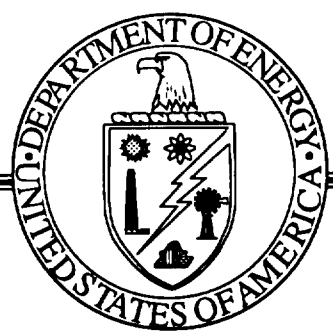
APPENDIX J

FIELD VERIFICATION REPORT
BROOKHAVEN NATIONAL LABORATORY
MAY 16 – 23, 1994



CONTENTS

ATTACHMENTS

EXECUTIVE SUMMARY

This report presents the results of a review of chemical safety vulnerabilities associated with facilities owned or operated by the Department of Energy (DOE) at the Brookhaven National Laboratory (BNL). The field verification review took place on May 16–23, 1994, and was part of the Chemical Safety Vulnerability Review being conducted by the Office of Environment, Safety and Health at the direction of the Secretary of Energy. The purpose of the review is to identify and characterize conditions or circumstances involving potentially hazardous chemicals at DOE sites and facilities—with emphasis on facilities being transitioned to, awaiting, or undergoing decontamination and decommissioning. Specifically, the review is designed to identify, characterize, and prioritize chemical safety vulnerabilities associated with conditions or circumstances that might result in (1) fires or explosions from uncontrolled chemical reactions, (2) exposure of workers or the public to chemicals, or (3) releases of chemicals to the environment. Activities involving hazardous chemicals at BNL are conducted in laboratories, process facilities, utilities, decontamination facilities, and waste treatment and storage facilities.

Field verification activities began with an analysis of the self-evaluation and visits to each facility examined in the self-evaluation. The self-evaluation included a review of a range of facilities, in addition to consideration of sitewide programs. The review was extended to additional facilities and interviews where further information was needed.

In all cases, the field verification review at BNL was conducted with a view toward identifying possible DOE-wide chemical safety vulnerabilities. Observations specific to individual operations or facilities were conveyed during the course of the site visit but were not considered further unless they appeared to be related to an issue that could be significant to a number of DOE sites. The effort did identify four issues that should be considered as part of the subsequent effort to identify DOE-wide chemical safety vulnerabilities. None of the conditions or circumstances identified requires immediate action to prevent severe consequences:

- Weaknesses in planning impede the effective elimination of hazards posed to workers and members of the public.
- Protracted implementation of core safety programs increases the potential for chemical safety vulnerabilities.
- Shortfalls in resources could lead to new chemical safety vulnerabilities and could impede the ability to resolve identified issues in a timely manner.
- Formal control measures have not been implemented to ensure that personnel who do not read or speak English understand the safety requirements and potential hazards associated with work in hazardous environments.

These vulnerabilities, along with those identified during field verifications at other DOE sites, will be evaluated to identify DOE-wide generic vulnerabilities. In addition, information from the Office of Environmental Management's Surplus Facilities Inventory Assessment and the extended review of facilities where there may be potential organic-nitrate vulnerabilities

(similar to those at Tomsk-7) will also be considered for any additional insights into potential chemical safety vulnerabilities.

Commendable practices observed by the field verification team included an effective and simple system for controlling plant maintenance work, an individual initiative to include a non-English speaking/reading clause in contracts, and the specific inclusion of chemicals in the safety analysis for the new Hazardous Waste Management Facility. These commendable practices, along with those observed at other sites, will be considered in developing the final report of the review of DOE operations.

1.0 INTRODUCTION

1.1 Purpose and Scope

Based on direction from the Secretary of Energy, the Assistant Secretary for Environment, Safety and Health established the Chemical Safety Vulnerability Working Group to review and identify chemical safety vulnerabilities at facilities operated by the Department of Energy (DOE). The information obtained from the review will provide the Working Group with valuable input for identifying generic chemical safety vulnerabilities that confront the DOE complex. Prioritizing the chemical safety vulnerabilities that are identified will establish the proper basis for departmental focus on programs, funding, and policy decisions related to chemical safety. The Secretary directed the Office of Environment, Safety and Health to lead this review, with full participation from DOE line organizations having operational responsibilities.

The Chemical Safety Vulnerability Review was designed and undertaken to identify and characterize adverse conditions and circumstances involving potentially hazardous chemicals at facilities owned or operated by the Department. Specifically, the review was intended to identify, characterize, and prioritize chemical safety vulnerabilities associated with conditions or circumstances that might result in (1) fires or explosions from uncontrolled chemical reactions, (2) exposure of workers or the public to hazardous chemicals, or (3) release of hazardous chemicals to the environment. Using input provided by line organizations having operational responsibilities, the Working Group developed the "Project Plan for the Chemical Safety Vulnerability Review," dated March 14, 1994, to guide the review.

This report documents activities related to the field verification phase of the Chemical Safety Vulnerability Review. The field self-evaluation process used a standardized question set developed and distributed by the Working Group to collect data related to chemical safety from 84 facilities located at 29 sites. Based on analysis of self-evaluation data, nine large sites, including Brookhaven National Laboratory (BNL), and four small sites were selected to participate in the field verification phase of the review. The field verification process was designed to use independent teams of technical professionals with experience in a variety of technical disciplines to confirm the accuracy and completeness of the data compiled during the field self-evaluation phase of the review.

The field verification team visiting BNL examined a broad range of facilities (based on facility type and operational status), with special attention given to those facilities being transitioned to, awaiting, or undergoing decontamination and decommissioning. Different types of chemical- and waste-handling facilities were examined to permit identification of vulnerabilities arising from hazardous chemicals and wastes at the site. Facilities selected for review at BNL included the Hazardous Waste Management Facility (HWMF), the Wastewater Treatment Plant, the Personnel Decontamination Facility Hold-Up Tank, the Tandem Van de Graaff Accelerator, and the Central Water Treatment Plant. Facilities were selected for review based on (1) the types of chemical hazards known to exist at given facilities; (2) the need to review a cross-section of laboratory, process, chemical storage, waste handling, and utility facilities; and (3) the need to examine chemical hazards associated with facilities at different points in their life cycle (such as operating, on standby, shutdown, or abandoned) or under changing mission.

The field verification team, under the direction of a DOE team leader, was composed of DOE and contractor personnel with technical expertise in various aspects of chemical safety, including management, operations, training, chemical process safety, industrial hygiene, maintenance, environmental protection, and emergency management. A team composition list is provided in Attachment 1 of this appendix.

The team began its review by visiting each of the facilities selected for self-evaluation. The team met with management or technical representatives from each of the facilities reviewed. Individual and small group meetings were also held, and team members conducted walkthroughs, document reviews, and personnel interviews to gather information related to potential chemical safety vulnerabilities at BNL. The team leader met daily with management personnel to discuss the team's activities and issues that may have surfaced during the previous day. Before the field verification team left BNL, management from local DOE and contractor organizations conducted a factual accuracy review of the draft report. An outbriefing was conducted on Monday, May 23, 1994. A draft copy of this report was left with DOE and contractor management.

1.2 Site Description

BNL is a multidisciplinary scientific research center located close to the geographical center of Suffolk County, New York, about 60 miles east of New York City (see Figure 1). The 5,620-acre site is mostly wooded, except for a developed area (see Figure 2) of about 1,600 acres. BNL was established by the Manhattan Engineer District of the U.S. Army Corps of Engineers, with its primary purpose being to advance scientific research in areas of interest to universities, industry, and government.

The Laboratory carries out basic and applied research in high-energy nuclear and solid-state physics, fundamental material and structural properties and interactions of matter, nuclear medicine, biomedical and environmental sciences, and selected energy technologies.

1.3 Facilities Visited

Facilities reviewed at BNL included the three facilities that participated in the self-evaluation phase of the Chemical Safety Vulnerability Review. In addition, the Tandem Van de Graaff Accelerator was reviewed by the team to evaluate potential issues and for comparison of similar issues found at other sites. Since chlorine use is being reviewed as an issue of special concern, review efforts were extended to the water treatment facilities. The field verification team reviewed activities involving hazardous chemicals in the following facilities at BNL.

Hazardous Waste Management Facility: The HWMF supports operations of the Laboratory through the removal of wastes generated at the site. This complex is the principal area for handling, packaging, and storing Resource Conservation and Recovery Act hazardous waste and DOE radioactive waste material generated at BNL. Activities are located within a fenced area of about 12 acres in the southeastern corner of the site. Two buildings are used for storage of hazardous wastes (Buildings 444 and 446), with another designed specifically for the storage of wastes packaged in drums (Building 483). Flammable and reactive wastes are

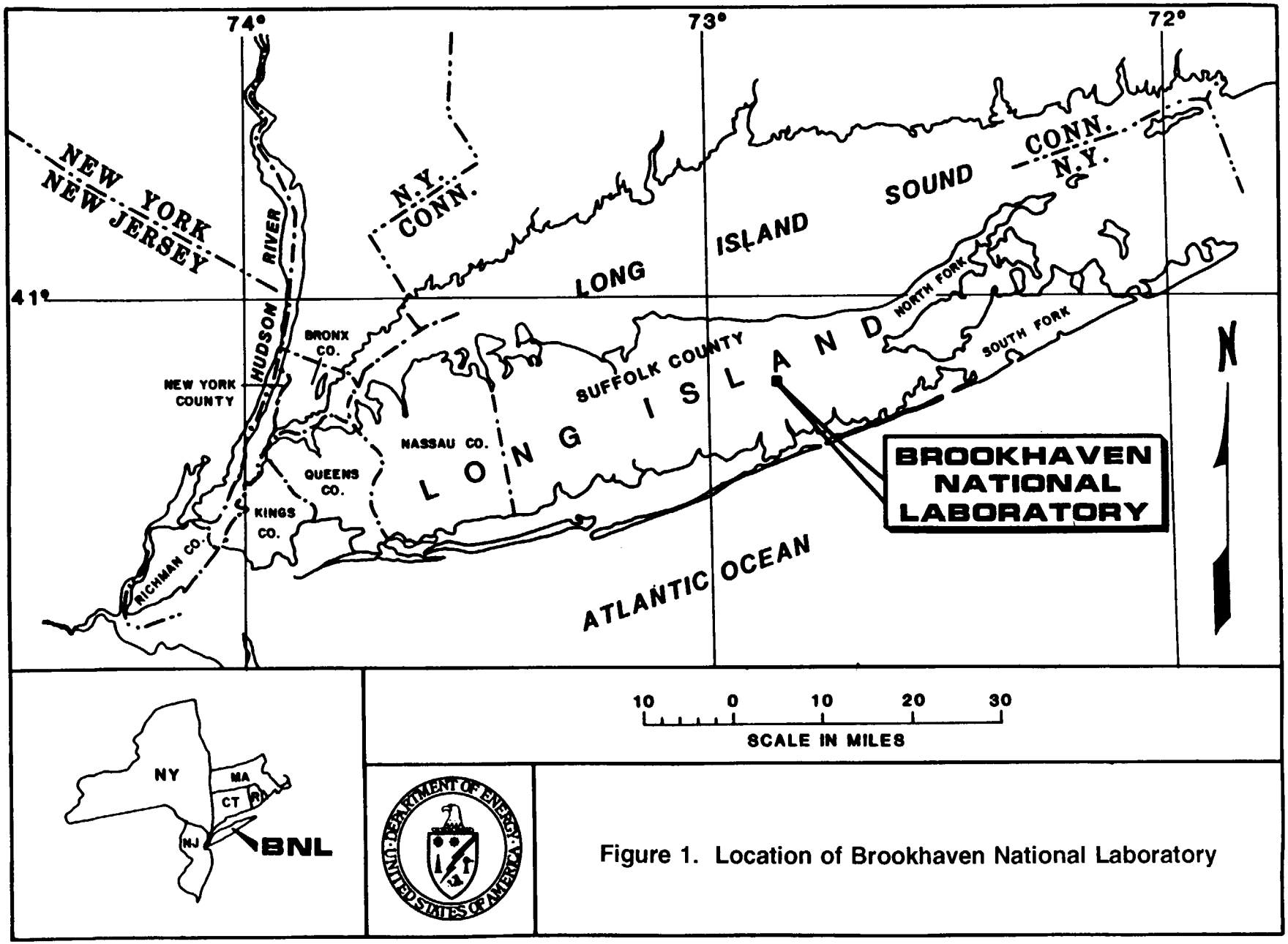


Figure 1. Location of Brookhaven National Laboratory

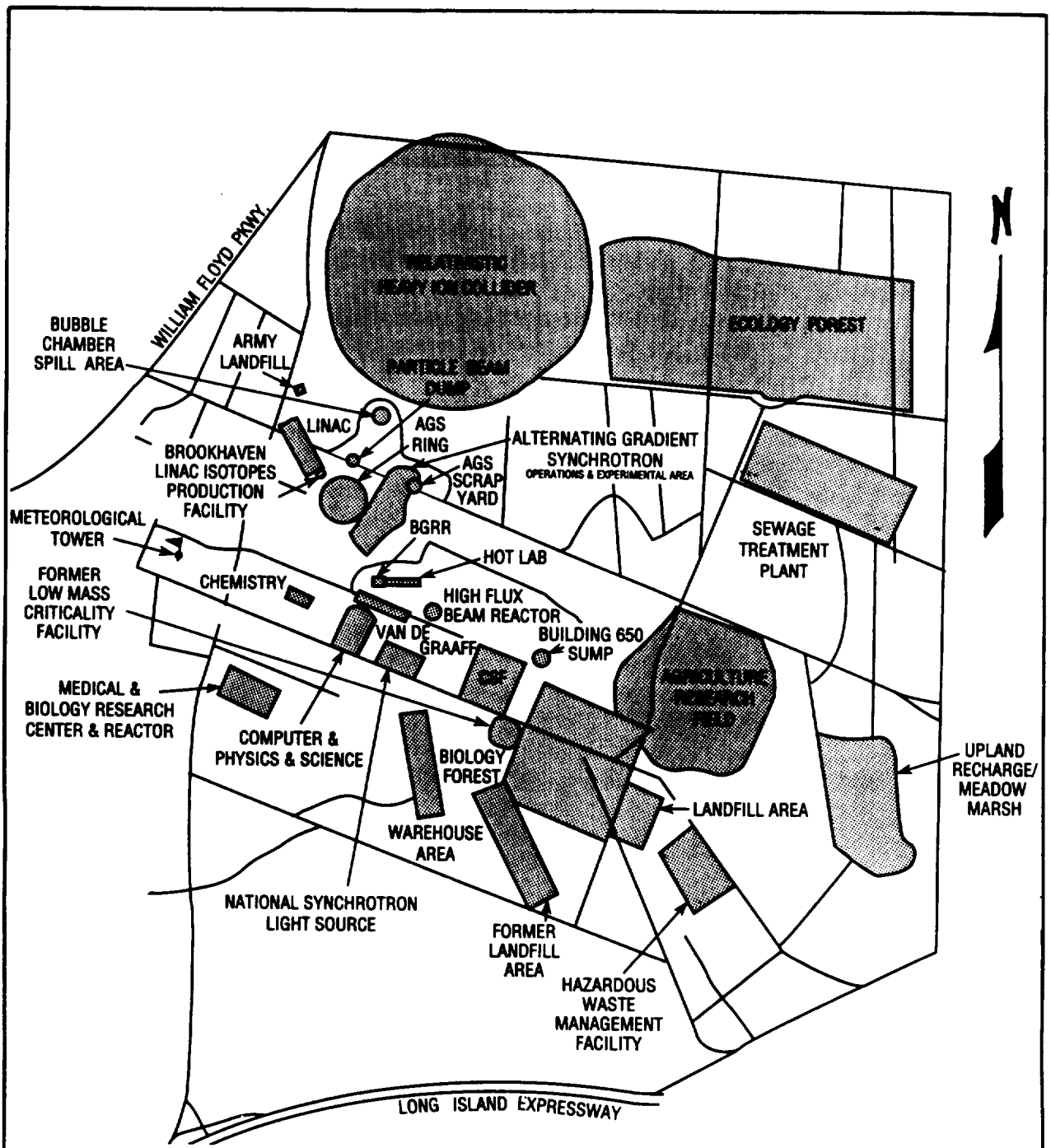


Figure 2. Major Facilities at Brookhaven National Laboratory

stored in three stand-alone "Haz-Stor" buildings (Buildings 360, 361, and 386). All HWMF buildings are used for the interim storage of hazardous wastes before packaging for offsite shipment.

With the exception of Building 483, most existing buildings were constructed between 1956 and 1966. Construction of a new HWMF is expected to begin in the near future. On completion of the new HWMF, the existing facility will be decommissioned. Initial characterization and remedial actions are being addressed by the BNL Office of Environmental Restoration.

Wastewater Treatment Facility: The sewage treatment facility is located northeast of the developed portion of the site. The purpose of this facility is to provide treatment of sanitary wastewater for protection of the environment and to meet regulatory discharge requirements.

Most of the sewage collection system was built by the U.S. Army in 1942. Treatment units at the facility include barminutors and grit chambers, prechlorination with sodium hypochlorite, a 250,000-gallon clarifier for primary clarification, and sand filtration by two of six sand filter beds with underlaid effluent collection. Subsequent discharge is to the headwaters of the Peconic River. Adjustment of pH is conducted by addition of lime to the sand filter beds. Average monthly sewage flow rates vary from 0.5 to 0.8 million gallons per day. Improved sewage collection and treatment is planned, funded, and initiated.

Inactive treatment equipment at the facility includes an Imhoff Tank, sludge-drying beds, and World War I-era sand filter beds. The Imhoff Tank was used for both wastewater clarification and sludge digestion. Sludge in slurry form was dried in the sludge-drying bed located near the Imhoff Tank. The old sand filter beds are overgrown with vegetation. Characterization of the entire wastewater treatment facility is being addressed by the BNL Office of Environmental Restoration.

Personnel Decontamination Facility Hold-Up Tank: The Personnel Decontamination Facility Hold-Up Tank (Tank 490-07) is a 550-gallon water collection tank, located below grade at the BNL Medical Research Center, Building 490. The purpose of this tank is to collect rinsewater generated as a result of emergency decontamination of patients. The tank has never been used, and plans are in place for its removal.

Tandem Van de Graaff Accelerator: The Tandem Van de Graaff Accelerator, operated by the Physics Department, has been in use since July 1970 and includes two Tandem Van de Graaff machines that can be used independently or in a coupled mode. The two machines are housed in a long building with a control room at its center, a mechanical equipment room containing water pumps and high-speed gas-handling equipment for pressurizing the accelerators with insulating gas, and various experimental stations in target rooms with a series of beam lines directed into them. Office and laboratory areas are adjacent to the experimental areas. Each accelerator has a capacity of 11,000 cubic feet of a mixture of nitrogen, carbon dioxide, and sulfur hexafluoride insulating gas at a pressure of 12–15 atmospheres.

Central Water Treatment Plant: The Central Water Treatment Plant was built in March 1964 to reduce the high natural concentration of carbon dioxide, iron, and low pH of groundwater in

this area. The plant was designed to provide up to 4,500 gallons per minute of treated water. This plant is located on the western side of the developed site. Treatment consists of aeration, lime neutralization, coagulation, and filtration. Ten 150-pound cylinders contain the chlorine gas used for water disinfection. The original plant was renovated in 1986 and new filters were installed; however, the chlorine addition system was not renovated.

2.0 SUMMARY OF RESULTS

Field verification is one phase in the process of arriving at a conclusion regarding the existence and significance of chemical safety vulnerabilities across the DOE complex. The field verification process was designed to use independent teams of safety professionals to confirm the accuracy and completeness of the data provided to the Chemical Safety Vulnerability Working Group by BNL for facilities selected to participate in the field self-evaluation process. The verification process offered an opportunity to examine site-specific chemical safety vulnerabilities and to make informed judgments about the relevance of these conditions as they relate to determinations of generic chemical safety vulnerabilities.

The goal of the field verification team was to identify and prioritize chemical safety vulnerabilities at BNL. Before arriving on site, the team reviewed the self-evaluation data and other documents to allow team members to develop a list of observations related to potential vulnerabilities for their functional area. During the onsite portion of the review, team members visited the facilities that participated in the self-evaluation to confirm reported observations and to look for other conditions and circumstances that could result in chemical safety vulnerabilities. In some instances, facilities or areas that were not involved in the original self-evaluation (i.e., Tandem Van de Graaff Accelerator and Central Water Treatment Plant) were reviewed and have provided valuable additional information.

To support effective team management and to expedite the identification of vulnerabilities across a wide range of technical disciplines associated with chemical safety, each field verification review has been organized to include five functional areas:

- Identification of chemical holdings, including the properties of chemicals located at the facility, the characterization of those chemicals, and an analysis of the inventory.

- Facility physical condition, including engineered barriers, maintenance conditions, chemical systems, safety systems, storage, monitoring systems, and hazards identification.

- Operational control and management systems, including organizational structure; requirements identification; hazard analysis; procedural adherence; maintenance control; engineering and design reviews; configuration control; safe shutdown plans; and site programs for quality assurance, chemical safety, inventory control, access control, disposal, transportation and packaging, and corrective actions.

- Human resource programs, including technical competence, staffing, training and qualifications, employee involvement, employee concerns, personnel performance requirements, and visitor and subcontractor control.

- Emergency management program, including the emergency plan, inplant consequences, environmental issues, coordination with the community, and community right-to-know issues.

These functional areas were evaluated on the basis of lines of inquiry provided in Attachment 1 of the "Field Verification Guide for the Chemical Safety Vulnerability Review," dated April 8, 1994. Verification of the self-evaluation data was accomplished by walkthrough of facilities, conduct of interviews with management and technical personnel, examination of facility and site documentation, and review of incident reports and other documents.

The self-evaluation report for BNL appeared to paint too optimistic a picture of the status of programs used to control hazardous chemicals. It did not identify existing weaknesses and only provided a hint of plans for improvement. To a large extent, the field verification team confirmed the existence of vulnerabilities at BNL that had been identified at other sites, even where those vulnerabilities had not been identified in the BNL self-evaluation. The team's identification of generic chemical safety vulnerabilities attempted to emphasize those issues that appeared to have DOE-wide implications.

Summaries of the functional areas are provided in the sections below. Completed chemical safety vulnerability forms resulting from the field verification activities at BNL are provided in Attachment 2 of this appendix.

2.1 Identification of Chemical Holdings

Three facilities were reviewed at BNL from a chemical inventory standpoint: the Tandem Van de Graaff Accelerator (Building 901A), the Central Water Treatment Plant (Building 624), and HWMF (primarily Buildings 444 and 446). Information relevant to chemical process safety was obtained through facility inspections; interviews with operating staff; reviews of facility safety and operating policies, procedures, and logs; and drawing and independent review documents relating to the facilities.

The Tandem Van de Graaff Accelerator facility has the proper safety systems in place to ensure that the insulating gas (41,000 pounds as of May 1994, composed of 45 percent sulfur hexafluoride, 45 percent nitrogen, 5 percent carbon dioxide, and 5 percent oxygen) does not present an asphyxiation risk to the operators. The pure sulfur hexafluoride (28,000 pounds as of May 1994), which is used on an as-needed replenishment basis, is contained in an underground bank of 39 "excessed" helium storage cylinders. The manifold system for distributing this gas is in a remotely located building. The insulating gas system pressure is monitored continuously and the system will lose 2–3 percent of the active inventory annually during normal operations. This release is readily accommodated by the building ventilation system; most of the loss goes into the central vacuum system (beam area) and is exhausted directly outside. Examination of the internal components of the accelerator shows that the primary containment barrier has incurred no physical degradation. Alarms are installed to ensure sufficient levels of oxygen are present and to detect the presence of sulfur hexafluoride in the operating areas. Three storage cabinets contain solid compounds of 58 elements (mainly metal salts). The content in any one container is below the Laboratory-wide reporting system threshold, but these materials were included on a list provided by the facility staff. This facility has its own configuration management system, an effective computerized

preventive maintenance control scheme for experimental equipment and safety-related systems, and a captive operating staff. The safety analysis document used as a basis for interim operation addresses the requirements in DOE 5480.25, "Safety of Accelerator Facilities," and has been submitted to the Brookhaven Area Office for approval. The equipment has been maintained in good operating condition (the facility has been in operation for almost 25 years), procedures are in place, operating logs are kept, and it is apparent that the management and operating personnel in this area take pride in the safety and quality record that they have achieved. There were no conditions identified in this facility that would lead to a chemical safety vulnerability.

The Central Water Treatment Plant has an isolated room, with its own outside entrance, which contains up to 10 chlorine cylinders (up to 1,500 pounds total chlorine is permitted and this limit is administratively controlled). The quantity of chlorine in the active cylinder bank is recorded each workday and is based on weight differentials. The high-chlorine alarm signal is fed into the control room and was demonstrated to be operational. The potential exists for exposure of employees to chlorine because procedures for handling chlorine were not available in the room where the active cylinder bank is installed. The team noted a distinct chlorine odor during the initial visit, but the odor was not noticeable during return visits (see Vulnerability CSVR-BNL-000-03). The development of the draft Chlorine Handling Procedure indicates that BNL is taking steps to alleviate problems associated with the lack of procedures. Some operating procedures were on file in the operating room, but most of the actual job performance is based on operator proficiency. This facility does not differ from ordinary municipal water treatment installations, so it is exempt from requirements in DOE 5481.1B. No hazardous wastes are generated by this facility.

The accumulation, storage, packaging, and eventual offsite shipment of Laboratory-generated hazardous wastes are performed at the HWMF. At the time of the Chemical Safety Vulnerability Review, approximately 215,000 pounds of hazardous chemicals and wastes were stored in this facility. This varied from 114,000 pounds of "evaporator bottoms" (less than 3 percent is actual radioactive contaminated residues; the rest is concrete/vermiculite encasement) to gram quantities of "acutely hazardous" (such as cyanide) materials. The hazardous materials are logged in on BNL Form 2568, "Hazardous Materials Waste Control Form (Nonradioactive)," and assigned a serial number by HWMF personnel. The inventory is controlled (the team was provided with specific as well as overall inventory data on request) while the material is within the facility fence. A sitewide program for handling or recycling unused chemicals does not exist. Storage conditions range from unprotected to sheltered with heat, depending on waste sensitivity to environmental conditions. Material degradation was evident, especially on cylinders that contain unknown gases and are stored outside. The facilities are old, and construction of a new facility is scheduled to begin in August 1994, with completion projected for calendar year 1996 or later. A preliminary hazard assessment was conducted for this facility in January 1994. The Implementation Plan for the Basis for Interim Operation document was rejected by the Brookhaven Area Office; a second version is scheduled to be submitted in May 1994. BNL workers are unnecessarily exposed to hazardous chemicals because such materials are treated as waste instead of being recycled; the requirement that some packages be opened and repackaged based on after-the-fact changes in shipping criteria; and the potential for repackaging due to repository or governmental policy shifts at other DOE facilities. (See Vulnerability CSVR-BNL-000-01.)

In summary, potential chemical safety vulnerabilities related to chlorine handling in various water treatment processes (see Vulnerability CSVR-BNL-000-01) and in processing hazardous wastes (see Vulnerability CSVR-BNL-000-01) exist at BNL. This chlorine-handling vulnerability could also affect the public.

2.2 Facility Physical Condition

The field verification review included a detailed walkdown of the Tandem Van de Graaff Accelerator (Building 901A), Central Water Treatment Plant (Building 624), Wastewater Treatment Facility (Buildings 575 and 579), and HWMF (Buildings 444 and 446) to gain an understanding of the physical condition of the structures, process equipment, utilities, and primary and secondary containment systems and to confirm data contained in the self-evaluation report. First-line maintenance supervisors, design engineering personnel, and maintenance management personnel were interviewed to determine the overall physical condition of the facilities and the quality of BNL maintenance programs.

At present, the mechanical integrity of the primary and secondary containment systems and equipment appears to be generally satisfactory for the facilities included in the field verification at BNL. However, maintenance and manpower budgets have remained essentially constant for the past 4 years in spite of a deteriorating physical infrastructure and new environment, safety, and health (ES&H) needs. There is no direct relationship between the physical condition of a facility and the preventive maintenance budget for that facility. Examples include the HWMF (Building 483), where the safety shower was inoperable; the waste incinerator (Building 444), where electrical repairs are incomplete; and the diesel fuel tank (Building 446), which is not equipped with secondary containment. There is no formal preventive maintenance budget for the HWMF. Sitewide, the preventive maintenance program has about 2,730 open work orders from the average 8,400 done each year. In addition, the corrective maintenance program is by its very nature reactive and, at present, has about 1,970 open work orders from the average 10,500 done each year. Enhancement of the existing sitewide predictive maintenance program using techniques to indicate the need for preventive maintenance before equipment fails would provide additional protection against failures that could lead to incidents involving hazardous chemicals. There is no formal sitewide pressure vessel or piping inspection program using ultrasonic or radiographic test methods to monitor system deterioration. With the exceptions of thermography of high-voltage electrical power lines, transformer oil testing, and vibration analysis at the Central Steam Plant and Central Chilled Water Plant, the predictive maintenance program at BNL is not consistent with generally accepted industrial practices.

The BNL *Operations and Maintenance Manual* provides a standard for developing and implementing maintenance management programs using a graded approach as provided for in DOE 4330.4A. However, under the terms of the BNL standards, many provisions of DOE 4330.4A have been identified as not applicable for BNL facilities. BNL did not prepare an annual site maintenance plan, as defined in DOE 4330.4A, in fiscal year (FY) 93 (nor was one requested by the Chicago Operations Office). In FY 92, the annual work plan document was used as the site maintenance plan per instructions from the Chicago Operations Office. Maintenance implementation plans, as defined in DOE 4330.4A, have been prepared for the two BNL reactors. The two recently identified nonreactor nuclear facilities, which include the HWMF, have not yet prepared maintenance implementation plans but have committed to do

so in FY 94. Annual budget preparation for routine preventive and corrective maintenance is based largely on the previous year's budget, adjusted for inflation and for new, known, recurring maintenance requirements. Major maintenance projects are identified and performed on a priority basis. The annual work plan, an outline document requested by the Chicago Operations Office, governs the preventive and corrective maintenance budget for FY 92 through FY 98. No annual update has been requested or furnished since FY 92. A less-than-adequate maintenance planning and budgeting process, in conjunction with a fixed maintenance staff level and an expanding inventory of facilities, has resulted in a deteriorating facility physical condition. Innovative approaches to conducting routine maintenance have permitted maintenance personnel to work smarter and have forestalled more rapid facility deterioration.

A computer-based program, the Maintenance Control Reporting System, is used to develop comprehensive work packages for routine corrective and preventive maintenance. This system provides computer-generated work procedures, maintenance work orders, replacement-part serial numbers, warehouse inventory information for over 10,000 consumable replacement parts, and cost-accounting information relating to the specific work orders. The creation and use of this program for routine maintenance work control by Plant Engineering Division is considered a commendable practice.

To promote the safety of maintenance and engineering personnel while work is performed, engineered design safeguards are included in facility design, modification, and maintenance packages. The Plant Engineering Division has developed the computer-based Key Plan to provide a visual display of each structure at BNL and to indicate where safety instructions are mandatory when preparing corrective or preventive maintenance packages. To provide further assistance, Plant Engineering Division personnel have also developed and maintain a computer-based visual display that generates detailed illustrations of site physical structures, utilities (electrical, water, steam, and sewers), environmentally sensitive areas, and topographic features. Routine inspections of selected facilities are conducted, backflow controllers and pressure-relief devices are tested, and piping identification is verified. For example, mechanical equipment rooms are inspected at 6-month intervals for various items, including pipe labels; the 500 backflow control devices on site are formally tested every year and rebuilt or replaced every 5 years; pressure-relief valves at the steam plant are rebuilt, calibrated, and tested on a formal schedule every 3 years; and air compressor pressure-relief valves are maintained on a yearly schedule. Health and safety personnel interface with engineering design personnel during the project review and approval process.

Chlorine gas is used at the Central Water Treatment Plant (Building 624) and at six potable water supply wells for iron content reduction and for biological control. Ten 150-pound cylinders are manifolded to a pressurized chlorine gas header operating at 80 pounds per square inch upstream of the pressure regulator. Brass fittings on the chlorine gas manifold at Building 624 were corroded; indications of a leak were observed immediately downstream of the pressure regulator; and a distinct odor of chlorine was detected in the chlorinator room during the familiarization tour (see Vulnerability CVSR-BNL-000-01).

2.3 Operational Control and Management Systems

The facilities selected for this review pose low hazards relative to other industrial and research operations at BNL and elsewhere. The operational control and management systems applied to the selected facilities are not inconsistent with the present operations.

BNL has recently put in place an array of policies and procedures, many of which are related to safe management of hazardous materials. The ES&H Management Plan has set forth a blueprint for the kind of programs that should be put in place at the site and includes a variety of activity data sheets summarizing possible areas of improvement. The overall chemical safety program will be greatly enhanced if these improvements are completely and correctly implemented.

The self-evaluation document provided a summary of important operational control and management systems at the site. The field verification team had the opportunity to review numerous documents regarding sitewide operational control and management systems, to discuss actual practices with site staff, and to observe conditions at the facilities selected for review.

As clearly set forth in the ES&H standards and other key site documents, most safety-related work at BNL is organized according to a graded approach to safety. Numerous documents require that the level of quality and formality for safety analysis and equipment be determined through an analysis of the risks posed by prospective operations. The standards and manuals go further and provide helpful details on how to actually implement a graded approach. BNL-O&M-I-01O, *Operations and Maintenance Manual* delegates responsibility "for establishing the Laboratory's conduct of operations, and maintenance management, and for the administration of these programs" to the Associate Director for Management and Physical Plant. Associate and Assistant Directors are responsible "for ensuring that the conduct of operations policies are supported and implemented in the programs under their jurisdiction. Cognizant Associate and Assistant Directors shall approve Conduct of Operations Conformance Matrices prepared by departments and divisions with their line of authority." Finally, "Department Chairpersons and Division Heads are directly responsible for implementing conduct of operations programs. They shall ensure that departmental and division facilities and activities comply with the conduct of operations requirements based on a graded approach that considers the risks involved with the activity." Note that supervisors are responsible only for acting in accordance with the "general conduct of operations principles."

Under the basic systems that control work involving hazardous chemicals at the site, the fundamental decisions on the level of operational controls to be applied to each operation are made by various line management organizations. As noted in Section 2.2, sitewide maintenance programs are carried out under overhead work orders. Work orders properly identify the basic safety precautions for work by crafts personnel in possibly hazardous areas (e.g., reactive chemical management). The effectiveness of this system depends on (1) the ability of the line to identify and secure support for its changing resource needs and (2) the willingness of senior management to fund sitewide and overhead programs necessary for progress in safe management of hazardous chemicals.

BNL policies do not appear to provide for a separate vision regarding the need for engineered barriers in the management of hazardous chemicals, nor do the various manuals and standards explicitly embed strong administrative controls over hazardous chemicals as a key activity or priority. Resources allocated to date have not resulted in consistent or fully implemented controls over hazardous chemicals at all facilities. Clearly, providing employees with stronger controls over possible hazards encountered when working with chemicals will improve the occupational health program. Weaknesses involving management support and emphasis have been considered as vulnerabilities at other sites.

As a related matter, BNL has initiated an evaluation of the difference between existing programs and those required for the Occupational Safety and Health Administration Voluntary Protection Program status. If a commitment is made to move to such a program, a number of changes will have to be made to provide stronger operational controls over hazardous chemicals.

The current hazard analysis methodology is evolving with regard to chemical hazards. However, the accuracy and usefulness of the hazard analysis process is strongly dependent on the accuracy and thoroughness in identifying potential hazards in the workplace (e.g., in room locations, types, and conditions of chemical in each process and room). The self-evaluation did not identify any weaknesses in this area.

The hazard analysis methodology employed in the existing HWMF appears to be fairly superficial, and a decision has been made (reflected in a formal "basis for interim operation") to forgo further analysis pending shutdown of the facility in 1996. A more complete document, a preliminary safety analysis report, is being prepared for replacing the HWMF and contains an analysis of hazards posed by chemical operations in the new facility. The team noted that vulnerabilities are created by a less-than-adequate characterization of processes involving hazardous chemicals (see Vulnerability CSVR-BNL-001-01). As discussed in Section 2.1, the successful use of hazard analysis is directly related to the accuracy and completeness of the chemical inventory.

Each of these observations is traceable, in part, to the difficult circumstances that arise when new requirements and directions are issued during a period of limited and possibly declining budgets. The fundamental structure of placing most of the Safety and Environmental Protection Division costs in an overhead account, together with a well-publicized effort to constrain growth in the overhead account, appears to create a potential for built-in conflict between research mission and excellence in ES&H.

The team's review of existing and planned ES&H programs and budgets resulted in a general conclusion that weaknesses, if left unchecked, will turn into new or more severe chemical safety vulnerabilities. This was identified as a vulnerability for further consideration as a DOE-wide concern. Vulnerability CVSR-BNL-000-03 was identified as a medium-priority vulnerability that could result in short-term consequences.

2.4 Human Resource Programs

Verification activities associated with the human resource programs functional area focused on training and qualifications, technical competence, employee involvement, staffing, employee

concerns, and visitor and subcontractor control. Discussions related to human resource programs were held with BNL management, training, and operations personnel. BNL policy documents related to chemical safety programs were also reviewed. Procedures and documents were examined to review the strategy used to implement policies. During the course of these activities, one chemical safety vulnerability was identified concerning the protracted period over which core safety programs are implemented (see Vulnerability CSVR-BNL-000-02).

The Tandem Van de Graaff Accelerator (Building 901A), the Central Water Treatment Plant (Building 624), and the HWMF (primarily Buildings 444 and 446) were visited. Personnel assigned to these facilities were interviewed to determine the effectiveness of the implementation of human resources programs relative to chemical safety in the workplace.

BNL promotes worker awareness of safety issues related to chemicals. Chemical hazard information is communicated to employees in many ways. In addition to formal training, facility-specific safety briefings are provided for all personnel entering certain facilities. The BNL Training Policy has been approved; however, the lower tier program-implementing documents are incomplete and lack the rigor associated with a formal training program. A training manual addressing this issue is in the early stages of development.

With three exceptions, staff levels in areas related to chemical safety were found to be sufficient to ensure that personnel are not working excessive hours and have sufficient time to address chemical safety issues. At HWMF, operations personnel have been working an average of 46 hours per week for the past 6 weeks. This fact has been noted by BNL management, and several additional HWMF operations positions are in the process of being approved. In the Occupational Safety and Health Training Department, personnel have been working an average of 55 hours per week for the past 6 months. Action has not been taken by BNL management to address this resource variance. The ratio of full-time equivalent training personnel to total staff at BNL is much less than that of many other DOE facilities.

In addition, although a variety of health and safety professionals are available to support operating facilities (with sufficient resources generally available to oversee routine chemical activities and provide technical assistance), adequate industrial hygiene and occupational safety resources are not available to provide infrastructure and programmatic support (see Vulnerability CSVR-BNL-000-03).

The team found that BNL first-level management has been addressing employee concerns effectively. BNL has implemented a formal program to address these concerns. The program is independent of the line organization. Employees regard the program as effective and useful, although it is more appropriate for personnel-oriented issues than safety-related issues. The formal BNL program is administered by the Employee Relations Committee, which ensures confidentiality of the program and provides activity reports to the director. This program is supplemented by the DOE Occupational Safety and Health (OS&H) Protection Program.

The BNL Self-Assessment Program has been established to determine the adequacy of efforts in achieving ES&H goals. The program uses multitiered approach involving appraisals and multiple levels of self-assessment. The Office of Planning and Program Review coordinates

self-assessments of the adherence to BNL policies, procedures, and requirements. The Laboratory ES&H Management Advisory Committee oversees the process and provides an annual report to the director. Implementation of the program is lagging; the results of self-assessments are not shared with affected personnel; the 1992–93 Tier II Self-Assessment Report and the 1993 Annual Self-Assessment Report have not been published (draft reports have been shared with management); and personnel have not received training prior to performing self-assessments.

The prescription of training for an individual is the responsibility of the individual, his or her immediate supervisor, and management of the facility or program in which the individual is employed. Each supervisor is responsible to ensure that the individual receives the requisite training of his or her respective organization. Safety training requirements, the emphasis placed on the completion of training, and the accuracy and retention of records vary greatly between organizations. BNL is working to implement a centralized training data base, which should improve recordkeeping.

The communication required to establish and maintain a cohesive and effective safety training function in the BNL organization is extensive. At some facilities, communications regarding work assignments, job location, and required safety training do not ensure that all BNL personnel and visitors are receiving proper safety training before being granted unescorted access.

A fence does not surround the entire BNL perimeter, nor is there a perimeter patrol road. General access to the BNL site is through monitored entry points. Perimeter access control is consistent with the level of chemical hazards and other potential threats. Once an individual is inside the perimeter, entry into some facilities is uncontrolled. Personnel assigned to BNL facilities are encouraged to supplement access control by challenging all unknown personnel in the facility.

The effort of one construction safety engineer to address the issue of safety and hazard awareness for subcontractor personnel who do not read or speak English was recognized as a commendable practice. Contract specifications to address this issue have not been institutionalized and no formal control measures (such as testing) have been established to verify comprehension of chemical safety requirements and hazards by non-English speakers. This is considered to be a chemical safety vulnerability (see Vulnerability CSVR-BNL-000-04).

A potential exists for a chemical safety vulnerability at BNL due to the protracted period over which core safety programs are implemented. These programs include mandated ES&H training programs, hazards analysis programs, emergency preparedness, and a complete integrated sitewide chemical inventory system (see Vulnerabilities CSVR-BNL-000-01 and CSVR-BNL-000-02).

2.5 Emergency Management Program

The emergency management program for BNL has been in place for many years and continues to evolve as new needs are identified and new requirements are imposed. The sitewide and facility-specific emergency plans were not originally developed with a view toward mitigating potential releases of hazardous chemicals but focused predominantly on

radiological and nuclear criticality issues, with hazardous chemical issues receiving less emphasis. This review evaluated the existing documentation and capabilities with a specific focus on chemical safety vulnerabilities. This approach included review of emergency plans and procedures, review of other related documents and inspection records, conduct of walkthroughs of various facilities, review of emergency response facilities and equipment, and conduct of interviews with numerous individuals representing all facets of the emergency preparedness program.

BNL has developed a sitewide emergency plan, augmented by individual facility-specific local emergency plans for significant site facilities. The sitewide emergency plan addresses multiple types of events, including chemical hazards events, radiological and criticality events, natural phenomena, severe-weather events, and security events. These plans do consider a range of real and potential hazards, including chemical hazards; however, they were not developed using the results of a mature hazards identification and analysis program because that program is not complete. Completion of the hazards identification and analysis program is planned for December 1994, if adequately funded. In addition to the broad-based plans, topic-specific plans have been developed where necessary (e.g., for oil spills and hazardous materials).

Coordination with offsite authorities and organizations is implemented primarily through interaction with, and participation on, the Suffolk County Local Emergency Planning Committee. BNL has the only fire department in Suffolk County composed entirely of full-time, paid personnel. The fire department participates in the county-wide mutual-aid agreement, which includes over 100 other fire and emergency services organizations. Members of the BNL fire/rescue department are highly trained and appear fully qualified to perform the full range of emergency response duties they may be called upon to perform. In fact, BNL provides fire/rescue personnel and equipment as a significant resource for assistance throughout Suffolk County, including response to offsite hazardous materials incidents.

BNL does not have a formal program for performance-based, position-specific training for other members of its emergency response organization. Instead, BNL relies on individual employees to read those emergency response procedures for which they are responsible; to attend procedure briefings when new procedures are issued; and to participate in drills and exercises. This approach has been identified as a weakness on a number of occasions, most recently during a January 1994 appraisal by the Chicago Operations Office; however, as of this time BNL has not changed its training process.

The BNL Emergency Plan does not appear to recognize "sheltering in place" as an effective protective action, especially for hazardous-chemical events. Evacuation of personnel is the only protective action discussed. Hazardous-chemical events are characterized by little or no warning before the actual release, and by the fact that physical contact with the released material is the only means of receiving a dose. Therefore, evacuation could actually expose site personnel to the hazard. On the other hand, sheltering is very effective for short periods of time to prevent or significantly reduce exposures to hazards not involving direct radiation.

Another weakness of the BNL Emergency Plan is the implicit assumption that there are no events with consequences that would involve the offsite public. Although the notification of offsite authorities is addressed in the sitewide emergency plan, the supporting safety

assessments do not address potential public impacts, which necessitate special planning. For example, the BNL document providing a basis for interim operations of the HWMF concludes that "no significant off-site release or consequences would result from a postulated major chemical spill." Even if this were true, a more proactive treatment of this issue, including explicit provisions to cope with possible offsite impacts, would demonstrate the Department's full commitment to protection of the public and the environment.

Facilities and equipment necessary for response to hazardous-materials incidents were generally available but varied from facility to facility. During facility walkdowns, the team noted the general availability of eyewash stations, emergency showers, and personnel protective equipment in most locations where such equipment may be needed. Within the last few months, BNL has received two new fire trucks with 1,500 gallon-per-minute pumpers, the specifications and equipment loadings of which were developed by BNL firefighters. In addition, BNL has an initial response hazardous-materials vehicle that is equipped to support initial response operations up through and including Class A chemical suits. A more extensively equipped trailer for hazardous-material incident response is also available and would be brought to the scene of the incident by the BNL Utilities organization.

BNL is in the process of moving the Emergency Operations Facility (EOF) from a nondedicated facility on the second story of the Police Group Headquarters, Building 50, to a dedicated bunker-type facility, Building 754. For hazardous-materials emergency consequence assessment, BNL uses EPIcode®, Version 4.1. BNL has an upgraded meteorological tower and other provisions for acquiring real-time meteorological data, including the colocation onsite of the Next Generation Radar (NEXRAD) Facility of the National Weather Service/National Oceanographic and Atmospheric Administration.

Exercises and drills are part of the emergency preparedness program and were addressed in the sitewide emergency plan. Some offsite authorities and response organizations are afforded the opportunity to participate in drills and exercises.

In summary, the overall state of emergency preparedness at BNL has not resulted in identification of a significant chemical safety vulnerability from the limited standpoint of this review. However, the thoroughness and rigor applied to emergency planning and the level of maturity of the emergency preparedness program vary considerably from facility to facility, with the overall program considered marginal. The BNL emergency preparedness program was the subject of a detailed review by the Chicago Operations Office during January 18–28, 1994. The basic findings of that review were confirmed by the field verification team, and additional weaknesses were identified for consideration by BNL. It should be noted that a significant number of new and/or revised standard operating procedures for the emergency plan have been implemented over the past few years and that a number of necessary (significant) improvements in the overall emergency preparedness program are scheduled for completion by the end of December 1994.

3.0 CATEGORIZATION AND PRIORITIZATION OF VULNERABILITIES

3.1 Criteria

A vulnerability is a weakness or potential weakness involving hazardous chemicals that could result in a threat to the environment, the public, or worker health and safety. Vulnerabilities can be characterized by physical or programmatic conditions associated with uncertainties, acknowledged deficiencies, and/or unacknowledged deficiencies in the area of chemical safety. Conditions required to create the vulnerability should either currently exist or be reasonably expected to exist in the future, based on degradation of systems and chemicals or through expected actions (e.g., D&D of facility).

A vulnerability will be determined to exist if current or expected future conditions or weaknesses could result in either of the following:

- The death of or serious physical harm[1] to a worker or a member of the public or continuous exposure of a worker or member of the public to levels of hazardous chemicals above hazardous limits; or

- Environmental impacts resulting from the release of hazardous chemical above established limits.

The prioritization of the chemical safety vulnerabilities is based on professional judgment of team members concerning the immediacy of the potential consequences posed by each vulnerability and on the potential severity of those consequences. The first step in the prioritization process was to group vulnerabilities according to the timeframe in which they are expected to produce consequences. The following categories are defined for the timeframe within which the consequences are expected to occur:

- Immediate — Any chemical safety vulnerability that could result in immediate consequences.

- Short-Term — Any chemical safety vulnerability at a facility in which there is a significant chance of a consequence occurring within a 3-year timeframe as a result of chemical degradation, change in mission for the facility, degradation of the containment systems, change in personnel at the facility, or other factors affecting the facility.

- Medium-Term — Any chemical safety vulnerability at a facility in which there is a significant chance of a consequence occurring within a 3–10-year timeframe as a result of chemical degradation, change in mission for the facility, degradation of the containment systems, change in personnel at the facility, or other factors affecting the facility.

---

[1] Serious physical harm is defined as impairment of the body, leaving part of the body functionally useless or substantially reducing efficiency on or off the job.

- Long-Term – Any chemical safety vulnerability at a facility in which there is a significant chance of a consequence occurring within a timeframe of more than 10 years as a result of chemical degradation, change in mission for the facility, degradation of the containment systems, change in personnel at the facility, or other factors affecting the facility.

Vulnerabilities within each category should be further prioritized to specify "high," "medium," or "low" priority based on the severity of the potential consequences. Examples of the second level of prioritization include the following:

- Prioritize potential harm to workers or the public according to the possible level of injury and/or health effect, ranging from transient reversible illness or injury to death.

- Prioritize environmental impacts based on the level of irreversible damage and/or restoration costs.

3.2 Chemical Safety Vulnerabilities at Brookhaven National Laboratory

Four vulnerabilities were identified during the conduct of this review. Each is related to vulnerabilities identified in other reviews and is identified here to focus on vulnerabilities evident at BNL and to provide a more complete set of vulnerabilities with potential DOE-wide implications. Each of the four vulnerabilities is summarized below and is presented in detail in Attachment 2 of this appendix.

CSVR-BNL-000-01: Weaknesses in planning impede the effective elimination of hazards posed to workers and members of the public.

Weaknesses in planning are evident in the site maintenance program, facility and/or process construction and design, management of chemicals, and packaging of waste materials. Maintenance programs are not effective in preventing facility deterioration to minimize the loss of chemicals from facility systems. Relatively new system designs have not incorporated engineered controls to prevent chemical exposures. Several older facilities are used to store hazardous materials. These facilities do not include all safety systems that are common to general industry. Site chemical inventories are incomplete and do not provide the detail needed to plan appropriately for procurement, use, storage, and disposal of hazardous chemicals. Immature and incomplete programs fail to mitigate chemical release incidents to workers or the environment. These conditions and circumstances represent a medium- to high-priority vulnerability with a potential for short-term consequences.

CSVR-BNL-000-02: Protracted implementation of core safety programs increases the potential for chemical safety vulnerabilities.

The three means for managing hazardous chemicals are (1) a knowledgeable and well-directed operating organization, (2) technically capable advocates for ES&H who can provide specialized assistance to line organizations, and (3) an array of core or model safety programs to guide both groups. The core safety programs at the BNL have not been fully implemented, and completion of such programs, including training, is not scheduled for several years. Protracted implementation of core safety program elements could lead to chemical safety vulnerabilities in several areas, including (1) hazards assessment to support

emergency management, (2) ES&H training, and (3) guidance associated with chemical inventory in the ES&H Standards for Hazard Communication and the Laboratory Chemical Hygiene Plan. These conditions and circumstances represent a medium-priority vulnerability with a potential for short-term consequences.

CSVR-BNL-000-03: Shortfalls in resources could lead to new chemical safety vulnerabilities and could impede the ability to resolve identified issues in a timely manner.

The BNL Safety and Environmental Protection Division provides technical expertise to line programs and supports independent reviews of self-assessments by various operating organizations. A declining Laboratory budget, combined with a fairly rigid control over general and administrative expenses (which is where most costs for the Safety and Environmental Division are funded), means that BNL is entering a period in which there could be real decreases in resources applied to ES&H. Budget constraints will lead to a deterioration in the capabilities to provide the technical support necessary to carry out mandated ES&H programs. The relatively small number of personnel at BNL who are well qualified to recognize and provide solutions to chemical safety vulnerabilities can be expected to decrease with time. These conditions and circumstances represent a medium- to high-priority vulnerability with a potential for short-term consequences.

CSVR-BNL-000-04: Formal control measures have not been implemented to ensure that personnel who do not read or speak English understand the safety requirements and potential hazards associated with work in hazardous environments.

The requirement for contract specifications to provide positive assurance that subcontractor personnel who do not read or speak English understand workplace safety requirements and hazards has not been institutionalized. On an individual basis, specifications for subcontracts have, at the request of a safety engineer, included a clause stating, "Workers shall be able to comprehend work and safety instructions in English or a supervisor who can translate shall be provided and be present at all times." On several occasions, a safety engineer has suspended work by invoking the contract clause that requires a bilingual person to be present at all times. These conditions and circumstances represent a high-priority vulnerability with a potential for short-term consequences.

ATTACHMENT 1

TEAM COMPOSITION

Area of Responsibility	Name/Organization
Team Leader	Victor I. Crawford Office of Environmental Audit U.S. Department of Energy
Management/Operations	Del Bunch Management Strategies, Inc.
Management/Training	Thomas L. Van Witbeck Toma Enterprises
Chemical Process Safety	Ernest W. Johnson Oak Ridge Associated Universities
Industrial Hygiene	J. Michael Brooks EG&G Rocky Flats, Inc.
Environmental Protection	Raymond F. Machacek Arthur D. Little, Inc.
Maintenance	F. Richard Myal Compa Industries, Inc.
Emergency Management	David M. Rohrer Office of Health U.S. Department of Energy
Site Liaison	Gerald A. Granzen Brookhaven Area Office U.S. Department of Energy
Coordinator	Rita A. Bieri Los Alamos National Laboratory
Technical Editor	Larry D. Warren Evergreen Innovations, Inc.

ATTACHMENT 2

CHEMICAL SAFETY VULNERABILITY REVIEW
VULNERABILITY FORM DATE: May 20, 1994

Site/Facility:	Brookhaven National Laboratory
Vulnerability Number:	CSVR-BNL-000-01
Functional Area(s):	Identification of Chemical Holdings, Facility Physical Condition, Operational Control and Management Systems

1. Brief Description of Vulnerability.

   Weaknesses in planning impede the effective elimination of hazards posed to workers and members of the public.

2. Summary of Vulnerability.

   Weaknesses in planning are evident in the site maintenance program, facility and/or process construction and design, management of chemicals, and packaging of waste materials. Maintenance programs are not effective in preventing facility deterioration to minimize the loss of chemicals from facility systems. Relatively new system designs have not incorporated engineered controls (redundant safety systems design) to prevent chemical exposures. Because of lack of overall site planning, older facilities are being used to store hazardous materials, despite the lack of minimal safety systems that are common to general industry. Site chemical inventories are incomplete and do not provide the detail needed to plan appropriately for procurement, use, storage, and disposal of hazardous chemicals.

3. Basis.

   a. Requirements:
      - The Occupational Safety and Health Act (OSHA) requires evaluation and communication of chemical hazards to employees (29 CFR 1910.1200 and 29 CFR 1910.1450). Provisions for chemical inventories are also included in these regulations.
      - Emergency management requirements for notification and communication of chemical hazards are contained in community right-to-know regulations (40 CFR 355 and 40 CFR 370).
      - Requirements for evaluation and control of hazardous chemical processes and operations at DOE contractor-operated facilities are given in DOE 5483.1A and DOE 5480.10; maintenance management requirements for DOE facilities are found in DOE 4330.4A

   b. Chemicals Involved: All potentially hazardous chemicals. Brookhaven National Laboratory (BNL) has large quantities of compressed gases and laboratory chemicals in containers of less than 1 pint or quantities of less than 1 pound. Materials are tracked for Emergency Planning Community Right-to-Know Act (EPCRA) at the 1-gallon/5-pound level. Specific chemicals observed that contribute to vulnerabilities are chlorine and ethyl ether.

   c. Relevant Self-Evaluation Data: Lack of fire detection and suppression systems was noted in the BNL self-evaluation. The new Hazardous Waste Management Facility (HWMF), scheduled to open in calendar year 1996 or later, should reduce the potential for chemical safety vulnerabilities.

   d. Contributing Causes:
      - Restrictive waste acceptance criteria and changing regulations (e.g., Resource Conservation and Recovery Act [RCRA]) often require resampling and/or repackaging of materials by a facility (e.g., HWMF) that is not equipped to perform this function.

Site/Facility:	Brookhaven National Laboratory
Vulnerability Number:	CSVR-BNL-000-01
Functional Area(s):	Identification of Chemical Holdings, Facility Physical Condition, Operational Control and Management Systems

3. Basis. (Continued)

- Lack of definition of radioactive release or content criteria for activated scrap metal has resulted in material being cut up for disposal as hazardous, contaminated waste instead of being recycled. This situation further reduces available financial and human resources dedicated to chemical management and potentially exposes employee to added chemical hazards.
- Chemical inventories in BNL facilities are incomplete. Chemical tracking practices vary widely, depending on the rigor applied by each facility in formulating inventories.
- Increases in maintenance funding have not been sufficient to address the deterioration of aging facilities at BNL.

e. Potential Consequences:

- Resampling and/or repackaging of waste in facilities that do not have adequate engineering controls can result in increased exposure of workers to chemical hazards.
- Additional processing of materials as waste, instead of pursuing a recycling program, can increase worker exposure to chemical hazards.
- Decreased maintenance can lead to an unacceptable facility condition, which will increase the likelihood of release of chemicals to the environment and result in employee exposures to chemicals, fire, or explosions.
- A potential exists for explosions or fires in site facilities if unstable materials are not controlled.
- These conditions and circumstances represent a medium- to high-priority vulnerability with a potential for short-term consequences.

4. Supporting Observations.

- DOE 5480.10 requires that chemical hazards in the workplace be identified and evaluated and that control measures be implemented to prevent or mitigate exposures.
- Neither an annual site maintenance plan nor a maintenance implementation plan has been prepared as defined in DOE 4330.4A.
- An annual maintenance plan (i.e., an outline document requested by the Chicago Operations Office) governs the preventive and corrective maintenance budget for fiscal year (FY) 92 through FY 98. No annual update to this document has been requested or furnished since FY 92.

Site/Facility:	Brookhaven National Laboratory
Vulnerability Number:	CSVR-BNL-000-01
Functional Area(s):	Identification of Chemical Holdings, Facility Physical Condition, Operational Control and Management Systems

4. Supporting Observations. (Continued)

- Little predictive maintenance is being conducted at BNL. Thermography is used intermittently to locate hot spots on the high-voltage electric power system, and some transformer oil analysis is done. Vibration analysis is conducted at the Central Steam Plant and at the Central Chilled Water Plant, neither of which were visited at part of this review. However, no formal ultrasonic or radiographic surveys are undertaken to monitor thickness or vessel integrity of corrosion-or erosion-susceptible pipes for systems that could pose chemical hazards.

- Personnel and budgets for preventive and corrective maintenance have been kept constant for the past 4 years. The addition of new tasks means that more activities are required under a fixed maintenance budget. The current preventive maintenance staff consists of 140 personnel; 20 are supervisors, and 120 are maintenance craft personnel.

- The manner in which the preventive maintenance budget is used at a given facility is based on the discretion of the facility manager (programmatic maintenance) and the manager of plant engineering (facility maintenance).

- Safety showers were inoperable (repaired the week of 5-9-94) at HWMF (this issue was identified in the self-evaluation). Portable showers were used in the building as an interim measure. An emergency shower in Building 444 had no record of maintenance functional testing since 1991.

- Brass fittings on the chlorine gas manifold at Building 624 were corroded, and an indication of a chlorine leak was observed immediately downstream of the pressure regulator on the six-bottle manifold.

- Materials tracked for EPCRA reporting are included in the sitewide inventory for the Tandem Van de Graaff Accelerator. Several elements and compounds used for source and target preparation were not included in the sitewide inventory because they were below the 5-pound/1-gallon reporting requirement, but they were included in a building-specific/cabinet-specific inventory.

- Materials were found in laboratories that were not on the EPCRA inventory or building inventory. Containers of ethyl ether were found in two fume hoods that were not included in the last building-specific/laboratory-specific inventory. One container of ether was found with an expiration date of May 1994, which violates decomposition or instability guidance given in BNL-ES&H Standard 2.1.1, "Chemical Hygiene Plan," Section IX. The proposed implementation of the Pacific Northwest Laboratory chemical tracking system will minimize future vulnerabilities of this type.

Site/Facility:	Brookhaven National Laboratory
Vulnerability Number:	CSVR-BNL-000-01
Functional Area(s):	Identification of Chemical Holdings, Facility Physical Condition, Operational Control and Management Systems

4. Supporting Observations. (Continued)

- Lack of planning in facility design and construction was indicated at the chlorine (gas) system used at the Central Water Treatment Plant (Building 624). An audible alarm was installed at the chlorinator to warn operators of leaking gas. In the event of a chlorine cylinder or piping failure, personnel would be required to wear self-contained breathing apparatus to control the leak. Neither the manifold nor the individual pigtails were equipped with emergency shutdown devices to limit chlorine flow in the event of a manifold or pigtail failure.

- Because of lack of clear policy and integrated waste management requirements (a DOE-wide issue), the limited resources available to manage chemical hazards at the site are often spent staging and dispositioning waste. For example, magnet segments of copper or steel exhibiting neither measurable direct nor smearable contamination are scheduled to be cut up and packaged as waste and subsequently transported to Hanford. Based on the apparent lack of radiological hazard associated with this sort of material, the undefined, added risks to operators and the environment make the need for this unclear.

- Because of lack of clear policy and integrated waste management requirements (a DOE-wide issue), a weakness associated with planning was identified at the HWMF. This facility lacks appropriate engineering controls for repackaging of hazardous materials. Repackaging is often performed by operators who must wear personal protective equipment because of the lack of engineering controls. The need for multiple repackaging has occurred to meet waste acceptance criteria. Resampling of moratorium-generated wastes that were previously lab-packed and ready for shipment was conducted at HWMF. Because of funding constraints, materials packed in the late 1980s were not shipped. When funds became available, shipment, resampling, and repackaging were required. Concrete vaults packed for shipment in the mid-1980s must be opened with a jackhammer, emptied, characterized, and repacked.

- A group of about 15 subcontractor personnel attended the New Employee Safety Orientation Course before onsite asbestos abatement activities began. Only one member of the group spoke English; he translated the course into the native language of the group. No measures such as written or verbal tests were used to validate comprehension.

- Specifications for the subcontract under which the asbestos abatement project was conducted contained a clause stating: "Workers shall be able to comprehend work and safety instructions in English or a supervisor who can translate shall be provided and be present at all times." When enforced, this clause when enforced provides some measure of assurance that non-English speakers will be aware of safety requirements and potential hazards in the workplace. An individual safety engineer requires that this clause be incorporated in all contracts that he supervises: it is not an institutional requirement. Therefore, the requirement would not necessarily be included in the specifications of all contracts having similar circumstances.

CHEMICAL SAFETY VULNERABILITY REVIEW
VULNERABILITY FORM DATE: May 19, 1994

Site/Facility:	Brookhaven National Laboratory
Vulnerability Number:	CSVR-BNL-000-02
Functional Area(s):	Human Resource Programs, Operational Control and Management Systems, and Emergency Management Program

1. Brief Description of Vulnerability.

   Protracted implementation of core safety programs increases the potential for chemical safety vulnerabilities.

2. Summary of Vulnerability.

   Protracted implementation of core safety program elements could lead to chemical safety vulnerabilities in several areas, including (1) hazards assessment to support emergency management; (2) implementation of environment, safety, and health (ES&H) training; and (3) guidance concerning chemical inventory in ES&H Standards for Hazard Communication and the Laboratory Chemical Hygiene Plan.

3. Basis.

   a. Requirements:
      - The Occupational Safety and Health Act requires evaluation and communication of chemical hazards to employees (29 CFR 1910.1200 and 29 CFR 1910.1450).
      - Requirements for evaluation and control of hazardous chemical processes and operations at DOE contractor-operated facilities are provided in DOE 5483.1A and DOE 5480.10.
      - Requirements for training of hazardous waste operations and emergency preparedness personnel are provided in 29 CFR 1910.120. Additional training and qualification requirements for nonreactor nuclear facilities personnel are provided in DOE 5480.20.
      - The framework for a program to ensure personnel receive adequate information regarding hazards associated with chemicals in the workplace is provided in Brookhaven National Laboratory (BNL) ES&H Standard 2.1.1, "Chemical Hygiene Plan."

   b. Chemicals Involved: All potentially hazardous chemicals at BNL.

   c. Relevant Self-Evaluation Data: The site self-evaluation did not identify this issue as a potential vulnerability.

   d. Contributing Causes: Perceived sense of low risks, low allocation of resources to core safety programs, and reluctance to increase spending on overhead projects.

   e. Potential Consequences: Potential consequences include personnel injury or death and property damage. These conditions and circumstances represent a medium-priority vulnerability with a potential for short-term consequences.

Site/Facility:	Brookhaven National Laboratory
Vulnerability Number:	CSVR-BNL-000-02
Functional Area(s):	Human Resource Programs, Operational Control and Management Systems, and Emergency Management Program

4. Supporting Observations.

- An ES&H appraisal conducted by Chicago Operations Office during January 18–28, 1994, stated that "the Hazards Assessment, which determines the extent and scope of emergency planning and preparedness activities, has not been completed." This weakness has been identified to BNL on numerous occasions, even by the Brookhaven Area Office. The problem still exists as of the date of the field verification visit. DOE 5480.10 requires, in part, that chemical hazards in the workplace be identified and evaluated and that control measures be implemented to prevent or mitigate exposures.

- BNL has started gathering the information (e.g., chemical inventory, building layouts, weather records) necessary to perform the hazards assessment and has requested funding. The current funding for this effort is $10,000, with an additional $90,000 or more needed. BNL has requested funding to perform hazards assessments in previous budgets, but the priority assigned to the task, based on risk, has fallen below the funding cutoff.

- The schedule for implementation of the ES&H training programs is protracted. The level of effort currently directed to training course development will yield courses that satisfactorily address the mandated safety training in about 2 years.

- The BNL Training Policy has been approved; however, program implementation is incomplete and lacks the rigor associated with a formal training program. Job-specific training developed by the operating facilities is not required to undergo a systematic review by the professional staff training office to ensure (1) consistent content and (2) application of accepted training standards and BNL safety requirements. A BNL training manual is in the early stages of development.

- A formalized, performance-based, position-specific training program has not been developed for the members of the emergency response organization other than the BNL fire/rescue department. Instead, as their means of training, BNL replied on individual employees to read the emergency response procedures for which they are responsible, to attend a procedure briefing when new procedures are issued, and to participate in drills and exercises as their means of training. This has been identified as a weakness on a number of occasions.

Site/Facility:	Brookhaven National Laboratory
Vulnerability Number:	CSVR-BNL-000-02
Functional Area(s):	Human Resource Programs, Operational Control and Management Systems, and Emergency Management Program

4. Supporting Observations. (Continued)

- Some personnel providing performance evaluations of on-the-job training (OJT) have not been certified as OJT instructors.
- Visitors may gain unescorted access to some facilities prior to completing the required safety training.
- Materials tracked for Environmental Protection and Community Right-to-Know Act (EPCRA) reporting are included in the sitewide inventory for the Tandem Van de Graaff Accelerator. Because several elements and compounds used for target preparation were below the reporting threshold, they were not included in the sitewide inventory but were included in a building-specific/laboratory-specific inventory.
- Materials were found in laboratories that were not on the EPCRA inventory or building inventory. Containers of ethyl ether that were not contained in the last building-specific/laboratory-specific inventory were found in two laboratory hoods. One container of ether was found that had an expiration date of May 1994. Storage of out-of-date materials that pose a hazard due to decomposition or instability is contrary to guidance given in BNL-ES&H Standard 2.1.1 "Chemical Hygiene Plan," Section IX. The proposed implementation of the Pacific Northwest Laboratory chemical tracking system will minimize future vulnerabilities of this type.
- Implementation of the self-assessment program is incomplete.
  - The BNL Environment, Safety and Health Self-Assessment Program is in draft form.
  - The 1992/1993 Annual Self-Assessment has not been published.
  - Feedback is not always provided to the senior managers and staff affected by self-assessments.
  - Personnel have not been trained to perform self-assessments.

CHEMICAL SAFETY VULNERABILITY REVIEW
VULNERABILITY FORM DATE: May 19, 1994

Site/Facility:	Brookhaven National Laboratory
Vulnerability Number:	CSVR-BNL-000-03
Functional Area(s):	Operational Control and Management Systems

1. Brief Description of Vulnerability.

   Shortfalls in resources could lead to new chemical safety vulnerabilities and could impede the ability to resolve identified issues in a timely manner.

2. Summary of Vulnerability.

   The BNL Safety and Environmental Protection (S&EP) Division provides technical expertise to line programs and supports independent reviews of self-assessments by various operating organizations. A declining Laboratory budget, combined with a fairly rigid control over general and administrative expenses (which is where most costs for the S&EP organization are funded), means that Brookhaven National Laboratory (BNL) is entering a period in which there could be real decreases in resources applied to environment, safety, and health (ES&H). Budget constraints will create pressures to limit or delay efforts to carry out mandated ES&H programs. The relatively small number of personnel at BNL who are well qualified to recognize and provide solutions to chemical safety vulnerabilities can be expected to decrease with time, unless special efforts are made to recruit and train personnel.

3. Basis.

   a. Requirements: Section 161 of the Atomic Energy Act requires DOE to ensure that management and operations contractors "protect health and minimize danger to life or property." DOE implements this requirement through the nuclear safety clause in contracts and through the issuance of DOE 5483.1A, "Occupational Safety and Health Program for DOE Contractor Employees at Government-Owned Contractor-Operated Facilities," which mandates application of standards comparable to those promulgated by the Occupational Safety and Health Administration (OSHA). Good practices would be those identified for OSHA's Voluntary Protection Program (VPP) and contained in 29 CFR 1910.119, "Process Safety Management," even where chemical quantities are below the requirements level.

   b. Chemicals Involved: Water Treatment Facility: chlorine gas. Tandem Van de Graaff Accelerator: small quantities of various types of flammable material used and stored in a cabinet; a variety of chemicals in small quantities; tens of thousands of pounds of sulfur hexafluoride, plus other asphyxiants. Hazardous Waste Management Facility: up to drum quantities of acids, caustics, and organics are stored or repackaged and held for shipment from the site (capacity of up to 104 drums per area). Many other areas on the site also contain hazardous chemicals (liquids, solids, and compressed or liquefied gases).

   c. Relevant Self-Evaluation Data: BNL self-evaluation indicated that controls were adequate to prevent worker exposure. It also states that the "long-range objectives for the Laboratory in these areas are to ensure that those organizations which need formal Conduct of Operations and Maintenance Management programs, implement them along with a continuous improvement program to achieve excellence in operations and maintenance." [page 15]

Site/Facility:	Brookhaven National Laboratory
Vulnerability Number:	CSVR-BNL-000-03
Functional Area(s):	Operational Control and Management Systems

3. Basis. (Continued)

   d. Contributing Causes: A ceiling imposed on general and administration expenses limits ability to recruit new staff, and limitations in overall funding for BNL in fiscal year (FY) 95 will reduce the base for resolving identified shortfalls in ES&H performance. Strong emphasis on applying resources to perceived risks creates strong dependency on correctly gauging the relative risks of various site activities. Aging physical infrastructure increases reliance on administrative controls to prevent or mitigate incidents; any deterioration in plant will complicate efforts to eliminate or reduce chemical safety concerns.

   e. Potential Consequences: The number of incidents and noncompliances will increase with time, as will the potential for events leading to releases of hazardous chemicals. These conditions and circumstances represent a medium-to high-priority vulnerability with a potential for short-term consequences.

4. Supporting Observations.

   - In letters of August 21, 1987; July 30, 1990; and February 21, 1992, the Laboratory Director raised overhead rates from 44.5 percent to 49.5 percent. These rates would have been 55.5 percent or more if requests had been approved. (The cited letters note that increases would have been 11 percent instead of 6 percent but for special efforts made by BNL, including staff reductions in the G&A pool.) In the past, staff reductions occurred in non-ES&H areas.

   - Staff levels for S&EP have gone from 110 to 190 since 1988. Staff levels for industrial hygiene-related functions are low relative to overall site staff (e.g., nine full-time equivalents for industrial hygiene for a site staff of roughly 3,000, versus 40 industrial hygienists at a site where the staff is about 8,000). Even though these two figures are not exactly comparable, they may be indicative of the impact of budget constraints.

   - "Environmental Safety and Health Management Plan, Fiscal Years 1994–2000," dated April 13, 1994, identifies a number of strategic plans, but many are unfunded or occur some years from now. Interviews suggest that requests for funds are substantially in excess of funds provided; the ability to find creative solutions to problems depends on a highly motivated and supportive ES&H staff.

Site/Facility: Brookhaven National Laboratory

Vulnerability Number: CSVR-BNL-000-03

Functional Area(s): Operational Control and Management Systems

4. Supporting Observations. (Continued)

- Recent reviews in crucial areas reveal substantial shortfalls in performance, below requirements (see "Operations Assessment, Hazardous Waste Management Facility," [by EM-25], October 4–8, 1993, and the "Environmental Protection Program Appraisal Report," Chicago Operations Office, January 18–27, 1994). Although not all concerns may be due to resource constraints, efforts to eliminate concerns identified by such reviews will require additional resources.

- The site uses a graded approach to apply resources to areas of perceived higher risk. The BNL *Operations and Maintenance Manual* contains several standards or guidance documents that describe or require the graded approach (see the manuals BNL-O&M-I-01 and BNL-O&M-IV-01, which reference and invoke other BNL standards — e.g., BNL ES&H Standard 1.3.3; the Safety and Environmental Division Standard SEAPPM 1.3.0, Attachment 4; the Quality Assurance standard, BNL-QAG-301; and the BNL Internal Notice 94-01 on Startup and Restart of Nuclear Facilities). However, as noted in those various documents, the actual decision on how to proceed is left to individual line managers, who may have no special expertise in identifying or characterizing chemical safety vulnerabilities and who may have a limited cadre of S&EP staff because of constrained resources.

- The chlorine delivery system at the Central Water Treatment Plant was found to be visibly corroded, with an evident smell of chlorine on entry. The detector for chlorine appeared to be inappropriately located (the flow of leaking chlorine would be away from the detector). The impression was that the decision to upgrade the existing chlorine system instead of replacing the system was due in some measure to resource constraints.

- The new Hazardous Waste Management Facility will be completed no sooner than 1996. The need for a replacement facility was evident years ago, but resource constraints and reassignments of responsibility within DOE Headquarters appeared to have caused this project to be delayed. This project is now tied to a cleanup requirement under a Federal Facilities Compliance Agreement.

- The budget for maintenance and ES&H staff was said to have peaked in 1994, with staff reductions to occur in 1995 and beyond, unrelated to need.

- Staff levels for training are low for a site having staff of about 3,000 (about 30 FTEs for training, versus a staff of 3,000). Staff levels for training at several other DOE facilities are on the order of 120 FTEs for a staff of 7,000. A direct correlation is not valid, but the magnitude of the variation may be indicative of the budget constraints.

CHEMICAL SAFETY VULNERABILITY REVIEW
VULNERABILITY FORM DATE: May 21, 1994

Site/Facility:	Brookhaven National Laboratory
Vulnerability Number:	CSVR-BNL-000-04
Functional Area(s):	Human Resource Programs

1. Brief Description of Vulnerability.

   Formal control measures have not been implemented to ensure that personnel who do not read or speak English understand the safety requirements and potential hazards associated with work in hazardous environments.

2. Summary of Vulnerability.

   Subcontractor personnel who do not read or speak English are performing environmental activities, including asbestos abatement, without Brookhaven National Laboratory (BNL) having positive assurance that workplace safety requirements and hazards are understood.

3. Basis.

   a. Requirements: The Occupational Safety and Health Act requires evaluation and communication of chemical hazards to employees (29 CFR 1910.1200 and 29 CFR 1910.1450).

   b. Chemicals Involved: Hazardous chemicals primarily associated with environmental remediation at BNL facilities.

   c. Relevant Self-Evaluation Data: BNL did not identify this issue as a potential chemical safety vulnerability.

   d. Contributing Causes:

      - BNL has not defined requirements and procedures to address the ramifications of a non-English-speaking work force.
      - Lack of a positive measure of safety requirements knowledge (such as testing) during subcontractor training.

   e. Potential Consequences: The consequences include personnel injury or death and property damage. These conditions and circumstances represent a high-priority vulnerability with a potential for short-term consequences.

Site/Facility: Brookhaven National Laboratory

Vulnerability Number: CSVR-BNL-000-04

Functional Area(s): Human Resource Programs

4. Supporting Observations.

- A group of about 15 subcontractor personnel attended the New Employee Safety Orientation Course prior to starting asbestos abatement activities on site. Only one member of the group spoke English; he translated the course into the native language of the group. No measures, such as written or verbal tests, were used to validate comprehension of safety requirements and potential hazards by non-English speakers.

- The specifications for the subcontract under which the asbestos abatement project was conducted contained a clause stating: "Workers shall be able to comprehend work and safety instructions in English or a supervisor who can translate shall be provided and be present at all times." This clause when enforced provides some measure of assurance that non-English speakers will be aware of the safety requirements and hazards in the workplace. A safety engineer requires that this clause be incorporated in all contracts he supervises; it is not an institutional requirement. The requirement, therefore, would not necessarily be included in the specifications of all contracts having similar circumstances.

- A safety engineer has, on several occasions, suspended work on a job site by invoking the contract clause that requires a bilingual person to be present on the work site at all times.

ATTACHMENT 3

SELECTED ACRONYMS

DOE	U.S. Department of Energy
BNL	Brookhaven National Laboratory
FY	Fiscal Year
HWMF	Hazardous Waste Management Facility
ES&H	Environment, Safety, and Health