is less than adequate. With regard to the Issues Management Module of SMART database: 1) issues are not being adequately followed and tracked to closure, and 2) there is no formal process to manage or utilize the data. (See Finding #D-2)

Facility Representative (FR) Program. The BHSO FR Program is satisfactory, with a few exceptions.

BHSO does not have a separate stand alone procedure that governs FR activities and adequate guidance for FRs is contained in several procedures including: BHSO's *Facility Representative Qualification and Training Procedure* BHSO-OA-13, and procedures BHSO-OA-01 *Conduct of ES&H Assessments* and BHSO-OA-02 *Conduct of ES&H Surveillances and Walkthroughs*.

According to the FR Performance Indicator data for eight quarters (2005-2007) BHSO exceeded the goal for overall contractor oversight time of 65 percent, but FRs were consistently below the 40 percent field time goal established for conducting plant walkthroughs, surveillances, and other activities. BHSO personnel indicated that this shortcoming was due to the assignment of significant collateral and programmatic duties to meet office requirements and the relatively small size of the site office.

All six FRs have good experience and strong technical backgrounds. Based on walkthroughs with a number of fully and interim qualified FRs, they are highly motivated, have good knowledge of what is important to safety, and demonstrated their personal interest in and commitment to implementation of their responsibilities in their assigned facilities. Most of the FR surveillances (done as a result of walkthroughs with Independent Oversight team members) were of good technical quality and fully captured team observations. Verbal and written communication to BNL management was good. FRs have unencumbered access to facilities by formalized written agreements.

The quality and openness of communications between BHSO FRs, Subject Matter Experts (SMEs) and managers is a good practice. The Weekly Issues and BNL Facility Status Updates were of appropriate technical quality and serve management needs. Distribution includes all senior management in BHSO. Effective communications and the reporting processes have improved the BHSO oversight program. The small office size facilitates close and frequent communication between FRs and all levels of staff and management.

BHSO has been effective in dealing with attrition to maintain full staffing by recruiting, hiring, and qualifying two highly qualified and experienced FRs. Additionally, FRs that were previously qualified as FRs (at other DOE sites) enhance the present BHSO FR program by bringing new perspectives, additional methods, and experience with other sites.

Qualifications and re-qualifications of all BHSO FRs are current and in accordance with DOE-STD-1063-2006, *Facility Representatives*, and the BHSO procedure. The two interim qualified FRs recently completed this program in less than one year. The BHSO Manager, Deputy Manager, and Director, Operations Management Division all conduct periodic operational awareness tours with FRs. All involved personnel reported benefits of the program. The BHSO Manager advised the tours enhanced his knowledge of the facilities, the work going on, and any issues necessitating further communication to BNL management. However, the current BHSO procedure for FR re-qualification does not fully conform to DOE-STD-1063-2006, because it permits latitude for extending re-qualification intervals in excess of the standard allowable constraints.

Although the program was acceptable overall, Facility Representative Qualification Records in some instances were not complete (i.e., Independent Oversight was unable to determine the date some qualification cards were issued). There is no central records system for maintaining these records and record retrieval in this area is difficult because separate files are maintained in different locations. One FR did not re-qualify in accordance with the DOE Standard requirement of three years between re-qualifications (re-qualification actually exceeded 4.5 years). BHSO has not performed a FR Staffing analysis as described in DOE–STD-1063-2006.

Operational Awareness. Positive aspects of BHSO operational awareness (e.g., FR feedback, periodic meetings) were identified previously in this report. The BHSO Operational Awareness database has not been fully implemented and is not currently an effective tool for shaping the BHSO oversight program. Some informal training on the SMART database was performed for BHSO personnel. Training consisted primarily of familiarization of the database. BHSO subsequently decided (due to support issues, inability to support tracking, and lack of user friendliness of the system) to develop and implement a local capability, the OMD Operational Awareness Database. BHSO recognized the importance of tracking and trending, and justified and hired a qualified individual to accomplish this work. BHSO has developed basic metrics and intends to start reporting OMD database metrics in the OMD Weekly Report. The OMD

Database SME has migrated approximately 80 entries from the SMART database (since May of 2007 when he assumed this position).

Although all FRs and SMEs are expected to make regular Operational Awareness database entries (Procedure OA-23, section 4.3, and annual performance evaluation elements), few of these individuals have made entries in the system. Procedure OA-23, *OMD Database Usage*, dated July 26, 2007, does not provide sufficient information to provide a clear understanding of roles, responsibilities, and authorities for the various databases (i.e., no direction on grading of deficiencies; no information on how deficiencies identified are to be communicated to the contractor; no information on how tracking or trending is to be conducted or communicated; and, inadequate information on what is to be included in closure notes). The BHSO ES&H Oversight SME is charged with performing data analysis to identify trends. Data collected to date is insufficient to support a trending analysis and limited analysis or trending has been accomplished. (See Finding #D-2)

Employee Concerns Program (ECP). The BHSO ECP meets the requirements of DOE Order 442.1A, *Department of Energy Employee Concerns Program*, with some exceptions. These exceptions were, in large part, identified by a 2007 BHSO self-assessment. Corrective actions were developed and implemented, including re-issuance of the current ECP procedure. Remaining open items are being tracked to completion. Some of the specific deficiencies included closure reporting, the identification of tracking and log keeping inadequacies, no assessment of the BNL ECP program and a lack of an annual self-assessment. Both the annual self-assessment and the BNL assessment have been added to the draft 2008 assessment schedule.

This program is relatively small with only a total of eight concerns being processed over the past two years. There were no ES&H concerns.

The ECP master files were reviewed for accuracy and completeness. There were no active files or pending cases. One past complex case was handled effectively by BHSO. Records are properly maintained in locked files with good controls. A unique date identifier exists for each file. Confidentiality is maintained both in files and electronic records. Correspondence in preparation is also maintained in a locked file.

The current ECP Manager/Coordinator has not received any formal ECP specific training. He has held this position for four (4) years and is qualified and experienced in handling E&SH issues.

Postings were observed in various locations and work spaces providing good visibility. BHSO and BNL use a combined poster to advertise this program. All BHSO staff contacted were aware of the program and the identity of the ECP Manager. There is active involvement of the Deputy Site Manager in the BHSO ECP, which enhances the overall effectiveness of the program. Training records indicated that ECP training was provided for BHSO staff in June 2007. The last previously documented training, however, was in December 1999.

A check of the ECP hotline phone off hours indicated there was no message specifically identifying this phone as an ECP line. BHSO promptly corrected this weakness.

Technical Training and Qualification. BHSO intends to implement a "graded approach" of the *Office of Science Technical Qualification Program*, as promulgated by the SC COO because of impending plans to downgrade the remaining nuclear facilities at BNL. There are plans to downgrade the only remaining Hazard Category 3 nuclear facility (the Waste Management

Facility) to a radiological facility by the end of the year. The Brookhaven Graphite Research Reactor (BGRR) and the High Flux Beam Reactor (HFBR) will experience periods (less than 90 days) at the Hazard Category 3 level in coming years.

BHSO has not performed the periodic review of training and qualification as required by DOE Manual 360.1-1B, *Federal Training Manual*. BHSO-ADM-03, *Brookhaven Site Office Training,* does not address roles and responsibilities for training record retention and maintenance of the official training records. Although the BHSO training procedure requires the Training Coordinator to prepare and forward an annual training needs assessment to the ISC the Training Coordinator advises that this action has not been performed. The Independent Oversight team was later provided a budget authority document that was presented as evidence of a "needs analysis." The document provides information on funding but does not represent a "roll-up" of Individual Development Plan (IDP) training needs. The BHSO procedure requires the retention of a copy of personnel IDPs in a file at BHSO, but this action is not accomplished. Instead, IDPs are created electronically, and are reviewed and approved by BHSO supervisors on-line (this alternative action is not addressed by the procedure).

The SC Management System Description (MSD) for Human Resource Services indicates that it is a Integrated Support Center (ISC) responsibility to provide Human Resources Services (including training needs assessments, training plans, and training reports) for BHSO. MSD supporting directives remain in draft. Directive required needs assessments, training plans, or training reports (specific to BHSO) may not have been completed for FY 2007 and previous years. There is evidence (BHSO Staffing Plan, dated April 1, 2006; and, Office of Science-Chicago Office Human Capital Management Plan, dated Fiscal Year 2007) of some needs analysis (i.e., skill gaps, critical hires). No evidence was provided of completion of the IDP "roll-up" needs assessment, annual training plans, and annual training reports, which are required by DOE Manual 360.1-1B, Chapter 1, paragraphs 4.a., 5.a., and 3.b. respectively.

A new office procedure BHSO-OA-22, *Subject Matter Functional Area Qualification and Training*, was approved during the data gathering phase of the Independent Oversight inspection. Although the development of a procedure is a positive step, weaknesses in the new procedure included insufficient: 1) designation of Qualifying Officials; 2) definition of record handling/retention roles and responsibilities; 3) coordination with ISC necessary to ensure directive required needs analysis, training plans, and training reports are completed; and, 4) requirements for periodic self-assessment of training program.

Lessons Learned/Operational Experience Program. BHSO approved and issued procedure BHSO-ADM-23, *Lessons Learned*, on August 16, 2007. Previously, some limited sharing of lessons learned occurred in BHSO without a formal process being in place (i.e., OMD distributed Operating Experience bulletins and alerts as they came in, and lessons learned were discussed at staff meetings).

The new BHSO lessons learned procedure is not fully implemented and is inadequate to implement the roles, responsibilities, and authorities required by DOE Order 210.2, *DOE Corporate Lessons Learned Program*. BHSO-ADM-23 does not require an annual self-assessment in accordance with the order. The BHSO FY 2007 Contractor Assurance System assessment did not review all of the criteria and responsibilities of DOE Order 210.2 even though the contractor requirements document from this order had been incorporated in the BNL contract months earlier. (See Finding #D-2)

BHSO FEOSH. The FEOSH program is in most ways adequate. BHSO has established a FEOSH committee that meets regularly (about monthly) to discuss FEOSH issues and concerns. The annual walkthrough of Federal spaces was accomplished by BHSO in August 2007, and several deficiencies were identified. There were no injuries or illnesses reported to site medical by BHSO personnel, so no investigations were required. The FR/SME who performed the walkthrough is qualified by experience to conduct the walkthroughs.

There is no checklist or procedural direction on methods for accomplishing the annual walkthrough of Federal spaces (i.e., what to look for). The results were documented only by email. Corrective actions were developed, but not captured in a formal tracking program.

Quality Assurance (QA). The BHSO Quality Management Plan, in most cases, is compliant with DOE Order 414.1C, *Quality Assurance*. One notable exception is in records management. BHSO has defined a Document Control System and a Records Management Coordinator. Each Division is tasked to implement the requirements outlined in the Quality Management Plan. Throughout the inspection, BHSO had difficulty locating and providing documents and records. BHSO has self-identified the need for an electronic capability to capture quality assurance records (i.e., assessment reports, required correspondence, corrective action plans, etc.) and make them readily available in a central location. The Quality Management Plan states that BHSO has a designated Document Control Coordinator; however, it is not clear that any one individual performs this function or that an adequate process for coordinating the document maintenance function has been established.

D.2.3 BSA Feedback and Improvement Systems

BSA has established and implemented the safety assurance elements defined in DOE Order 226.1 that are contributing to safer conditions and 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. However, insufficiently and inconsistently defined requirements and processes for these assurance system elements; numerous and fragmented approaches employed by line organizations to implement institutional requirements and management expectations; and insufficient rigor and oversight in the implementation of assurance processes are limiting their effectiveness in driving substantial and continuous improvement in safety performance. 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. However, 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 also identified substantial weaknesses in line and support organization feedback and improvement processes and implementation. A longstanding approach of independent organizational processes to address BNL and DOE performance requirements and expectations and limitations on access to organization issues management data continue to hamper effective BNL-wide data analysis and program performance evaluation. Institutional level contractor assurance activities at all levels have been insufficient to ensure effective implementation of safety programs and accountability for performance. Although recent safety management assessments have resulted in many corrective actions to strengthen safety assurance programs and performance and other initiatives are being implemented to address identified deficiencies and weaknesses, many of these efforts are ongoing and have not yet achieved the needed improvements.

Assessments. BSA has established and implemented a comprehensive tiered self-assessment program and conducts many ES&H related assessment activities. These assessment activities include corporate level reviews, internal independent assessments, management system assessments and support organization self-assessments, and line and institutional management reviews, self-assessments, and workplace inspections. However, weaknesses in management expectations and institutional processes and deficiencies in program implementation by line and support organizations hinder the assessment program's effectiveness in identifying safety program and implementation deficiencies.

The processes and requirements for assessment and inspection activities are defined in SBMS program description, subject area, and procedure documents. The Integrated Assessment Program and Management System documents describe requirements for organization self-assessments and annual reviews of performance and for Management System self-evaluations by system stewards. The Quality Management Office develops an institutional assessment schedule identifying institutional level self-assessments, internal independent assessments, and external assessments, including DOE assessments. Line and support organizations develop self-assessment plans and schedules and conduct annual reviews reflecting analysis of performance against the objectives and measures established in their self-assessment programs as well as performance data from external sources and identify needed improvement actions and input to the subsequent years self-assessment planning.

The Quality Assurance Program description and the Management System for Quality Management specify an independent assessment function for the Internal Audit and Oversight (IA&O) Office. IA&O conducts approximately 15 safety related assessments annually. With some exceptions, these independent assessments were rigorous, addressed pertinent, risk prioritized topics, and were well documented. Several assessments consisted of detailed work observations, which were conducted with participation by senior Laboratory managers and were similar to the work observation activities performed by this Independent Oversight team. Results of independent assessments are input to the BNL issues management tool (i.e., Assessment Tracking System or ATS) and managed to completion in accordance with the institutional procedure.

BSA has also submitted to external reviews and received registration of its Environmental Management System in accordance with International Organization for Standardization (ISO) Standard 14001 and its Occupational Health and Safety Management Program in accordance with (OHSAS) Standard 18001. The Operations Risk Committee of the BSA Board of Directors also provides periodic review of safety performance at BNL.

Physical condition inspections of facilities and work areas are governed by the ESH&Q (Tier 1) Inspections subject area and associated procedures, part of the Worker Safety and Health Management System. Each line organization is required to conduct periodic inspections of all work areas for ESH&Q vulnerabilities on a quarterly basis. Office spaces are inspected annually. Some organizations have written internal procedures for Tier 1 inspections and have developed checklists to aid inspectors. Deficiencies are to be documented, addressed in a timely manner, and tracked to completion. With some exceptions, organizations are conducting these inspections and identifying and correcting physical condition deficiencies to create a safer workplace.

BSA has recently initiated an institutional level planning and performance management process that consists of an annual cycle of analysis and planning linked to development of a long range Laboratory Strategic Plan and an Annual Laboratory Plan that establish performance measures and targets based on budget, input from the BSA board, the DOE contract Performance

Evaluation and Measurement Plan (PEMP), and the results of evaluations performed by line and support organizations. This comprehensive planning process addresses achieving excellence in ES&H and security as well as other BNL focus areas (advancing science, attracting talented personnel, modernizing infrastructure, improving quality and reducing costs, fostering stakeholder relationships). Key elements of this process include development of annual business plans for each organization to flow down institutional objectives and targets and annual organizational management performance reviews that provide input to the next planning cycle. Periodic progress reviews to the institutional plans and the PEMP are conducted during the year. The FY 2007 Annual Laboratory Plan identified eight ES&H objectives including revitalizing ISM, transitioning to a culture of injury prevention and upgrading and sustaining facility authorization basis documents and associated processes. Seventeen targets were identified to achieve these objectives. Although the annual management reviews conducted by each organization are not always sufficiently rigorous in analyzing feedback information, these reviews provide an effective tool for organizational level performance analysis and provide input for a composite view of BNL-wide performance.

In early 2006, BSA initiated a safety observation program to be conducted by the top three levels of management (down to division/office managers). This "no name, no blame" program, piloted in the Facilities and Operations Directorate consists of managers, with support from organization ES&H personnel, observing work activities and interacting with personnel in the workplace with the goals of identifying safe and unsafe work conditions and behaviors, improving communications between employees and management, and demonstrate and communicate management's expectations and commitment to safety. This observation program provides an effective forum for feedback from employees to management and communication of expectations to workers and results in a better understanding of working conditions, safety requirements, and processes by managers.

Over the last few years the SC Integrated Service Center, the Chicago Operations Office (which was responsible for BNL until the SC reengineering effort), BHSO, BSA, and contractors have conducted various targeted assessments of the safety management programs of the Laboratory. These reviews included: a multidisciplinary task force BSA self assessment in 2004; an assessment by the Chicago Operations Office and BHSO in August 2004; a December 2005 readiness review of ISM conducted by contractors and peers from other national laboratories in anticipation of this Independent Oversight inspection; a 2006 institutional level self-assessment of ISM at BNL; and a July 2007 evaluation of the BSA contractor assurance system conducted by contractors, BHSO, ISC, and peers from other national laboratories. The 2005 ISM review and resulting analysis identified a programmatic deficiency in feedback and improvement at the institutional level. In addition to developing and implementing corrective actions for specific organizational and institutional issues, analysis of common deficiencies from these assessments identified five broader problem areas. These problem areas included ineffective institutional level self-assessment, corrective action management, and feedback and improvement processes; work planning and control and corrective action/issues management processes that were not achieving Laboratory goals and objectives; deficiencies in procedures; and inadequate understanding and responses to ES&H issues. Further causal analyses of these areas were conducted and additional corrective and preventive actions were identified. Because of the many and varied issues and actions, BSA identified an ISM/Safety Improvement Project Organization and managed the resolution of the issues using formal project management methods. The BSA Board and BHSO have been periodically apprised of project status and a formal project plan has been updated and maintained by an assigned project manager. This formal issues management approach has provided assurance of continuing progress, timely change management, and coordination of efforts to address these complex issues.

Notwithstanding the many assessment activities performed at BNL and recently established improvements in processes and management expectations, as discussed in the following paragraphs, there remain many deficiencies in assessment processes and in implementation that are hindering the effective evaluation of processes and performance and in identification and effective resolution of ES&H program deficiencies.

The BSA assessment program is not adequately defined in SBMS documents: (See Finding #D-3 and #C-1)

- Although the Quality Assurance Program Description and the Quality Management System Description state that the independent assessment requirements of DOE Order 414.1C and 10 CFR 830.120 are implemented through the Integrated Assessment Program Management System Description, there is no associated supporting subject area or procedures for this management system providing details of how independent assessment is performed or how it is part of the "integrated" assessment program. Expectations to develop an institutional level assessment plan and schedule are not identified in SBMS documents.
- Although an attachment (exhibit) to the Integrated Assessment Program Subject Area identifies "required" assessments, this list does not include all assessments that are mandated by external standards, such as confined space permit reviews (which are reflected on SHSD self-assessment plans for FY 2006 and FY 2007).
- In the case of lockout/tagout, BNL provided (in FY2006 and FY2007) information (i.e., a checklist to be completed by "all" organizations) that does not include some elements (performance of the inspection of procedures and interviews with authorized and affected employees) required by OSHA 29 CFR1910.147. Although the lockout/tagout subject area of SBMS requires this inspection, neither the line organizations nor the BSA subject matter expert are performing these inspections. Further, the scope of the inspection specified in the SBMS documents is not in compliance (less conservative) than specified by OSHA regulations and interpretations. Additionally, the responsibilities and requirements for development of this "required assessments" attachment are not detailed in the SBMS documents.
- The Integrated Assessment Program Subject Area and procedures do not establish or define standard designations for classifying assessment results (e.g., findings, concerns, observations, opportunity for improvement). As a result, BNL organizations use various terms to identify safety issues, hindering implementation of the issues management program and performing uniform significance classification and prioritization criteria for the management of safety issues.

Line and support organizations are not adequately conducting effective self-assessments of safety program implementation. The planning, scheduling and performance of self-assessments are not in accordance with the requirements specified in SBMS documents. Line organizations are inadequately identifying work processes and safety risks and are not appropriately prioritizing self-assessments. Very few structured internal self-assessments of ES&H functions, processes, and activities are performed by line organizations (e.g., assessments that are formal, prioritized, planned, criteria/requirements based, and documented). Management systems (e.g., assessment, issues management, lessons learned, or work control) are not being evaluated. Most "self-assessment" plans and schedules developed by organizations include or take credit for assessments performed by external organizations such as the Safety and Heath Services Division (SHSD), IA&O, or DOE. For example, 47 of 50 listed "self" assessments (including business, security, and science related assessments) for one major organization for FY2007 were external and only one ES&H-related self-assessment was scheduled to be performed by that organization's

personnel. For FY 2007, one major line organization scheduled only four ES&H related self assessments in addition to their Tier 1 inspections and the annual management review; one of which was required to meet environmental management system requirements, two of which were Integrated Assessment Program "required" assessments of lockout/tagout and interlocks that consisted of completing surveys reported to SHSD subject matter expert, and one of which was an emergency plan drill. (See Finding #D-3)

Some BNL assessment activities are not being performed in a rigorous manner or completed in a timely manner, and issues are not being input to tracking systems or acted upon. Organization self-assessments often lack sufficient rigor. With the exception of the Tier 1 inspection results, no issues that required corrective action tracking have been identified by assessment activities in one science directorate at least for the past year. That organization also did not develop the required organizational performance objectives, appropriate measures/assessments, or schedule of assessment activities for the annual self-assessment to Laboratory Critical Outcomes for FY 2007, as required by the SBMS and subject area for Integrated Assessment, Procedure 1. (See Finding #D-3)

The focus of management system owner self-assessments has been on the SBMS documents and the safety program without sufficient verification of implementation in the field by line and support organizations. In many cases, assessments relied on surveys completed by line organizations rather than direct reviews of records and field observations by subject matter experts. The FY 2006 SHSD assessment of the BNL Chemical Hygiene Plan conducted in July and August 2006 was not issued until April 23, 2007 and the corrective action plan was not entered into the Assessment Tracking System (ATS) until July 24, 2007--11 months after the completion of the assessment. The findings from the 2006 SHSD assessment of injury and illness investigations were not put into ATS (family or institutional) or acted upon. The multi-topic industrial safety/hygiene programs self assessment performed by SHSD in 2006 addressing lead, compressed gases, bloodborne pathogens, confined space, heat stress and lockout/tagout was not issued until September 25, 2007, and the identified issues have not yet been input to the action tracking system or acted upon by BNL. (See Finding #D-3)

Tier 1 physical condition inspections are performed to standards or methods specified by each organization. In most cases, although the subject area and procedures in SBMS do not require their use, inspection checklists have been developed by each organization without direction/guidance from the institutional subject area owner or SBMS documents. Often, the checklists are not used and when used the different content makes collective trending difficult. The number of physical condition deficiencies identified by this Independent Oversight team and BHSO operational awareness activities and the number of repeat findings in some directorate inspections does not reflect a consistently rigorous inspection program. (See Finding #D-3)

The suggested frequency exhibit of the ESH&Q Tier 1 Inspection Subject Area specifies that mechanical equipment areas are to be inspected semi-annually, once by the building occupant and once by Plant Engineering. However, Plant Engineering has identified over 275 of these rooms and only inspected nine of them in 2006 and only six are scheduled for inspection in 2007. BSA staff stated that many of these rooms are known to have numerous deficiencies, but BNL management has not held personnel accountable for inspection and correction of deficiencies, in part because of inadequately delineated responsibilities and ownership, use of these spaces by multiple organizations, and insufficient management oversight.

BNL attempted laboratory-wide trend analysis of Tier 1 inspection findings in CY 2006, but the effort was discontinued, at least in part because of incomplete data input. Although inspection

results are typically included in year-end organization management reviews, there is typically no analysis of the data or evidence that adverse trends or unacceptable levels of certain deficiency types have been identified or that any change in inspection focus or directed actions have been identified.

Although the BSA independent assessment organization's assessments of line performance were typically thorough, evaluations of organization self-assessment and issues management processes conducted in FY2006 did not identify the performance deficiencies and discontinuities with BNL-wide requirements, as delineated in SBMS, in these areas such as those discussed in this appendix and Appendix C. (See Finding #D-3)

Management of Safety Issues. The requirements and processes for managing safety issues, as well as abnormal events, is detailed in the *Events/Issues Management* subject area and associated procedures as part of the Management System of Quality Management in SBMS. The ATS database provides an adequate tool for tracking and managing issues to completion. The Integrated Assessment subject area procedures specify that "corrective/improvement actions" resulting from organization and management system self-assessments must be managed in accordance with the events/issues management subject area. The ATS is comprised of an institutional level module and numerous "family" level modules made available for individual organizations to manage issues related to their activities if they choose to employ this tool. The data contained in the institutional level ATS is accessible to any BNL employee. Issues management data maintained at the family level are only accessible to persons given specific access by the organization. Organizations may make any or all issues in their family ATS public (i.e., allowing access to any BSA employee). Line and support organizations used various methods to track issue resolution, including a family ATS, internal databases, direct notations on assessment or inspection documents, or less formal means including logbooks, electronic mail, or verbal/telephone notification of responsible parties.

Input to the institutional ATS is closely monitored and controlled by a Quality Management Organization gatekeeper who ensures that requirements are met and inputs are of appropriate quality before entry into the database. The SBMS documents and the ATS include provisions for causal analysis, recurrence controls, extent-of-condition, verification of closure, effectiveness reviews, and change management. They provide adequate instructions and mechanisms to document and manage the disposition of issues identified as pertaining to the Laboratory at the institutional level. Institutional level ATS corrective action data reviewed by Independent Oversight were sufficiently timely and appropriate.

BSA has established a generally adequate process and tool for managing and tracking corrective actions for events and "institutional" safety issues identified by external parties or the independent oversight organization. However, the requirements for managing issues identified by line and support organizations are not adequately detailed and management of those issues is inconsistent and often lacks sufficient rigor, with inadequate documentation, analysis for causes and extent of condition, and recurrence controls. Document processes and requirements in SBMS do not provide sufficient detail for effective management of all identified safety issues at BNL. Examples of SBMS weaknesses include the following: (See Finding #D-4 and #C-1)

- The Integrated Assessment subject area procedures only specify that BNL-wide issues or concerns identified through management system self-assessments, "should" be tracked in the institutional level ATS.
- The Integrated Assessment subject area procedures for conducting annual performance reviews and self-evaluations are silent about managing any identified improvement actions or areas needing further management attention.

- The Event/Issues Management subject area introduction only discusses management of the results of events, not issues identified by assessments.
- The Integrated Assessment subject area states that corrective and improvement actions resulting from organizational self-assessments are to be managed in accordance with the Events/Issues Management subject area, which only describes management of issues using the ATS tool and does not distinguish between institutional-level and family-level ATS. However, the *Self-Assessment Requirements* exhibit of this subject area requires the Self Assessment program to include "a description of programs/processes used to assign responsibility and tracking corrective, preventive, and improvement actions." Further, the Work Planning and Control Management System ISM Program Description states that "conditions, including findings are analyzed through the Event/Issues Management Subject Area" but then specifies that for "below the Laboratory-level, organizations use either the ATS or organizational processes" to track corrective actions. In practice, line and support organizations use a variety of issues management methods and do not adequately describe the programs and processes for managing all safety issues. Some line organizations have not established procedures or program descriptions for how issues are managed (e.g., screening for PAAA, required analysis, action development, responsibilities and due dates assigned, tracking, verification, closure) when they do not use ATS. Other line organizations do have procedures and internal tracking systems, but do not address the above cited issues management elements and, in several cases, refer to SBMS documents that no longer exist or are outdated (e.g., Quality Management subject areas *Nonconformances, Identifying and Reporting* and *Graded Approach for Quality Requirements*, due for review in April 2005 and December 2006 respectively). In cases where line organization procedures specified the use of the nonconformance SBMS, it was not followed in practice and the nonconformance form was not used to document issues.
- The lack of common terminology for issues and guidance for determining significance or priorities for management hinder application of a proper graded approach to issue management.
- The management safety observation program processes, requirements, and management expectations have not been adequately defined in site documents that would provide a basis for oversight and accountability. No formal Laboratory level guidance, goals, management expectations, or BNL-wide documents for conducting management safety observations have been established although general guidance and direction is included in a new assessment procedure in a draft revision to the Work Planning and Control for Experiments and Operations subject area. The expectations for the frequency performance have been incorporated into individual performance goals by individual organization managers without defined expectations from an institutional perspective. Typically, over half of all management observations are being performed by the Facilities and Operations directorate.

Other implementation deficiencies prevent a fully effective issues management program. One line organization that does use the family ATS for tracking many issues does not consider that identification of causes, documentation of cause codes, and evaluation of extent of condition elements of ATS apply to the family level and are not performing these elements. Whether the family ATS or internal tracking systems are used by organizations, the resolution of issues from self-assessments are not always being tracked. For example, for the two safety assessments performed in FY 2006 by Facilities and Operations, findings and improvement items were not put into their tracking tool and the other assessment did not clearly identify the deficiencies and thus no issues were entered for tracking. Little collective trending or analysis of issues data is performed at the organization or institutional level. Trending is not performed for Tier 1 inspection results and when data is summarized in organization and BNL annual performance

reviews, actions to address the reduction of findings in specific areas are not identified. Formal trending was not performed for the thousands of deficiencies identified by the comprehensive inspection conducted by OSHA in late 2003. The lack of common terminology, multiple tracking mechanisms, inconsistent documentation of results of assessments and inspections make effective trend analysis problematic. Even when ATS is used for tracking issues by line organizations, fields for cause codes and extent of condition are not completed. Although the public access feature is available for organization family ATS, no BNL organizations extend broad or public access to family level data, except in rare cases. No self-assessments have been posted to the public view of organizational ATS in CY2007. As described in the above section on assessments, the results of three 2006 SHSD safety program assessments were not put into ATS (family or institutional) or acted upon. (See Finding #D-4)

Deficiencies in various contractor assurance programs, similar to those identified in this Independent Oversight report, have been identified multiple times in previous ISM and DOE assessments over the past several years. These deficiencies have not been aggressively and thoroughly analyzed for causes and effective corrective actions, and recurrence controls have not been put in place. For example, the ISM assessment of BNL conducted by the Office of Science Chicago Office identified deficiencies in injury and illness investigations, lessons learned, work control and "skill of the craft," SBMS documents, and issues management and identified that many of these had been identified in previous assessments. The area of feedback and improvement was rated as a significant weakness. Although the ISM/Safety Improvement Project includes almost 200 corrective actions to address issues from prior assessments, most of which are completed or nearly completed, fundamental issues in ISM processes and performance remain. Additional deficiencies in the management of safety issues are discussed in the following section on occupational injury and illness investigations. (See Finding #D-4)

Injury and Illness Investigation and Prevention. Although BSA has established and implemented processes to report, investigate and take appropriate actions for occupational injuries and illnesses, there are weaknesses in injury management and investigation processes. Further, the investigations of occupational injuries and illnesses often are not performed with sufficient rigor to address work control/ISM elements and accurately identify causes, and corrective actions often fail to adequately address causes, extent of condition, or recurrence controls.

BNL's Total Recordable Case and Days Away and Restricted Time rates have generally reflected an improving trend over the past 5 years. However, there has been an uptrend since starting in the first quarter of 2007 and BNL rates are still higher than other SC laboratories.

The processes and requirements for managing occupational injuries and illnesses are established in the Subject Area *Investigation of Incidents, Accidents, and Injuries* and its associated procedures and guidance attachments. With some exceptions, these defined processes are adequate to effectively manage occupational injuries and illnesses. All injuries, illnesses, and potential exposures are required to be reported to the Occupational Medicine Clinic (OMC) and the employee is to be accompanied to the clinic by a designated representative from their organization. The OMC completes an injury/illness notification report with details communicated by the worker and identifying examination and treatment information. The BNL CAIRS Coordinator makes a determination regarding OSHA recordability (i.e., recordable, first aid only, or restricted duty). A "line authority or management designee" and the ES&H coordinator from the employee's organization, with support from ES&H subject matter experts as needed, conducts an investigation and documents the results on a *Line Organization Accident/Incident Investigation Report* form.

The investigation report form consists of two parts. The first part documents the general facts about the incident and is all that is required to be completed for non-OSHA recordable injuries and illnesses. The second part of the form, documenting the details of the investigation and analysis, is required to be completed for recordable injuries. The second part of this form provides the mechanism for determining the appropriate information to support effective analysis of the incident and development of appropriate corrective actions and recurrence controls and includes more detailed information regarding work control and causal analysis elements than the DOE Computerized Accident/Incident Reporting System (CAIRS) reporting Form 5484.3. For injuries determined to be OSHA recordable, the completed report is required to be reviewed by the Safety Engineering Group Leader and the worker's cognizant department or division manager. For non-recordable injuries and injuries to students, collaborators, visitors, and guests, only the line authority is required to conduct the investigation with management review conducted by the ES&H coordinator.

In response to an increase in the number of injuries onsite, the BNL Director recently directed SHSD to evaluate the injuries and make recommendations for reducing them. A "white paper" was provided to the Director and the Senior Management Council by SHSD in July 2007 and in early August the BNL Director tasked various managers and organizations with responding to the increase in injuries by implementing various actions and reporting back an implementation schedule by August 17. This initiative involves numerous and extensive actions by many managers and organizations across the site including communication of safety performance and BNL institutional and line management expectations and requirements regarding ISM, work control and injury prevention; solicitation of suggestions from workers; development of safety incentive programs; evaluating incident investigations; reviews of risk analyses and PPE requirements. If pursued rigorously, these actions could be effective in improving safety performance and reducing injuries. However, responses from a few line organizations indicated a lack of rigor and depth in the evaluations requested by the Director.

Over the years, BSA has identified specific trends or certain types of injuries with high frequency and initiated effective actions to reduce these injuries. For example, in 2006 a variety of actions were taken in response to strain and sprain injuries associated with cable pulling and other material handling activities in the Collider-Accelerator Department. Ergonomics training and other work planning improvements for cable pullers were effective in reducing these types of injuries. SHSD has developed presentations and training on preventing employee injuries during moving activities and back safety.

Although BSA has processes for management of occupational injuries and illnesses, these processes continue to reflect unclear, undefined, or inappropriate process steps and requirements. Further, although injuries and illnesses are being documented and investigated by supervisors and incident investigators, many injury and illness investigations, conducted both before and after process improvements, do not demonstrate sufficient rigor to address work control and ISM elements and accurately identify causes. In addition, corrective actions often do not adequately address causes, extent of condition, or recurrence controls. Examples of BNL-wide and other process deficiencies for the management of occupational injuries and illnesses include the following: (See Finding #D-5 and #C-1)

- The Subject Areas in SBMS do not require investigation of injuries and illnesses that are determined to be not-OSHA recordable. Therefore, injuries and exposures that only result in first aid treatment do not get evaluated for causes, extent of condition, hazard identification and controls, or identification of proper PPE and no corrective/preventive actions are

identified. However, non-recordable/reportable first aid cases can often be near misses to significant injuries or are the result of deficiencies in ISM.

- The SBMS subject area and associated procedures and the referenced process flow chart do not specifically identify the responsibility for classifying occupational injuries and illnesses. Classification decisions are handwritten but unsigned on the clinic visit forms, apparently by the BNL CAIRS coordinator.
- There are conflicts between subject areas and subordinate and referenced documents (e.g., flow charts and procedures) on the time limit to report injuries to the OMC, variously identified as within 24 or 48 hours. These documents do not specifically define time requirements or expectations for the employee to be examined or treated by the OMC. The expectation should be that injuries, illnesses and exposures be reported immediately or as soon as possible and prompt examination and/or treatment at the clinic. Late reporting is a long standing and recognized problem at BNL and the review of investigation report forms identified numerous cases of reporting beyond the 24 or 48 hour period, some of which were OSHA recordable.
- The Plant Engineering organization permits injured workers to document incidents on a "potential injury" reporting form without reporting to the OMC. However, there are no institutional or organizational level procedures defining a "potential" injury or addressing the use of this form. In some cases, the form was inappropriately used instead of reporting to an examination by the OMC. Independent Oversight's review of the use of this form during the past year identified at least three injuries that should have been reported to OMC and that eventually resulted in medical treatment and classification and reporting to CAIRS and OSH reportable. The information on this form is approved by signature of Facilities and Operations supervision and completed forms are reviewed and maintained by the Facilities and Operations ES&H organization, but review of its use in these instances was insufficient.
- Although the investigation form has a block (but without a signature line) for Safety Engineering (SHSD) to note whether the report is adequate for reporting to CAIRS and for noting rejection and a return to the line manager with reasons for rejection, this field is not addressed in the SBMS documents and is typically not completed.
- Although the Injury Management subject area procedure for Initial Management of Near Misses and Occupational Injuries/Illnesses states in the "required procedure" section that BNL "encourages" reporting of near misses, none are being documented by BSA organizations using this procedure. Further, a near miss is not defined in this subject area and there are no steps in the procedure that specifically address management of near misses.
- Although a sound mechanism to improve line investigations, the draft internal procedure for Safety Engineering performing quality checks is an internal division level document for which there is no BNL-wide requirement.
- The clinic visit report form is out of date and, because of the configuration of this carbon paper form, the treatment narrative on the copies sent to SHSD and retained in SHSD case files are truncated hindering classification of injuries pending clarification with medical and resulting in incomplete documentation in case files.

In addition to process and procedure weaknesses, there are deficiencies in the performance of injury and illness investigation efforts. Most investigation reports reviewed by Independent Oversight, selected from incidents occurring in CY 2006 and CY2007, contained one or more of the following deficiencies: (See Finding #D-5)

- Inadequate or incomplete discussion of the injuries or details of the incident on clinic injury reporting form.
- No investigation conducted.
- Use of superseded investigation forms.

- Incomplete investigation reports forms.
- Inadequate or inappropriate cause specification. In some cases, only a direct cause was identified although the procedure/investigation form requires designation of direct, contributing and root causes.
- Multiple cases of late reporting involving both late reporting to supervision and late reporting to the BNL clinic, in some cases when the supervisor was aware of the injury.
- Some reports not signed by the injured worker and/or by the supervisor as required.
- Corrective Action block marked "N/A" when corrective or preventive actions could or should have been taken.
- The block on the form containing questions related to hazard analysis, planning and PPE not always completed or marked "N/A".
- The investigation report not completed in a timely manner as required by procedure. For example, although the procedure specifies the report be completed in one day, some were signed up to three weeks after the incident.
- Failure of the investigation to include a review for conduct an extent of condition or development of lessons learned for sharing with other organizations when appropriate.
- Inadequate corrective actions or incomplete investigation. For example, in one case a worker suffered a minor burn/puncture while pushing trash down into full radioactive waste container that was treated at the OMC with first aid. However, the investigation report did not indicate that the trash was examined to determine what caused the injury and if any contamination concerns other than radioactivity were involved. Further, there were no actions to address the unsafe behavior of the worker.

SHSD is aware of weaknesses and inadequacies in investigations as identified in assessments in 2001 and 2006 that identified that a significant number of investigations were either not done or inadequately done. However, corrective actions have not been sufficient or effective in improving performance. SHSD has drafted an internal procedure for Safety Engineering to review and approve line management investigations that can provide feedback to investigation performers and provide a vehicle to communicate performance deficiencies to senior management to hold personnel accountable for effective implementation of the program. (See Finding #D-4 and #D-5)

The FY2006 Injury Performance and Trend Analysis provided substantial data and graphical presentations related to injuries, but did not result in any specific conclusions or recommendations (analysis) for actions to be taken based on the "analysis" of performance and trends. Although SHSD personnel described several ongoing or planned actions, none had been entered into ATS for documenting and tracking actions. (See Finding #D-5)

Occupational Injury and Illness Recordkeeping and Reporting. The Independent Oversight team assessment of the occupational injury and illness recordkeeping and reporting program at BNL included a review of program procedures, analytical reports, case files and interviews. Interviews were conducted with injured employees and the BNL CAIRS coordinator, who is responsible for the recordkeeping and reporting decisions and program maintenance. BNL has established local procedures to document responsibilities for identifying, classifying, recording and reporting occupational injuries and illnesses. The review of 2006 and 2007 cases included 165 non-recordable cases (first aid/not work related/observation only) and 57 recordable cases. The OSHA Summary for 2006 was appropriately certified. A cross-check of the OSHA Log for both years with the CAIRS Log was consistent except for the cases identified below.

A weekly case management meeting has proven to be a successful means of sharing information and maintaining communication on open cases. This meeting is attended by staff from the OMC, the SHSD Manager, the BNL CAIRS Coordinator, Human Resources, and the BNL Return-to-Work Coordinator. BNL has implemented a case management approach that includes feedback from a Return-To-Work Coordinator. This individual is responsible for interaction with the injured employees and line managers to ensure that the employee works within medical restrictions and returns to full duty as soon as possible.

Classification errors were identified in four 2006 cases; three of these cases were Days Away, Restricted or on Job Transfer (DART) cases incorrectly identified as non-recordable. Two classification errors were identified in 2007 cases; one of these cases was not properly classified but was reported, and one DART case was incorrectly classified as first aid. BNL case information and work hours are not always reported to CAIRS on time. Late reporting of case information in many cases appears to be in part due to late reporting of injuries to OMC and supervisors by the injured employee as discussed in the previous section of this report. Another factor contributing to late CAIRS reporting was inadequate and late investigation reports.

In many cases, BNL files lacked investigation reports and other documentation was not sufficient to support classification decisions. Investigation reports were not included with the files for most non-recordable cases. When included, these reports contained information on activities leading to the event and additional information from off-site medical obtained from the employee. The level of information provided varied from minimal to descriptive reports that included supplemental documentation.

Other documentation deficiencies were identified. Some of these deficiencies may be due to breaks in communication between OMC and SHSD. In most cases, the initial source of communication between OMC to SHSD is the BNL Employee Illness/Injury Report. This form is used by OMC to document initial and follow-up onsite treatment and to communicate information obtain from offsite medical providers. A copy of each new and revised form is sent to SHSD through the office mail system. A cross-check of the OMC medical treatment list with an equivalent list maintained by SHSD identified a few discrepancies. These deficiencies were resolved with file information. However, a larger number of documentation deficiencies were apparently due to the design of the multi-copy carbonless form. In most cases, information necessary to make classifications decisions was cut off the initial forms due to the half page carbonless sheet. Notations in the margin of this form documents classification decision by the BNL CAIRS Coordinator. BNL recently developed and instituted the use of two new forms to improve coordination of information between the two organizations. A new OMC Treating Physicians Work Activity Recommendation form, recently developed by the OMC staff, is intended to document and communicate work restrictions imposed by off-site medical providers, with a copy sent to the BNL CAIRS Coordinator. However, this form does not include offsite treatment information. A new process implemented by SHSD during the course of the review added a case summary sheet in each case file. This sheet is used to document information not included in other reports and information needed to validate classification decisions. Prior to implementation of the new SHSD summary sheet, file documentation often did not include sufficient information to validate the classification. These two new documents and instructions for their use are not yet incorporated into procedures within SBMS.

Off-site medical treatment information was not always included in recordkeeping case files. Complete information relating to offsite medical treatment and restrictions are needed in these files to document recordkeeping decisions. The supporting information for some cases where recordkeeping decisions where questionable was included in the Worker's Compensation files.

The BNL CAIRS Coordinator is also the Workers' Compensation Program Manager. Although this dual assignment is ideal for case tracking between two programs where case files do include some of the same information, separate documentation is needed to provide a clear audit trail and preserve the need-to-know rights of employees and investigation team members.

Occurrence Investigation and Reporting. BNL has established and implemented an adequate process for identifying, categorizing, responding to, investigating, reporting of incidents and events and for taking corrective/preventive actions to address associated issues. Requirements, including roles, responsibilities, authorities, and process steps for managing potentially reportable events are contained in the *Events/Issues Management* and *Occurrence Reporting and Processing System* subject areas that include procedures for the initial response to events, scheduling and conducting fact findings, categorizing and reporting events, event analysis, and developing and managing corrective and preventive actions. Abnormal events are reported by BNL staff to a trained Event Categorizer who determines if the event meets the reporting criteria of the DOE Occurrence Reporting and Processing System (ORPS). Based on a review of reported events, BNL has established and is employing an appropriate threshold for incidents that warrant consideration of ORPS reportability. BSA has established an event significance category below the threshold for ORPS reportability (designated as SCBNL) for events that are reportable to BNL management and may warrant further fact-finding, investigation, and analysis. Actions for ORPS and SCBNL are managed through the formal ATS issues management process and tool.

As required by DOE Manual 231.1A, the BNL ORPS coordinator issues a quarterly report documenting a review of reportable and non-reportable events, nonconformances, and radiological awareness reports for recurring issues and events that would require reporting to DOE. Before the second quarter 2007 report, BNL also reviewed issues from a limited number of institutional level assessments. The last four reports have not identified any reportable recurring events, but have identified and monitored areas "requiring attention;" however, they have not identified or recommended any additional specific actions to address these areas of concern other than existing issues management efforts. However, although the responsibility to conduct this review is identified in the Occurrence Reporting Program Description, the process for conducting this review is not addressed in associated subject area or procedures.

Independent Oversight's review of critique and fact finding reports and ORPS reports from CY2006 and CY2007 abnormal events, including some SCBNL or unclassified incidents, indicated that, in some cases, the investigations and documented reports lacked sufficient rigor to address all elements of the event. For example, the ORPS report for a Significance Category 3 event in 2006 where an 800-pound device being moved into a building tipped over just missing a rigger did not address the details and acceptability of workers righting the device and proceeding with the movement. The report for an ORPS Significance Category 4 event in May 2007, in which an ungrounded neutral was discovered in a 13.8kV/208V transformer, did not describe how or when the unit was installed or by whom and did not identify why it was not properly tested after installation. A critique of a non-reportable event August 2006 identified root and contributing causes but did not document any causal analysis for two related, but separate, incidents, documented in the report. The specified corrective actions were directed at addressing all three incidents but did not provide any specific work planning/oversight recurrence controls other than a reprimand of one individual and discussion of the lessons learned with group safety officers. In addition, the Event/Issues Management Subject Area requires the Event/Issue Summary form to be completed for ORPS reportable and SCBNL events. However, 19 of 37 of these summary reports initiated since November 2006 remain open, including at least 11 where final ORPS reports have been sent to DOE, several dating back to December 2006, and five SCBNL events, several dating back to March 2007. (See Finding #D-4 and #D-5)

Operating Experience/Lessons Learned. External lessons learned are being screened and distributed and internal lessons learned are being generated, disseminated, and posted to the BSA website, and lessons are being incorporated into work activities. The development, screening, distribution and application of operating experience/lessons learned is defined in the *Lessons Learned* subject area and associated procedures and forms of the Quality Management system. The operating experience program is administered by an institutional lessons learned coordinator and assigned organizational coordinators. External lessons learned are being screened by the institutional coordinator, disseminated to site managers and ES&H coordinators and designated coordinators, and posted to the BSA intranet lessons learned website. The website has a search function by topical area, hazard type and ISM core function. After a lessons learned is opened on the website a pop-up window is displayed that requests feedback on the lesson. The pop-up window provides a selection of disposition choices including not applicable, already adopted, will adopt, under investigation, distributed for information, or just reading for interest only. There is evidence that lessons learned are being discussed in organization staff and safety meetings and incorporated into work activities. Several organizations, including Facilities and Operations and NSLS, periodically develop, disseminate and post on bulletin boards internal lessons learned or lessons learned identified through review of external sources.

The Laboratory lessons learned coordinator has also developed and made presentations, which are also posted to the Quality Management Office website, to communicate details about the BNL lessons learned program and solicit feedback for improvement and on special topics of significance such as electrical safety, material handling, and the arc flash injury at SLAC. Approximately 15 lessons learned were shared with the DOE complex by forwarding to the DOE HSS Operating Experience Manager in the past 32 months.

Although lessons learned are being identified, disseminated, and applied, there are weaknesses in the subject area and the implementation of the program lacks sufficient rigor and documentation to adequately demonstrate the extent or adequacy of screening, evaluation, and application of pertinent lessons learned. The procedure for identifying, analyzing, and disseminating lessons learned information in the Lessons Learned Subject Area has a note in the applicability section stating that the subject area is only "required" for organizations that have identified lessons learned as a method of self-assessment and is only "recommended" for other organizations. Documentation of applicability and technical reviews by functional area subject matter experts at the institutional level and by line organizations and evidence of actions deemed necessary and of actions taken is not required by procedures and is not formally documented. Some evidence of dissemination is available in electronic mail files, but documentation is not maintained in any systematic process that demonstrates consistent or rigorous application and implementation of the lessons learned program at either the institutional or organizational level.

Independent Oversight selected two special lessons learned reports (one on laser safety and one of respirator cartridge recalls) from the DOE Operating Experience websites to determine whether there was evidence they had been screened and distributed at BNL. These reports were not posted on the website and no evidence could be retrieved of distribution of these reports.

Although the feedback tool pop-up window on the internal lessons learned webpage is a positive feature and the results are trended yielding a global sense of interest in a lesson, there are no established mechanisms to identify the actions of the initial target audience of managers and organizational coordinators for any given lessons learned. Further, the feedback option of "adopted" has no definition or field to explain what was actually done to adopt the lesson. In some cases, Independent Oversight identified line organization commitments to develop lessons

learned that were not completed or insufficiently implemented. For example, issuing a lessons learned was one of the corrective actions resulting from the investigation of a November 2005 injury to a student researcher (fingers were blistered when placed in liquid nitrogen without wearing required gloves or using forceps). This action was also recommended in a BHSO surveillance of this incident/injury. Although a local organization lesson was issued, it was not issued until October 2006 and was not communicated to the institutional level for sharing with other organizations that work with cryogenics or for consideration for sharing with the DOE complex.

The lessons learned subject area of SBMS does not identify responsibilities or procedures detailing expectations and requirements for the institutional lessons learned coordinator to screen and disseminate externally generated lessons learned or to maintain the lessons learned website and database. Only two responsibilities are identified for the BNL coordinator (i.e., conduct and document a yearly evaluation of the effectiveness of actions implemented from lessons learned and conduct bi-annual workshops to prompt feedback). Although the workshops have been held, no effectiveness reviews have been conducted.

Although the development of a systematic approach to lessons learned is "highly encouraged" in the subject area, BNL organizations have not developed internal lessons learned procedures. The subject area procedure requires organizations to document program improvements from their lessons learned activities during midyear and annual self-assessment reports in accordance with the Self-Assessment Program. However, the Integrated Assessment Program procedure does not address any midyear review and does not address the evaluation of lessons learned improvements for the annual review of organizational performance.

Employee Concerns. Workers at BNL have many ways to express and get resolution of safety concerns and the few formal concerns being reported are generally adequately dispositioned. Methods available to workers include direct interaction with supervision and ES&H coordinators and subject matter experts, an SHSD maintained hotline, a Facilities and Operations concerns program, and a program administered by the Human Resources Division. As part of the concerns program administered by Human Resources, a line Level 1 manager has been designated as the Employee Concerns Program Manager, responsible for investigation and resolution of concerns. The Employee Concerns Program Manager has issued a document entitled the Employee Concerns Program that specifies responsibilities and program requirements. The means for reporting concerns are also communicated to workers through posters on site bulletin boards, information in visitor and new employee orientation and training, on websites maintained by Human Resources and the Environment, Safety and Health directorate. The Facilities and Operations ECP has been in place for many years, is governed by a Directorate level procedure, provides an effective mechanism for workers to communicate concerns (including anonymously or requesting confidentiality, and provides documented communication of status and disposition to concerned individuals. Many of the concerns reflect Facilities and Operations worker interest in improving work environments to promote safety and safe work. Facilities and Operations workers formally reported 18 concerns in 2006 and ten to date in 2007. Investigation efforts are primarily led by ES&H personnel with involvement of the organization ES&H Committee.

With some exceptions, the ES&H Concerns Hotline managed by the SHSD and the organizational concerns program of Facilities and Operations are adequately addressing concerns reported through these mechanisms in a timely manner. Recent investigation reports for (CY2006 and CY2007) formal concerns received in the Human Resources organization reviewed by Independent Oversight were appropriately rigorous and well documented.

As a result of the 2006 ISM review and an April 2007 program evaluation and report of lessons learned from Independent Oversight inspections at other DOE sites, a number of actions have been taken or are in progress to strengthen the formal BNL Employee Concerns Program. Recent program improvements included updated forms, posters, websites, and an "Employee Concerns Program" document (not part of SBMS). Employee concerns processes are communicated to workers and visitor during orientation presentations and to supervisors as part of new supervisor training. In addition, at least once a year, an article about the resolution of employee concerns is published by Human Resources in the BNL newspaper. The recent program review also identified untimely resolution of concerns reported to Human Resources – all five formal concerns reported in CY2006 were still unresolved and had been open for almost a year. In recent months, four of the five open 2006 cases have been closed and the fifth was awaiting a closure meeting with the concerned individual at the time of this inspection.

Although there have been numerous improvements and strengthening of the formal BNL Employee Concern Program, some weaknesses in structure, processes, and implementation remain. Resolution of the roles and responsibilities issues identified in the April program review have not been fully addressed and recurrence controls for untimely resolution of concerns appears to be insufficient. The relationship and roles, responsibilities, and authorities of the Human Resources concerns program administrator and the line Program Manager, who does not work for or report to Human Resources management, are not sufficiently delineated. Further, the concerns management system description is not part of a controlled document system such as SBMS. No recurrence controls were put in place to address the untimely resolution of concerns other than changing of Program Managers. Although the Human Resources Services Manager prepares quarterly and annual status reports and provides them to the Concerns Program Manager and the Human Resources Division Manager as specified in the program description document, these reports are not provided to more senior management and are not effectively used to ensure accountability for timely resolution of concerns. BNL and BHSO meet quarterly to review employee concern case status. BNL has also not established any formal protocol/procedure for interfacing with BHSO for supporting DOE concern resolution for referred concerns or for managing the disposition of transferred concerns.

The documentation of the disposition of some concerns called in to the ES&H hotline did not demonstrate a rigorous evaluation and some concerns were closed based on intent or the definition of actions to be taken, not after actions are taken. Actual actions taken or verifications not documented. For example, an April 2007 concern involved observation of a subcontractor on a 15-20 foot ladder that was not tied off, using both hands to use a hammer to break out a window, wearing no safety glasses, and without cordoning off the area below. The response was a safety person responding to the scene asking the contractor to tie off the ladder, maintain 3-point contact and cordon off the area below and to wear safety glasses. No discussion of citation of the contractor, formally stopping work, contacting the contractor's management or safety personnel, review of work planning or the contractor's health and safety plan, or review of the adequacy of controls (e.g., were safety glasses sufficient, was fall protection required?). Another case involving sparks coming from a range in an apartment was closed based on the shift supervisor's statement that they were "taking care of this concern. The circuit breaker will be shut off", with no permanent resolution specified.

The documentation of investigation details for concerns managed by Facilities and Operations was also sometimes insufficient. For example, several CY 2006 concerns that identified similar inadequate work planning issues (e.g., workers working alone on roofs and in man-lifts after hours) were substantiated as inappropriate behavior, but there was no identification of specific work or planning deficiencies and no specific recurrence controls were identified. In another

case, the disposition for a concern related to inadequate briefing/communications to maintenance staff/responders on newly installed equipment, which cited several concerns with design elements of a specific new installation, only addressed the lack of briefings and did not address the design questions.

Other Feedback and Improvement Processes. In addition to the above discussed feedback and processes, BSA organizations also use various other mechanisms to share information on ES&H performance, issues, initiatives, and lessons learned and concerns. These mechanisms also provide effective forums for interaction and obtaining feedback from researchers, employees, contractors, management, and ES&H subject matter experts that result in safety improvements for conditions, processes, and activities for BNL projects and operations. These mechanisms include ESR and FSA and other peer reviews of new and revised projects and work control documents. The Laboratory ES&H Committee advises operating organizations and the Laboratory director on impacts and initiatives related to site activities involving various safety elements such as pressure safety, environmental protection, cryogenics, radiation, and general safety and health issues. Plant Engineering has an active, chartered ES&H committee that is involved in employee concern resolution and injury prevention. Plant Engineering also regularly communicates ES&H matters in a quarterly organization newspaper and during documented toolbox meetings with the crafts. SHSD publishes a monthly newsletter summarizing ES&H performance, processes, and initiatives. SHSD also conducts monthly counterpart meetings with ES&H Coordinators and Quality Representative. The BNL Director also chairs the Director's Safety Committee; membership of this Committee includes the Vice President of the bargaining unit, the SHSD Manager, the OMC Director, and representatives from NSLS and RHIC user groups, technicians, administration, researchers, and construction supervision.

BSA has established a Safety Solutions suggestion program soliciting improvement ideas from site workers that are tabulated and communicated to reflect the involvement of workers and recognition of management through implementation of suggestions. BSA has also established a Sitewide Safety Steward program where nominees are solicited for recognition for substantial contributions to safety program and performance improvement. In 2006, four individuals and one team were recognized for this achievement with a plaque, luncheon and safety related prize. Twelve individuals were recognized with honorable mention status.

The Management Council provides a forum for interaction and feedback between senior Laboratory managers and ES&H and quality support staff on expectations, initiatives, and safety performance.

After over a year of study, benchmarking, and analysis BSA management has decided to incorporate Human Performance Improvement (HPI) concepts and tools into BNL management systems and into the approach of employees and managers towards work control and evaluation of incidents and performance deficiencies. A multi-year plan to train managers and workers and employ HPI in BNL work planning, event analysis and issues management is underway. Rigorous and comprehensive implementation of HPI should refocus planning and analysis away from individual actions and failings towards identifying precursors, error likely situations, and undetected weaknesses in management control processes and values that degrade defenses against errors and resulting injuries and upsets.

BSA Activity Level Feedback and Improvement Processes. Activity level feedback and improvement processes (e.g., pre-job briefs, post-job briefs, and plan-of-the-day meetings) are an important part of a work planning and control process. All of the organizations that were reviewed (see Appendix C) had established and implemented multiple processes for collecting

ES&H related information from workers following selected work activities. For example, NSLS has a process to solicit feedback from scientists/users following a series of experiments and several organizations have implemented processes for regular management and ES&H coordinator walkdowns of work spaces.

Many aspects of the activity level processes were effective and were contributing to enhancements in ES&H practices. For example, the Maintenance organization ensures that annual performance appraisals for workers and supervisors consider safety performance and implements several complementary mechanisms (e.g., regular workplace inspection, worker feedback forms, supervisor behavior-based observations, committee participation) for gathering feedback from and providing feedback to workers. Interviews with management and workers in the Plant Engineering Division indicated that management was actively involved in safety issues and that workers believed that management encouraged and was responsive to worker feedback. In a number of cases, worker feedback prompted additional safety measures (e.g., additional industrial hygiene monitoring as a result of worker concerns about odors from an adhesive).

Plant Engineering has established and implemented a notably effective program for inspection of heavy equipment. Plant Engineering inspects heavy equipment including cranes, earth-working equipment, aerial lifts, and rigging to ensure that it is in good condition before it is used onsite and to ensure that operators are qualified to operate this equipment safely. Construction contracts require that BNL be notified 48 hours before such equipment is brought onsite. This notification requirement is also included in SBMS and is reiterated in annual subcontractor 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 cranes, rigging equipment, and a well drilling rig were observed to be thorough and properly documented. Equipment inspected by the Independent Oversight team was in good condition.

Although many aspects of activity-level feedback are effective, in some cases, the effectiveness of the processes is reduced because the processes are performed at the facility level but not adequately defined or mandated by BNL-wide requirements. In addition, some of the established processes rarely result in ES&H feedback. Further, the workplace inspections in some areas have not identified and addressed longstanding deficiencies in laboratory practices (e.g.., PPE that does not conform to requirements, procedure nonconformance, eating in laboratory areas where chemicals are used), indicating that the workplace inspections are not sufficiently focused on ensuring strict compliance with ES&H requirements. (See Findings #C-1 and #D-3)

D.3 OPPORTUNITIES FOR IMPROVEMENT

The Independent Oversight review identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive. Rather, they are intended to be reviewed and evaluated by the responsible line management organizations, and prioritized and modified as appropriate, in accordance with site-specific programmatic objectives.

Office of Science:

1. **Take steps to ensure that SC Training and Qualification Programs at Headquarters, at the Integrated Support Center (ISC), and at site offices are improved.** Specific actions to consider include:
   - Perform a gap analysis to the requirements of training directives DOE Order 360.1B, DOE Manual 360.1-1B, and DOE Manual 426.1-1A.

- Ensure Management System Description and supporting procedures in SCMS address the training and qualification directive requirements.
- Ensure that appropriate training and qualification programs are implemented at headquarters, the ISC and at the site offices.

2. Continue the emphasis on developing, approving, and issuing high quality SCMS management system descriptions and procedures to meet April 2008 projection for completion of corrective action for CATS# SLAC-01/17/07-I0007-0002-A.

Brookhaven Site Office:

1. **Take steps to improve the BHSO Contract Oversight Process.** Specific actions to consider include:
   - Ensure that laboratory performance input is received on time to prevent impacting other contract performance measurement deliverables or delaying tri-annual feedback to the contractor.
   - Ensure that persons evaluating contract performance have appropriate training, experience, and qualification.
   - Take steps to capture/document the basis (i.e., review of BSA self-assessment reports in the area, DOE assessment results, operational awareness information, etc.) for the BHSO evaluation and color rating.

2. **Take steps to improve the BHSO assessment process.** Specific actions to consider include:
   - Ensure all directive-required assessments are included in the baseline assessment program. Schedule such assessments to meet the prescribed directive periodicity or a periodicity that is supported by a BHSO risk analysis.
   - Capture assessment plans, reports, correspondence, and corrective action plans in a central (preferably electronic fashion) so that they may be easily retrieved when needed (also needs to address quality assurance records requirements).
   - Clearly communicate management expectations for technical quality and rigor to improve consistency in documentation and communication to the contractor.
   - Encourage ownership of assessment results by requiring Lead Assessors and Division Directors to review and approve (sign) assessment reports, ensuring that the previously agreed to scope/criteria are addressed (or if not, justification as to why not are documented).
   - Ensure deficiency identification is consistent with implementing procedure requirements (i.e., concerns, findings, observations) and that undefined terms (e.g., recommendations) are not used.
   - Ensure causal analysis, extent of condition determinations, and expected delivery date for the CAP are specified (when appropriate) in letter transmitting assessment to BSA.
   - Schedule and conduct periodic contractor training assessment (using DOE-STD-107O-94) in accordance with DOE Order 5480.24A in a timely manner.

3. **Take steps to improve the BHSO self-assessment process.** Specific actions to consider include:
   - Ensure direction is provided in the self-assessment procedure for "topical" self-assessments.

- Complete identification of risk analysis and identify directive drivers, determine minimum periodicities for self-assessment, determine when self-assessments were last performed. Use this information to schedule the "out-years" for topical self-assessments.
- Ensure capture of self-assessments (also see Opportunity for Improvement 2 above).
- Ensure that direction is provided in the OMD Database Procedure and the Corrective Action Tracking Procedure for handling, documenting, and closing validation requirements for self-assessment CAP actions.

4. **Take steps to improve the BHSO issues management/corrective action tracking process.** Specific actions to consider should include:
   - Expedite the development, approval and implementation of the BHSO Corrective Action Tracking Procedure, and revise and re-issue the OMD Database procedure to ensure consistent knowledge of expectations for the use of the new assessments/corrective action tracking module.
   - Conduct an effectiveness review of BHSO performance at a specified time (e.g., six months) after issuance of the two procedures.

5. **Take actions to enhance the Facility Representative Program.** Specific actions to consider include:
   - Ensure that qualification extensions are controlled and documented in accordance with DOE Standard-1063-2006.
   - Develop a centralized system to maintain complete and accurate qualification and re-qualification records.

6. **Take actions to enhance the Operational Awareness Program.** Specific actions to consider include:
   - Revise and re-issue BHSO-OA-23, OMD Database Usage, to include expectations for: 1) communication of operational awareness information to the contractor, 2) grading of deficiencies (i.e., findings, observations, etc.), and 3) appropriate closure notes and closure validation.
   - Formalize the requirement to perform analysis, and metrics expectations in the procedure and reporting in the OMD weekly.

7. **Take actions to enhance the Employee Concerns Program.** Consider inviting an outside expert (high performing ECP manager from Oak Ridge Office or other site) to participate in the 2008 BNL ECP assessment and provide additional ECP specific insight/training.

8. **Take actions to enhance the Technical Training and Qualification Program.** Specific actions to consider include:
   - Ensure that the requirements of DOE Manual 360.1-1B, Chapter 1, with regards to training plans, staffing analysis, and training reports (paragraphs 4.a., 5.a., and 3.b. respectively) are understood , and then coordinate their completion with the ISC.
   - Implement BHSO-OA-22, Subject Matter Functional Area Qualification and Training.
   - Expedite development of functional area qualification standards for SMEs/SMAs.
   - Prioritize functional area qualification standard for those BHSO personnel required to qualify to multiple standards.

9. **Take actions to enhance the Lessons Learned/Operational Experience Program.** Specific actions to consider include:
   - Revise and re-issue implementing procedure to address identified deficiencies.

- Encourage the BHSO Coordinator to participate in the Society for Excellence in Lessons Learned (or its successor).

BSA

1. **Correct errors, omissions and conflicts in SBMS documents that govern feedback and improvement programs and processes.** Specific actions to consider include:
   - Conduct process mapping and rigorously review and revise each assurance system SBMS document from management system, to program description, to subject area, to procedure, to attachments and guides to ensure that all roles, responsibilities, authorities and BSA and external requirements are sufficiently addressed and rolled down to the procedure level. Ensure that interfacing SBMS documents provide unambiguous linkages without conflicting requirements.
   - Line and support organizations formally review SBMS documents and identify and issue needed internal procedures that delineate how the organization implements institutional procedures.
   - Correct the SBMS Record of Decision documentation for DOE Order 210.2, *Corporate Operating Experience Program,* to reflect gaps and corrective actions and determine of other Records of Decisions need similar clarification.
   - Perform overdue reviews of Quality Management subject areas for *Graded Approach for Quality Requirements* and *Nonconformances, Identifying and Reporting* and ensure linkages in other SBMS documents and organization implementing procedures are accurate.

2. **Strengthen the self-assessment program to ensure that safety programs, processes, and performance are being appropriately and rigorously evaluated.** Specific actions to consider include:
   - Strengthen line self-assessment programs and increase the number of safety self-assessments by ensuring that formal, scheduled, periodic assessments of internal safety processes and performance in safety functional areas and management systems implementation are identified and prioritized through a structured analysis. Assessment area selection and frequency should be based on a graded analysis of factors such as the type of activities performed, the hazards involved, past performance, and management discretion.
   - While acknowledging that a comprehensive and effective program for self-assessment of safety processes and performance needs to consider and integrate inputs from the assessment activities of external organizations, prepare separate schedules and plans that reflect the true self-assessment activities to be performed by internal contracted/requested resources.
   - Establish a standard set of terminology and hierarchy of assessment results such that all internal independent and self-assessments employ common definitions for categorizing deficiencies and opportunities for improvement. Common and consistent use of specific terminology will support issues management prioritization and trend analysis efforts.
   - Establish a position of assessment and issues management coordinator reporting directly to the Deputy Laboratory Director for Operations with responsibility and authority to ensure effective assessment and issues management programs are developed and implemented. Establish requirements, authorities, and mechanisms for this coordinator, or the Quality Management organization, to review and approve the quality and content of self-assessments and corrective action plans. Establish a formal assessment review

and grading process to provide feedback to performers and managers on the quality of assessments.

- Strengthen the scope of ES&H functional area and program reviews by increasing the focus on evaluation of implementation. Ensure that implementation and effectiveness evaluations are based on objective evidence of compliance with requirements and performance rather than responses to surveys and interview questions. Reinforce the ownership responsibilities for ES&H programs by ensuring that program reviews are lead by the program owner even if teams or external parties are employed in the conduct of the assessments.
- Develop mandatory training and hands-on workshops on self-assessment processes and on the tools and techniques of effective assessment. Develop a mentored workshop where assessment teams from organizations plan, conduct, analyze, and document actual self-assessments that not only provides hands-on training but results in an assessment product that meets commitments and provides value to the organization. Consider engaging, proven, effective external expertise to provide training and mentoring.

3. **Strengthen the issues management process and implementation to ensure the consistent capture, classification, analysis, and management of safety deficiencies to effective resolution.** Specific actions to consider include:
   - Revise issues management processes to require that safety deficiencies identified at BNL be managed in the same manner based on the issue significance and not the source (e.g., event, line assessments, BHSO assessment) of the issue. Ensure that access to issues management data is transparent and open to all BSA employees in a manner that supports organizational and Laboratory wide performance analysis and trending and communication of status and performance to senior management and program owners. At a minimum, establish common mechanisms to manage inspection findings, safety observation results, and limit the use of "family" ATS modules to commitment tracking.
   - In consonance with the development of common terminology for assessment results, develop/revise procedures to characterize issues for risk and significance to drive a graded approach to management, including determining extent of condition, a graded causal analysis of all issues, development of effective corrective actions and recurrence controls, establishing appropriate action due dates, tracking actions to closure with formal change controls, verification of completion, risk based validation of effectiveness, and trend analysis of issues and data.
   - Conduct training and communicate clear management expectations for full implementation of the issues management program. Include specific training and guidance on extent of condition, causal analysis and development of corrective/preventive actions.
   - Establish stronger responsibilities and authorities for oversight of issues management program implementation at the institutional level and within line and support organizations. Establish mechanisms for management review and approval and for monitoring and improvement of the quality of issues management documentation, at least until effective implementation has been established. Establish a formal process for reviewing and grading of a sample of issues analysis and corrective action plans to provide feedback to performers and managers on the quality of these activities. Consider establishing corrective action review boards at the organization and institutional level staffed with trained and qualified individuals, including management representation, with the responsibility and authority to review and impact the management of selected, prioritized issues or action plans. Include a sampling process to include periodic evaluation of the management of lower risk and significance issues.

- Ensure that assessments of the issues management program include rigorous evaluations of field implementation by all organizations. Conduct implementation reviews on an increased frequency until performance is determined to be compliant and effective.

4. **Strengthen the occupational injury and exposure investigation, recordkeeping and reporting processes and implementation to ensure that potential precursor events are thoroughly documented and analyzed with causes determined and appropriate preventive actions identified and implemented and cases are appropriately managed.** Specific actions to consider include:
   - Revise SBMS documents to require documented investigations of first aid cases as well as OSHA recordable injuries.
   - Clarify and formally communicate the requirements and management expectations for timely reporting all occupational injuries, illnesses, and exposures for all employees, contractors, and guests. Eliminate the specific time periods and require reporting and evaluation by medical personnel as soon as possible/practical. Eliminate the use of the Facilities and Operations potential injury form.
   - Expedite the incorporation of a requirement and process for the Safety Engineering quality review and feedback for line investigations and ensure that the process includes compilation and reporting of performance metrics to monitor improvement and provide senior management accountability information.
   - Ensure senior management holds line organizations accountable for conducting and documenting thorough investigations and identification of appropriate corrective actions and recurrence controls that are formally managed to completion.
   - Review and revise as necessary the outdated OMC visit form to ensure complete, clear and accurate information is provided to aid in investigation, categorizations, and insuring complete documentation records.
   - Clarify the responsibilities and process steps for classifying injuries and illnesses for OSHA recordability in SBMS procedures.
   - Add the treatment information from offsite providers to the new Worker Activity Recommendation form. Incorporate the use of new forms and case summary sheets into SBMS and organization level procedures.
   - Conduct more frequent cross checks with OMC information and self-assessments of recordkeeping and reporting practices to identify and correct weakness in the procedures and errors in classification.
   - Review and strengthen the training and qualification process and provide additional classroom training/workshops for all supervisors, managers, and ES&H coordinators on causal analysis and investigation techniques and tools.
   - Conduct focused management system implementation reviews on an increased frequency until performance is determined to be compliant and effective.

5. **Strengthen the incident investigation and occurrence reporting program to ensure consistent and rigorous identification, categorization, investigation and development of corrective and preventive actions for incidents and events**. Specific actions to consider include:
   - Clarify in SBMS documents the formality and processes for documenting investigations of operational incidents that are not deemed reportable through the ORPS. Clarify and establish the use of the Event/Issue Summary form as a means to record the evaluation and disposition of incidents.
   - Strengthen institutional level oversight of incident investigation efforts by establishing a common intranet database and/or forwarding of all fact findings or critiques and

Event/Issue summary's (e.g., for ORPS reportable and SCBNL events as well as uncategorized incidents) to the Laboratory ORPS coordinator in the Quality Management Office.

- Establish a formal BNL-wide process in the SBMS subject area for reviewing and providing feedback to performers and managers on the quality of fact finding and investigations of incidents and events. Consider including reviews of incident fact findings and investigations to the responsibilities of the corrective action review boards suggested above.
- Conduct focused management system implementation reviews.

6. **Increase the rigor and formality of management of the Employee Concerns Program.** Specific actions to consider include:
   - Develop comprehensive procedures for managing employee concerns in both the ES&H organization and Human Resources that address the roles, responsibilities, authorities, and process action steps for all organizations to implement the program. Establish defined requirements and processes elements such as the minimum levels of documentation for closure, contents of Human Resources program case files, objective evidence, interfaces with organizations assisting in investigations and with BHSO, confidentiality and disposition communications with concerned individuals, etc.
   - Establish formal SBMS procedures for responding to and managing concerns referred or transferred from BHSO to BSA.
   - Strengthen the documentation of the investigation and disposition of concerns reported to the ES&H hotline and concerns submitted to the Facilities and Operations program to provide more details on the analysis and resolution. Close concerns only after verification of completion of proposed actions.

7. **Increase the rigor and formality of management of the lessons learned program.** Specific actions to consider include:
   - Establish a formal means to document and track subject matter expert and field organization evaluations of applicability, needed actions, and actions taken for external and internally generated lessons learned.
   - Ensure that program and management system self-assessments and organization management reviews include evaluation of how line and support organizations are implementing the program and applying lessons learned.
   - Elevate the lessons learned program visibility with a hot link on the BNL intranet homepage.

APPENDIX E
Management of Selected Focus Areas

E.1 INTRODUCTION

The U.S. Department of Energy (DOE) Office of Independent Oversight inspection of environment, safety, and health (ES&H) programs at the Brookhaven National Laboratory (BNL) included an evaluation of the effectiveness of the Brookhaven Site Office (BHSO) and BNL contractor – Brookhaven Science Associates, LLC (BSA) – in managing selected focus areas.

Based on previous DOE-wide assessment results, Independent Oversight identified a number of focus areas that warrant increased management attention because of performance problems at several sites. During the planning phase of each inspection, Independent Oversight selects applicable focus areas for review based on the site mission, activities, and past ES&H performance. In addition to providing feedback to the Office of Science (SC), BHSO, and BSA, Independent Oversight uses the results of the review of the focus areas to gain DOE-wide perspectives on the effectiveness of DOE policy and programs. Such information is periodically analyzed and disseminated to appropriate DOE program offices, sites, and policy organizations.

The focus area selected for the review at BNL and discussed in this appendix is implementation of the site environmental management system (EMS) and pollution prevention programs.

The two other focus areas evaluated on this inspection – implementation of DOE Order 226.1, *Implementation of DOE Oversight Policy,* and injury and illness investigation and reporting – are directly relevant to feedback and improvement and are discussed in Appendix D.

The focus areas are not rated separately, but results of the review of the focus area is considered in the evaluation of integrated safety management (ISM) elements in Appendices C and D, where applicable.

E.2 RESULTS

Environmental Management System and Pollution Prevention Program

DOE Order 450.1, *Environmental Protection Program,* required DOE sites to implement an EMS by December 31, 2005. Independent Oversight selected the EMS as a focus area for 2006/2007 to provide feedback to DOE management on the effectiveness of implementation of the new EMS program by line organizations at DOE sites across the complex. For BNL environmental management program activities, Independent Oversight evaluated BHSO program management and oversight for EMS activities, the BNL environmental compliance program, and BNL's implementation of EMS. Independent Oversight observed research, construction, and maintenance activities performed primarily by BNL and subcontractor personnel at various laboratories and maintenance facilities, and for one restoration project.

BHSO. Although BNL had been in compliance with ISO 14001 for a number of years based on third party certification, in 2005 BHSO verified to SC that the BNL EMS was in conformance with DOE Order 450.1 based on an independent desk assessment by BHSO. Since 2005, BHSO

continues to monitor the rigor of the yearly third party re-certification of ISO 14001. Also, on a day-to-day basis, BHSO environmental staff members monitor environmental compliance reports and permit activities. In addition, BHSO staff and management participate with BNL in meetings to discuss ES&H performance and regularly attend BNL environmental meetings including a yearly meeting with senior managers and the BNL Director on the Directorate's progress in meeting EMS goals. Although BHSO environmental subject matter experts participated in a joint multi-topic assessment with BNL in 2006, a planned independent BHSO RCRA compliance assessment has been delayed. As a result, BHSO determination of the contractor's effectiveness in implementing EMS within the Directorates is currently based primarily on self-reporting by BNL and third party certification.

BHSO has established appropriate FY 07 contract performance measures to drive improvements in waste management and to obtain continued support for EMS. The measures for waste management drive pollution prevention by requiring each Directorate to prepare a pollution prevention proposal and those proposals with a less-than-three-year payback are required to be part of a budget request. The EMS is supported by BHSO performance measure requiring that BNL continue to achieve third party certification. This contractual performance measure ensures that BNL will use third party certification and enables BHSO to allocate its environmental oversight resources to examine environmental issues, recognizing that BNL's EMS will be examined by external experts.

BNL. The site has effectively implemented significant environmental aspects that are being applied by directorates to their line operations so that specific objective and targets can be developed and implemented. Line organizations are provided with required targets for cross cutting aspects such as waste management and suggested aspects such as electronics stewardship. Progress in achieving these objectives is discussed during monthly meetings with line EMS representatives. The EMS representatives in most directorates report directly to the associate laboratory directors. In addition, BNL has an annual meeting between the directorates and the Laboratory Director, in which EMS achievements by the directorates are reviewed.

Within line organizations, BNL has established processes to effectively implement environmental aspects within work planning and control for research and work performed under Work Permits. For research, environmental elements are fully integrated in Experiment Safety Reviews (ESRs). For example, the Chemistry Department has an extensive ESR process, which includes sections on proper waste management and methods for integrating pollution prevention into experiments. Job Risk Assessments (JRAs) developed for these ESRs go beyond BNL expectations (which call for addressing safety and health) by including environmental elements. The BNL Work Permit also includes environmental concerns that need to be considered during work planning activities including the potential for liquid discharges and types of waste that may be generated.

BNL enhances implementation of these processes and overall environmental performance by deploying Environmental Compliance Representatives (ECRs) and/or Waste Management Representatives (WMRs) to directly support line organizations. These individuals have substantial environmental and/or waste expertise and were actively involved in line actions that involved environmental functions including project and experiment development and waste management. As a result, environmental compliance is being effectively integrated into planned work and experiments in most cases.

However, several line organizations do not have WMRs. These organizations instead use the deployed ECRs to perform waste management functions in addition to their assignments to support environmental compliance, which is not always an effective practice because of the ECR

workload and the fact that some ECRs view waste management functions as routine work that is not consistent with their education and experience. In addition, the ECRs have responsibilities to independently monitor and evaluate the implementation of waste management functions; having the ECRs perform the waste management functions impacts the ability to perform independent reviews.

Although environmental aspects are being effectively considered for research and work performed by Work Permits, BNL does not have a process for analyzing environmental aspects for Facility and Operations work performed as skill of the craft in shop areas. Several tools have been used to identify environmental elements in shop areas including the Process Assessment (discussed below) and toolbox training. However, these tools do not provide a method to formally ensure skill of the craft work has been analyzed and controls have been implemented for environmental elements and that these controls have been effectively communicated to the workers. The primary ISM tools for analyzing safety and health hazards and communicating the resulting controls to workers are the JRAs and FRAs; these tools do not include environmental elements, which is not consistent with the requirement of DOE Order 450.1 to implement the Environmental Management System within ISM. As shown in the appendix on Work Planning and Control, this Inspection identified a number of environmental concerns in Facility and Operations including the container for receiving aerosol can drainage left open and an Operations and Maintenance procedure for work that generated hazardous waste not referencing compliance controls. These concerns could have been avoided through effective identification and communication of environmental controls to workers through the established ISM work control processes. (See Finding #C-1)

Last year, BNL performed a comprehensive Multi-Topic Environmental Assessment that identified several nonconformances with waste management requirements. Although the proposed corrective action would enhance line support by expanding WMR availability, the effectiveness in communicating waste management controls to workers was not addressed. BNL continues to evaluate compliance through scheduled assessments over a multi-year period to ensure all environmental topics are covered. However, even though waste management concerns were identified in the Multi-Topic Assessment last year, the next assessment that will include waste management is not scheduled until next year.

Numerous sitewide activities have resulted in BNL winning three DOE P2 awards and a National Partnership for Environmental Priorities award for reducing mercury and PCBs on site. Process Assessments were effectively used to determine chemicals that are used and identify the waste produced in line operations so that controls could be developed to address pollution prevention opportunities. These assessments have been developed for most activities performed at BNL. In addition as discussed above, planned work processes such as experimental safety reviews and work performed under Work Permits include an evaluation of pollution prevention opportunities for new starts.

However, only four pollution prevention projects to reduce waste generation were performed this year; BNL claimed that the low number was due to limited funding at the facility level. Driven by a contract performance measure, BNL is studying means to obtain additional funding using either a fee on waste disposal or assigning the proceeds from scrape metal sells to support pollution prevention projects. Additionally, BHSO is requiring that pollution prevention projects with a less-than-three-year payback be included in budget requests. In the interim, the current funds are being used as seed money for funding pollution prevention projects and the environmental coordinators and/or waste management personnel deployed out of the

environmental office are assisting line organizations in identifying pollution prevention opportunities in daily activities.

E.3 OPPORTUNITIES FOR IMPROVEMENT

This Independent Oversight inspection identified the following opportunities for improvement. These potential enhancements are not intended to be prescriptive or mandatory. Rather, they are offered to the site to be reviewed and evaluated by the responsible line management, and accepted, rejected, or modified as appropriate, in accordance with site-specific program objectives and priorities.

BHSO

1. **Ensure a RCRA compliance review is conducted in a timely manner.** Specific actions to consider include:
   - Review ECR and WMR effectiveness in supporting line in achieving compliance with site and external requirements.
   - Review ECR role in waste management activities to identify potential conflicts with their responsibilities to perform independent reviews of that function.
   - Evaluate environmental aspect analysis and control development for skill of craft work activities and the effectiveness in communicating these controls to workers.

BNL

1. **Ensure environmental compliance and pollution prevention opportunities are fully addressed in ESRs/ASRs, work permits, and skill of the craft activities during work planning and control for work.** Specific actions to consider include:
   - Require that future Job Risk Assessments and/or Facility Risk Assessments include environmental aspects and establish a project and schedule to upgrade existing assessments to include the environmental aspects.
   - Perform a review of Plant Engineering maintenance procedures and preventive maintenance documents to ensure environmental controls have been adequately addressed.
   - Formalize toolbox training used by Plant Engineering to address environmental requirements and processes to include a subject outline, schedule for recurring training, and employee training record tracking.