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JEFFERSON LAB'S
SITE ENVIRONMENTAL REPORT
For Calendar Year 2003

Prepared by:
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Executive Summary

*T*his report presents the results of environmental activities and monitoring programs at the Thomas Jefferson National Accelerator Facility, known as Jefferson Lab. The purpose of this annual report is to document the Lab's active environmental protection program. The report provides the U.S. Department of Energy (DOE) and the public with information on radioactive and non-radioactive pollutants, if any, added to the environment as a result of Lab operations.

Major Scientific Programs

Jefferson Lab's main purpose is to make available a research facility to support the nuclear physics community and the nation.

CEBAF The Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab provides an electron beam to three experimental halls (A, B, & C), where a variety of physics experiments are conducted. The electron beam begins its first orbit at the injector and proceeds through the underground racetrack-shaped accelerator tunnel at nearly the speed of light. The accelerator uses superconducting radio-frequency technology to drive electrons to higher and higher energies. The accelerator's electron beam can be split for simultaneous use by the three experimental halls, which are circular, partially buried domed chambers. Special equipment in each hall records the interactions between incoming electrons and the target materials. A continuous electron beam is necessary to accumulate data at an efficient rate yet ensures that each interaction is separate enough to be fully observed.

By the end of calendar year (CY) 2003, Jefferson Lab had completed a total of almost 100 experiments over the life of the Lab. Major experiments were conducted in all three halls, as well as preparation and logistics work for large-scale experiments that were planned to start in two of the halls during 2004. Research conducted in Hall B revealed the most convincing evidence at the time for a subatomic particle consisting of five quarks – the pentaquark. CLAS (CEBAF Large Acceptance Spectrometer) collaborators presented their results during a May 2003 Conference on the Intersections of Particle and Nuclear Physics held in New York City. Several weeks of CEBAF operation (and concurrent experiment data collection) time were lost in the aftermath of Hurricane Isabel, which devastated the region in September.

Early in the year, Jefferson Lab conducted a novel experiment with CEBAF to determine the feasibility and effectiveness of energy-recovery technology, which could lead to the development of a new class of particle accelerators.

In November, the DOE unveiled its 20-year facilities plan, which listed Jefferson Lab's CEBAF upgrade to 12 GeV (billion electron volts) as a near-term priority. In support of this, analysis

and research and development work continued on the proposed 12 GeV upgrade. This upgrade will help to keep the United States on the leading edge of world-class science.

FEL The initial Free-Electron Laser, the Infrared (IR) Demo FEL, operated through November 18, 2001. That machine was a 1,000 watt (one kilowatt) level IR light source. It was upgraded in 2002 and produced first light on June 17, 2003. As commissioning activities were continuing, they were also impacted by Hurricane Isabel. By year's end, commissioning work had resumed on this upgrade. This upgrade will result in a machine able to produce more than a 10,000 watt level of IR light, and 1,000 watts of ultraviolet (UV) light.

The FEL supports basic science research and serves universities, private industry, NASA (National Aeronautics and Space Administration), the U.S. Navy, the U.S. Air Force, and the U.S. Army.

SNS The Spallation Neutron Source (SNS) project involves a team of six Federal laboratories (Argonne, Brookhaven, Lawrence Berkeley, Los Alamos, Jefferson Lab, and Oak Ridge) cooperating in the design, engineering, and construction of the $1 billion-plus SNS being built in Oak Ridge, Tennessee. Once operational, it will provide the most intense pulsed-neutron beams in the world for scientific research and industrial development.

Jefferson Lab's contributions include building two types of superconducting radiofrequency (SRF) cryomodules for the SNS accelerator, and providing extensive expertise, guidance, and production effort in developing the SNS refrigeration plant. Work during 2003 was dominated by the production, testing, and shipping of medium-beta cryomodules. As road-worthiness to ship had been verified in 2002, seven cryomodules were built and five were shipped to Oak Ridge in 2003. At the end of 2003, work on several additional cryomodules was well underway in Jefferson Lab's cryomodule assembly area. The Lab will produce a total of 23 cryomodules for the SNS.

The *E* in Environment, Health, and Safety (EH&S)

Ultimate responsibility for protection of the environment and public health rests with the Lab Director, while line management implements identified objectives within their areas of responsibility. EH&S staff, situated within the line organizations, provide support to their line management and share their expertise with the Lab as a whole. There are numerous ways in which Jefferson Lab's EH&S program is implemented.

Integrated Safety Management (ISM) System Through ISM, Jefferson Lab incorporates EH&S requirements into all work procedures. The primary objective of ISM is to make safety, health, and environmental protection a part of routine business at Jefferson Lab.

Environmental Management System (EMS) Implementation Jefferson Lab has an environmental protection program in place, but the need to have an EMS was identified in 2003. The requirement for an EMS was incorporated into the DOE/SURA (Southeastern Universities Research Association, Inc.) contract in 2003. Key Lab staff began planning for development of

an EMS specific to the Jefferson Lab site. The EMS is expected to be fully implemented during 2005.

Jefferson Lab Work Smart Standards (WSS) Process The goal of the WSS process is to provide a means to implement EH&S in a manner that is both effective and cost-efficient. The WSS Set is comprised of the laws, regulations, and standards necessary and sufficient to ensure worker and public health and safety, and to protect the environment with respect to the hazard issues that are relevant to Jefferson Lab.

Implementation of NEPA Most facility construction activities and all accelerator upgrades are subject to review under the National Environmental Policy Act. The initial Jefferson Lab construction and a later upgrade to CEBAF were addressed in the 1987 and 1997 Environmental Assessments (EAs), and new buildings and additions to buildings were addressed in the 2002 EA. Routine Lab activities and special projects were covered under site-specific NEPA Categorical Exclusions (CXs).

EH&S Performance Measures The DOE/SURA contract-based measures, used to evaluate Jefferson Lab's EH&S performance, include items such as recycling and hazardous waste minimization.

Inspections The Hampton Roads Sanitation District (HRSD) performed an inspection in 2003. No deficiencies were identified. The Occupational Safety and Health Administration (OSHA) and the Nuclear Regulatory Commission (NRC) performed invited audits to identify items that may need attention if the Lab should become subject to external regulation at a future date.

Compliance

Jefferson Lab complied with all applicable Federal, State, and local environmental laws, regulations, and DOE guidance during 2003. As a consequence, Jefferson Lab operations had no discernable impact on public health or the environment. Our compliance status on all programs is identified in Section 3 of this report. Radiation-related issues, especially those dealing with water resources and public health, are highlighted in Section 4. Non-radiological environmental issues, such as water sampling and monitoring, are highlighted throughout. The Jefferson Lab EH&S Manual, which addresses many environmental topics, and the Lab's WSS Set are regularly updated to ensure that new environmental compliance initiatives are incorporated.

Environmental Protection Program Highlights

During 2003, Jefferson Lab accomplished many goals in its environmental protection and pollution prevention program. Following are but a few examples that include improvements since 2002.

- The Accelerator Division began operating a new acid neutralization system that has reduced the Lab's hazardous waste generation rate.
- Received the HRSD "Gold Award for Pretreatment Excellence."

- Increased the number of local recycling centers from 11 to 19.
- Maintained a top rating in the Lab's performance measure that addresses recycling performance compared to disposing of waste in a landfill.
- Toner cartridge recycling increased by over 35%, battery recycling more than doubled, and the quantity of solid waste disposed at the landfill was down 21%.
- Improved performance in the procurement of Environmental Protection Agency (EPA) designated recycled-content products from 87% in 2002 to 93%.
- Identified and implemented a number of new best management practices and measurable goals under a new storm water permit (see Section 3.5).
- Facilities Management instituted improved construction specifications that better address environmental protection issues.

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Note: 2003 refers to calendar year unless otherwise noted.

SECTION 1
INTRODUCTION

1.1 PURPOSE OF THIS REPORT

The U.S. Department of Energy (DOE) requires its facilities, of which Thomas Jefferson National Accelerator Facility (TJNAF or Jefferson Lab) is one, to establish and annually report on environmental programs and performance.

This document marks the 11th year that Jefferson Lab has been preparing a Site Environmental Report (SER). This report addresses the status and results of the Lab's environmental protection (EP) program, which also addresses public health items, for calendar year (CY) 2003. It serves to inform Jefferson Lab staff, DOE, regulators, and the public about site environmental performance, and provides a historical record of identified items of interest or concern.

Addressed within Section 2 is the Lab's environmental protection program. Section 3 summarizes the site's compliance status with applicable requirements, standards, and contractual commitments. Section 4 addresses the active site environmental radiological program.

The SER is available in downloadable *PDF* and *Word* files. Look for this CY 2003 SER under "Safe and Secure First" on the Jefferson Lab web page at **http://www.jlab.org**.

1.2 LABORATORY MISSION

Jefferson Lab, formerly known as CEBAF (Continuous Electron Beam Accelerator Facility), is a national accelerator facility managed and operated by the Southeastern Universities Research Association, Inc. (SURA) for the DOE. The accelerator complex portion of the Lab includes an underground electron accelerator, CEBAF, which is Jefferson Lab's primary research tool. CEBAF operates at energies up to about 6 GeV (billion electron volts) and provides beam to three underground halls that house physics program experiments.

The original Jefferson Lab mission evolved from the nuclear science community's recognition of the need for a state-of-the-art electron accelerator with a continuous high current electron beam with electron energies in the multi-billion electron volt region. Jefferson Lab's current mission statement addresses quality and excellence in research, community partnership, and environment, health, and safety (EH&S).

> Jefferson Lab's mission is to provide forefront scientific facilities, opportunities, and leadership essential for discovering the fundamental nature of nuclear matter, to partner with industry to apply its advanced technology, and to serve the nation and its communities through education and public outreach, all with uncompromising excellence in environment, health, and safety.

To accomplish mission-directed activities, the CEBAF accelerator is used to conduct user driven research into how nucleons are built from quarks and gluons, and how this structure leads to the standard nucleon-based picture of the nucleus.

Lab management recognizes that responsible stewardship of the $600 million investment in site program areas requires that management continue to work with a vision that exemplifies a world-class scientific facility. The Lab's vision is to: a) Foster user-driven nuclear physics research; b) Leverage resources to support national goals and objectives; c) Prepare a broadly educated next generation of scientists and engineers; d) Contribute to public science literacy and appreciation through community outreach and involvement; e) Maintain and further develop a world-class workforce; and, f) Lead responsibly by conducting environmentally sound, safe, and secure operations. Lab management has translated this vision into specific goals, as discussed in the current version of the Jefferson Lab Institutional Plan.

1.3 OPERATIONS

Jefferson Lab is a unique Nuclear Physics research facility in the United States and the world. The most recent DOE/SURA Contract, No. DE-AC05-84ER40150, became effective on November 1, 1999.

Jefferson Lab, a world-class research institution, attracts resident and visiting physicists and other scientists. Approximately 635 full-time physicists, engineers, technicians, and support staff work at Jefferson Lab. About 2,180 academic and industrial researchers from across the United States and approximately 30 countries from around the world participate in scientific collaborations. The Lab has thus far produced more than 160 patent disclosures. Of those, 111 were submitted for the patent-application process. Forty-four patents had been issued by the end of 2003, including light-guide technologies, medical imagers, flaw-detection equipment, a fire detection/prevention system, and an electronic lockout device that can be used for both safety and security purposes.

Jefferson Lab's annual budget is approximately $100 million, most of which directly supports the local economy through wages and purchases of materials and services, including from local contractors and businesses. Most full-time staff reside in Newport News or other nearby communities, thereby supporting the economic health of the area.

There are seven major facilities (program areas) on the DOE site: CEBAF, a superconducting radiofrequency (SRF) electron accelerator; End Stations A, B, and C (large halls that house physics experiments) that make use of beams from CEBAF; an SRF Institute that serves primarily as a research and development (R&D) center for SRF accelerator cavities; the Center for Advanced Studies of Accelerators (CASA) that supports the site accelerators and considers future planning opportunities; a Free-Electron Laser (FEL) User Facility that produces laser beams to serve university, industry, and military users; and, a Lattice QCD Computer, a 1/4 Teraflop commodity-PC-based machine.

1.4 HISTORY AND DESCRIPTION

Prior to the construction of Jefferson Lab, there were several users of this general area of Newport News, Virginia. The U.S. Department of Defense (DOD) acquired most of the Oyster Point area, including the land presently used by Jefferson Lab. The U.S. Air Force later acquired the land and installed a BOMARC missile site on a portion of the property. After closure of the BOMARC missile base, the DOD started disposing of the property. Some land was conveyed to the Commonwealth of Virginia, the National Aeronautics and Space Administration (NASA), and others. In 1987, ownership of the NASA property, including 100 acres of undeveloped land, was conveyed to the DOE as were an additional 52 acres of land transferred from other sources. At this time, the total DOE-owned parcel, upon which Jefferson Lab is built, is 163 acres.

An adjacent 44 acres, owned by the City of Newport News, were conveyed to SURA in 1986. A SURA residence facility is located on a portion of this land, and is used by guests and visiting experimenters, who are referred to as "users". Adjacent to this property is the former BOMARC missile site.

Sign at Main Entrance to Site

Also adjacent to the DOE-owned site is a 10.7-acre parcel owned by the Commonwealth of Virginia and leased to the City of Newport News. The Applied Research Center (ARC) is located on this property, and is used by Jefferson Lab, industry, and universities. Other adjacent land owned by the Commonwealth of Virginia is leased to SURA and the DOE for its use in support of Lab operations. This area, the DOE-owned site, and other nearby properties are considered part of the City's Jefferson Center for Research and Technology.

1.5 FACILITIES AND 2003 ACTIVITIES

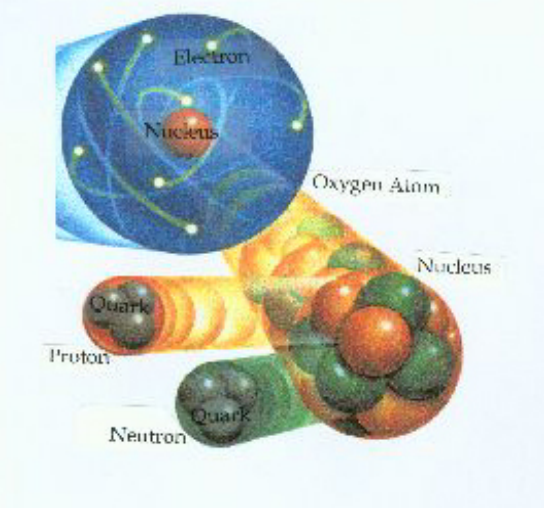
The 163-acre DOE site is primarily divided into two main areas. One includes R&D labs, fabrication facilities, and administrative offices including CEBAF Center. The second is a 40-acre fenced area, termed the accelerator site, where CEBAF and the FEL accelerators and

related experiments are housed. The accelerator site is located on the south end of the DOE property, and access is restricted through one entrance that is staffed 24-hours per day.

Front Entrance to CEBAF Center

The four major facilities that have environmental protection or public health-related implications are CEBAF, its halls (End Stations), the SRF Facility, and the FEL User Facility. A short description of each follows. Note that there are other activities that have potential environmental implications, such as the use of chemicals and oil products, but these are discussed elsewhere in the text.

CEBAF This accelerator provides continuous wave electron beams with energies from 0.5 to 5.7 GeV. CEBAF is used as a tool for exploring the transition area or range where strongly interacting (nuclear) matter can be understood as bound states of protons and neutrons, and the regime where the underlying fundamental quark-and-gluon structure of matter is evident. The nature of this transition is at the frontier of our understanding of matter.



Atomic Structure

End Stations (Halls A, B, and C) Each hall (or end station) has its own set of complementary experimental equipment. Hall A has a pair of superconducting, high-resolution magnetic spectrometers optimized for precision electron scattering coincidence experiments. The CEBAF Large Acceptance Spectrometer (CLAS) that supports studies of both electron and photon-induced reactions is housed in Hall B. The third end station, Hall C, contains a pair of moderate resolution spectrometers, with one capable of high momentum particle detection and the second optimized for the detection of short-lived reaction products.

The SRF Facility The SRF program is centered in the Lab's Institute for SRF Science and Technology. This Institute's strength is in R&D and large-scale applications of SRF, including to better CEBAF and the FEL. In addition, design, development, and fabrication of the SRF niobium cavities for the DOE's Spallation Neutron Source (SNS) are a current focus. Some ongoing work in the ARC also supports development of state-of-the-art surface science and SRF R&D to improve accelerator capabilities.

FEL User Facility The FEL is an accelerator that was initially designed to provide 1,000 watts (1 kilowatt (kW)) of infrared (IR) light with picosecond pulse length for use by Jefferson Lab, industrial, DOD, and university partners. The accelerator has since been upgraded and produced first light in 2003. This upgrade will enable operation in a wider range that extends from 1,000 watts of ultraviolet (UV) light to 10,000 watts (10 kW) of infrared light.

Future planning Analysis and R&D work on the proposed upgrade of CEBAF to 12 GeV continued in 2003. This upgrade in electron beam energy levels and a new experimental hall, Hall D, will support experiments that test the strong force that holds atomic particles together.

1.6 ENVIRONMENTAL REVIEW

An environmental assessment, termed EA, performed under National Environmental Policy Act (NEPA) procedures, was conducted prior to the construction of the original CEBAF project, resulting in a Finding of No Significant Impact (FONSI). EAs in 1997 and 2002, which also yielded FONSIs, addressed a CEBAF upgrade, an FEL upgrade, and five building construction projects. Existing NEPA-related documentation is periodically reviewed.

1.7 SITE EH&S RESOURCES

The facility makes available a variety of EH&S resources to serve the Jefferson Lab community. To ensure that staff, employees, subcontractors, and users are aware of and utilize EH&S principles, EH&S responsibilities are incorporated into each position description as described in the Jefferson Lab Integrated Safety Management (ISM) System Plan, which was validated by DOE in 1999.

Local EH&S resources are available to every employee, user, and visitor. They include: EH&S staff that support specific line organizations; EH&S program specialists that serve the entire facility in their area of expertise; groups and committees that address Lab-wide concerns,

develop policy, and resolve selected issues; and, the Jefferson Lab EH&S Manual, as the primary source of EH&S implementing procedures. The EH&S Manual is accessible via paper copy at designated locations in major site buildings and electronically at **http://www.jlab.org/ehs/manual/EHSbook.html**.
Other EH&S resources available to program managers at Jefferson Lab include: DOE subject matter experts; DOE program specialists that deal with policy issues at all levels; and, colleagues at other DOE facilities that share expertise and lessons learned from their own unique experiences. These resources were utilized in 2003 to support the continued development and implementation of EP and public health-related programs at Jefferson Lab.

SECTION 2
ENVIRONMENTAL PROTECTION PROGRAM

Jefferson Lab's mission includes protection of the environment and public health. Controls to accomplish this are established through multiple means including on-site programs, subcontractual agreements that address permit conditions, and as prescribed in other Lab commitments. There are many facets to the site EP program, including an Environmental Management System (EMS) strategy, which is integrated into facility operations under Jefferson Lab's ISM System Plan. The site's EP program provides guidance and requirements for making environmentally preferable choices; identifies requirements for radiological and non-radiological monitoring; and, reviews performance through actions such as assessments and inspections. This section provides information on these topics and other EP and public health-related events and activities for CY 2003.

2.1 ENVIRONMENTAL MANAGEMENT SYSTEM

In 2003, key Lab staff began preparing for implementation of a formal EMS. To date, Jefferson Lab's EMS program had been accomplished through implementation of the Lab's ISM System Plan, which addresses environment, health, and safety principles and functions, and through the detailed guidance in the Lab's EH&S Manual. The primary objective of the ISM System Plan is to make safety, health, and environmental protection a routine part of business at Jefferson Lab.

Some specific items that make up an EMS, such as the identification of performance measures, are included in the DOE/SURA operating contract. Other items, such as the identification of environmental aspects (such as air and water emissions), are documented, though not in EMS terms, in the EH&S Manual. EMS is currently applied on-site as described below, but this program will be modified as Jefferson Lab's EMS is developed and implemented during the course of 2004 and 2005.

Site EP Policy

Jefferson Lab has both a mission statement and an EH&S policy. The mission statement (see Section 1.2) calls for excellence in all activities while the policy commits the Lab to preserving the natural environment as well as to conducting operations without adverse impact on the surrounding community. The Jefferson Laboratory Policy on Safety, Health, and Environmental Protection is as follows.

> Jefferson Lab is committed to being a safe and healthful research laboratory.
>
> Jefferson Lab is committed to preserving the natural environment and conducting our operations without adverse impact on the surrounding community.
>
> These commitments include adherence to applicable laws, regulations, and standards.
>
> Safety, health, and environmental protection considerations are intrinsic to all work at Jefferson Lab and are essential to Jefferson Lab's overall scientific progress, productivity, and cost effectiveness. Thus, each individual must establish knowledge and control of the hazards and consequences of all work for which he or she is responsible. In addition, everyone has the right and responsibility to remedy or to report – without fear of reprisal – any practice, situation, or action which endangers people or the environment. These tenets are key ingredients of acceptable individual behavior and responsible management at Jefferson Lab.
>
> No activity is so urgent or important that our standards for safety, health, or environmental protection may be compromised.

Environmental Planning and Analysis Procedures

Environmental planning and analysis is handled by documenting and reviewing projects and activities for NEPA considerations. Line management is responsible for providing notice of actions and impacts to enable sufficient time for review and authorization as applicable. As well, construction-related subcontracts were enhanced in 2003 to address some new permit conditions, and relevant ongoing subcontracts continue to require and encourage subcontractors to take EP into account.

Environmental Objectives and Targets

The Lab operates within contractual limits, which include staying within permit criteria. New performance objectives and targets were identified under a general Virginia Department of Environmental Quality (DEQ) storm water discharge permit that became effective in June 2003. Additional objectives and targets will be identified as the site EMS program is developed.

Implementation and Operations Controls

The DOE/SURA contract defines general terms and conditions for operation and performance. EMS/ISM roles and responsibilities, along with some implementation procedures, are included in the Lab's EH&S Manual. No separate EMS training has been provided, though three key staff were trained in early 2004. The need for additional training was also being identified at that time.

Identification of Environmental Aspects and Impacts

No EMS-specific analysis had been performed before 2004; however, previous NEPA and other reviews have identified that the primary environmental aspects at Jefferson Lab are radiological concerns involving air, water, the public, and local biota. As well, intensive use of resources, including electricity and water, would be considered aspects. EMS aspect identification will occur during 2004.

Performance Measurement

The Lab semi-annually reviews contract performance measure results for various topical areas that include EH&S. As well, the compliance status towards meeting the new storm water measurable objectives was reviewed in late 2003. Additional performance measures will likely be developed in 2004 and 2005 as the EMS is implemented.

Corrective Action and Self-Assessment Procedures

The ISM System Plan is reviewed annually and updated (most recently in November 2003) as necessary and shared with the DOE Site Office. This review identified a few areas where ISM program improvements should be made and the Lab Director committed to making these changes. It is projected that the EMS self-assessment process may be linked with the ISM annual review.

Management Review Process

The Director's Council, composed of top management, reviews the ISM System Plan periodically through the self-assessment noted above. The review is documented and open items are tracked until closure, with regular status reports provided to the Lab Director. The possible integration of EMS with the ISM process will be evaluated during EMS implementation.

2.2 MAJOR ENVIRONMENTAL PROGRAMS

2.2.1 Waste Minimization and Pollution Prevention (WMin/P2)

Waste minimization, in combination with other pollution prevention (P2) strategies, such as source reduction, is recognized as the most cost-effective form of EP (environmental protection). Jefferson Lab's WMin/P2 Awareness Plan fosters the philosophy that waste prevention is superior to either paying for special disposal or for remediation. The goal of the program is to incorporate WMin/P2 into the decision-making process at every level throughout the organization. This is accomplished by having line managers, assisted by division EH&S staff, ensure that staff are knowledgeable about the benefits of WMin/P2, consider the waste implications of a new or modified process during the planning stage, and, are recognized when ways to enhance EP are brought to their manager's attention.

These practices benefit the environment, protect employees and public health, and reduce site waste disposal costs.

2.2.2 EP in Product and Service Life Cycles

A variety of products and materials are obtained and used on-site. When the materials have served their purpose, and are no longer needed, they will be disposed of in accordance with Jefferson Lab policy. As there are EH&S risks involved, Jefferson Lab has programs and procedures in place which include EP and sustainability considerations.

Purchasing and Planning

Environmentally Preferable Purchasing (EPP)

Jefferson Lab is committed to integrating EPP and sustainability considerations into the acquisition of products, services, and construction projects when feasible. This commitment is founded on the Lab's commitment to P2 and sound environmental stewardship. Our EPP efforts go beyond the affirmative procurement (AP) requirements spelled out in Executive Order (EO) 13101 and the referenced list of Environmental Protection Agency (EPA)-designated products.

Jefferson Lab continues to make satisfactory progress toward meeting the DOE AP goals and requirements and in implementing other EPP measures. Examples that are accomplishing the EPP implementation goals and practices include the following:

Affirmative Procurement (AP)

- Continue to increase employee awareness of EPA-designated products and provide ready access to these recycled content/remanufactured products.
- Office supply purchases made using Purchase Cards (PCards) have been restricted and a full line of AP items are available using the Lab's e-commerce system.
- A special AP-buyer training program was developed and presented to procurement staff.
- Jefferson Lab has made steady and consistent progress for the past three years in meeting the DOE established AP goals.
- The Jefferson Lab Copy Services contract includes the requirement to supply recycled content copy and computer printer paper site-wide. This preferred source for all copy and printer paper ensures maximum use of recycled content paper, while significantly reducing paper purchase costs.

Other Environmentally Preferable Purchasing Practices

- The Lab continues to support the Energy Star® program by purchasing and using energy efficient products whenever possible.
- Facilities Management has enhanced their construction specifications to encourage contractors to utilize recycled content items and report quantities used for a project.

EP Considerations in Building and System Design and Construction Activities

Though the CEBAF accelerator complex is the site's primary energy user, energy management principles are applied throughout the Lab. Subcontractors and staff involved with the design of new buildings or with changing and updating existing buildings or utility systems consider and implement energy and water conserving strategies. A major new project that will be constructed starting in 2004, the Phase 1 Addition to CEBAF Center, has been designed to incorporate multiple EP elements and may even meet the strict terms required for a future submission for LEED (Leadership in Energy and Environmental Design) certification. Examples of items that would meet LEED criteria are the use of energy efficient lighting and the use of an alternative source of energy, that is, to not use coal or oil.

Environmentally Preferable Use

Besides selecting the best environmentally preferred product or service for the desired activity, staff and users of Jefferson Lab are responsible for following safe and environmentally sound use, storage, and waste management practices.

Factors, such as ensuring that secondary containment is present and proper ventilation for the process is provided, help to minimize exposure to potential hazards. Lab staff and subcontractors have taken opportunities to minimize energy and water use, such as shutting off lights when not in the room, and providing prompt response to address reported water leaks.

Jefferson Lab uses about 56 million gallons of water annually, with 79% directly related to process or facility heat rejection. Much of this water is evaporated in cooling towers for process cooling and air conditioning. Available techniques are used to minimize water use, including a regular maintenance program. Water reductions for landscaping were again implemented in 2003.

Energy Management With an increased emphasis on energy management, selected mechanical and electrical improvements have been made to building and process systems and equipment in order to improve their performance and reliability.

The energy projects, including installation of motion-activated lighting, begun in 2002 were completed in 2003. The energy reduction through fiscal year (FY) 2003 was 25.7%. The Lab has exceeded the prescribed energy goals due in part to the installation of these measures.

Additionally, a new central chiller utility is being installed. When this project is completed in FY 2004, the air conditioning for the accelerator will be more accurate, economical, easier to maintain, and more robust. This project minimizes the use of mechanical cooling by employing an outdoor air economizer cycle.

The following projects or initiatives began and/or were completed during 2003.

- A central chiller project at the Test Lab – the new air conditioning system noted above that resulted in the replacement of two chillers containing ozone-depleting substances.
- Besides continuing to monitor energy activities for many site buildings, Facilities Management added more meters to buildings to better monitor energy usage.

Water Conservation With an increased emphasis on water conservation, water-using processes and site maintenance activities continue to receive extra attention. New projects that need water are reviewed to minimize water use. Existing water-using activities are, or will be, evaluated to reduce water usage as much as possible based on a life cycle cost. One example is that we are using process waste water to partly supply our cooling towers. A second example is minimizing the amount of water being used for landscaping.

Environmentally Preferable Disposal

Today's rapidly changing technologies, products, and practices carry the risk of generating materials and wastes that, if improperly managed, could threaten public health and the environment. In this regard, Jefferson Lab encourages, and, where appropriate, requires the purchase and use of products and services whose waste products will have minimal impact on the environment and public health. Once the waste is generated, staff are responsible for ensuring proper segregation and disposal of waste items.

The range of options for disposition of materials includes recycling, neutralizing, scrapping, providing spent chemicals or equipment to co-workers on-site or to other DOE facilities for reuse, and disposing in a local landfill. The Lab intends for all items to be disposed of in the most environmentally acceptable manner that meets all applicable regulatory and contractual requirements.

Facilities Management and other staff continue to explore opportunities to find users or vendors that will take or buy items that are no longer needed for Jefferson Lab operations.

2.2.3 Environmental Monitoring Program

Environmental monitoring is one of the primary methods used by the Lab to assess environmental conditions. Monitoring is conducted to: verify compliance with applicable regulations and other requirements; evaluate the Lab's impact on the environment and public health; identify potential environmental problems; provide data to support management decisions; and, evaluate the need for remedial actions or mitigative measures.

The site program establishes guidelines for examining chemical, oil, and radioactive effluents generated by the facility. An integral part of the program is routine sampling and tracking of air, process water, wastewater, and groundwater. These are monitored to ensure that Jefferson Lab effluents do not have a negative impact on the surrounding environment and that they remain within the allowable range. Jefferson Lab also assesses the effects of Lab activities by measuring, monitoring, and calculating the effects of past and current Lab operations to help minimize the effects on the environment and public health from planned Lab operations.

Both permit-required and routine monitoring emphasize potential environmental exposure pathways appropriate to medium-energy particle physics laboratories. These pathways include external and internal exposure to radiation, a major focus of the site's program. The external exposure potential is from direct penetrating and airborne radiation. The internal exposure pathway is from H-3 (tritium) and Na-22 (a sodium isotope) in potential drinking

water sources. These exposure potentials are discussed in Section 4 and do not present a concern either on or off the Jefferson Lab site at this time.

Sampling is conducted in a manner that adequately characterizes effluent streams. Standard collection and analysis methods are used and are documented in program and departmental procedures. Routine environmental monitoring is performed under the direction of responsible line management and overseen by the Lab's Office of Assessment. General program information is provided below, as well as some of the analytical results obtained under our site permits. Details and analytical results about the Lab's radiological monitoring program are provided in Section 4.

2.2.3.1 Water Programs

Jefferson Lab reported information to the DEQ under three permits in 2003: quantities of groundwater discharged under the Permit to Withdraw Groundwater; radiological and general groundwater quality parameters under Virginia Pollutant Discharge Elimination System (VPDES) Permit No. VA0089320; and, general surface water quality factors under VPDES Permit No. VAG253002. Results were also reported to the Hampton Roads Sanitation District (HRSD) under Permit No. 0117.

Permit to Withdraw Groundwater

Jefferson Lab withdraws groundwater from under the experimental halls to prevent hall flooding. The only factor of concern under the groundwater withdrawal permit is the quantity of water pumped, with the permit allowing a maximum of 6,000,000 gallons per month and 23,036,790 gallons annually. (Pumping is minimal in drought periods.) A broad range of rainfall levels results in wide withdrawal quantity variations. Quantities of water pumped from these tile fields are reported quarterly to the DEQ.

The quantity of water pumped in 2003 ranged from 117,834 gallons for the month of September to 616,838 gallons for August, with, over the year, a monthly average of 461,323 gallons. The maximum gallons per day for each month ranged from a low of 11,762 gallons in October to a high of 22,777 gallons in June and July. No unusually large quantity was evident after the hurricane in September as the rain fall was less than anticipated. There were no unusual issues regarding this discharge in 2003.

VPDES Permit No. VA0089320

This permit covers monitoring for water quality, both non-radiological and radiological, at fifteen groundwater monitoring wells and at the Outfall 001 (withdrawn groundwater) collection point. Refer to Section 4.2.2 for discussion on the radiological portions of the Permit.

Monitoring wells were sampled for the general water quality parameters of pH, conductivity, total suspended solids (TSS), and total dissolved solids (TDS) under the Permit terms. Groundwater collected at Outfall 001 is sampled and reported quarterly for these same parameters. Sampling data collected in 2003 was representative of groundwater quality during accelerator operations and is consistent with previous baseline measurements.

Minor variations in non-radiological information collected at the wells in 2003 may be due to seasonal, local ground conditions, and general earth-disturbing activities. All permit conditions were met in 2003.

VPDES Permit Nos. VAG253002 and VAG250018

A new general permit (VAG250018) became effective on March 2, 2003 and replaced VAG253002. Cooling water discharges from two cooling towers were covered by this permit.
The materials used for cooling water treatment were Coastline Formulas 2029 and 1909, and a small amount of a dispersant. There are no environmental concerns with the use of these chemicals.

Quarterly sampling and reporting are performed under the effective VPDES General Permit. Flow information and sampling results for pH, temperature, total hardness, total dissolved copper, total dissolved zinc, and total residual chlorine are provided to the DEQ. Sampling for ammonia was started in 2003. All permit conditions were met in 2003.

HRSD Permit No. 0117

Industrial wastewater, which includes a small quantity of activated water, is generated by Jefferson Lab and discharged to the HRSD through our Industrial Wastewater Discharge Permit. The activated water that was collected and discharged in 2003 was a combination of the output from dehumidification equipment in the experimental halls and small withdrawals from the beam dump cooling systems.

Jefferson Lab performs quarterly pH sampling at two sanitary sewer outflow streams to verify that pH levels are within permit limits. Besides the activated water discharge noted above, there are two special discharges to the sewer. One elementary neutralization tank handles waste acid rinsewater and continuously records pH levels. The second outflow is from a new elementary neutralization system that was installed and began operations in 2003. This system handles acid rinsewater and waste acid from cryomodule research and development, cavity production, and some general maintenance activities. This system records pH information electronically and has built in safeguards to prevent release of any acid below a set pH.

Radiation Control Group (RadCon) staff manage the HRSD radiological sampling and analysis requirements. The HRSD samples all discharge streams periodically for a full complement of metals and other parameters. On an annual basis, a seven-day period of monitoring flows and samples at each of the discharge points is performed to help determine if changes to the permit are necessary. Self-monitoring and HRSD results demonstrated that Jefferson Lab remained within the limits of the HRSD-issued permit in 2003. And, as there were no program or administrative violations in 2003, Jefferson Lab was given a Gold Award for this notable achievement.

2.2.4 Other Water Related Programs

Storm Water Management

Storm water runoff plays a part in the natural hydrologic process. Across the country contaminated storm water discharges have been increasingly identified as a significant source of water pollution. Pollutants in surface runoff are one of the main contributors to the degradation of our local Chesapeake Bay.

Two new permits became effective in 2003. The first is General Permit VAR040079 that covers storm water discharges from small municipal separate storm sewer systems (MS4). The permit is referred to as the MS4 Permit. The second is VAR103277 that authorizes Jefferson Lab to discharge storm water from areas disturbed by construction activities.
Permit VAR040079 requires that the Lab maintain a storm water management program, which is currently addressed under the Lab's Storm Water Pollution Prevention Program. This program addresses storm water pollution prevention, control, and countermeasure issues. The permit also requires that the Lab implement appropriate best management practices (BMP) and related measurable goals to address the minimum control measures (MCM) identified in the permit. One example of an MS4 permit goal that addressed the Illicit Discharge Detection and Elimination MCM is the Lab commitment to complete an accurate storm drain system map within the first year of the permit, which was accomplished.

The second permit, VAR103277, had as its main requirement that the Lab have in place a documented Storm Water Pollution Prevention Plan (SWP3) meeting all permit terms and conditions. An SWP3 was developed and put in place to enable coverage for two construction projects that would be disturbing at least one acre of land. The SWP3 includes commitments such as if ground disturbance does take place, Jefferson Lab will manage storm water runoff by implementing erosion and sediment control best management practices. Facilities Management has addressed these permit requirements by strengthening subcontract specifications.

Water Related Issues not Related to a Permit

The Federal Insecticide Fungicide and Rodenticide Act (FIFRA) applies to the storage and use of herbicides and pesticides. Use of these substances has environmental implications, especially in terms of water quality. As such, the application of herbicides and pesticides is permitted through a State-administered certification program, accomplished by certified subcontractors who comply with FIFRA through Virginia's program.

Herbicides were used on annual and perennial weeds and grasses, stumps of trees, and brush. Pesticides were applied on-site for control of insects. Areas treated included kitchens, laboratories, and other areas throughout the site.

In order to minimize the chances of herbicides and pesticides washing into local storm water channels, Jefferson Lab requires that there be no outdoor application of these compounds when rain is expected. To further minimize the chances of pollution, no industrial-strength herbicides or pesticides are prepared, mixed, stored, or disposed of on Jefferson Lab property. The subcontractor is responsible for handling any waste disposal

through an authorized disposal facility. Small containers of household pesticides are stored on-site and applied per manufacturer's recommendations.

2.2.5 Conventional Air Emissions

The Hampton Roads area of southeastern Virginia returned to the status of non-attainment for the ozone ambient air quality standards in 2003, from its previous rating as a Clean Air Act (CAA) maintenance area. The Hampton Roads area did, however, remain in attainment for the other criteria air pollutants: particulate matter, sulfur oxides, carbon monoxide, nitrogen dioxide, and lead. There is no required monitoring of criteria air pollutant emissions performed at Jefferson Lab except for a very small amount of ozone generation. There are no applicable National Ambient Air Quality Standards emission sources present on the site.
Accelerator operations result in the generation of small quantities of ozone. There are no environmental or public health effects from this generation; however, ozone is monitored as a worker health issue and is appropriately controlled.

Jefferson Lab is required to notify the DEQ regarding its air pollution sources and the types of potential air pollution that may be released into the atmosphere. Natural gas-fired boilers are the primary air pollutant sources at Jefferson Lab. Annual air emissions reports are provided to the DEQ upon request.

Since a 1995 review of non-radiological emission sources indicated a minimal level of emissions, there have been no major changes in air emissions. Jefferson Lab, therefore, remains below any reporting thresholds. No new requirements became applicable in 2003.

2.3 APPRAISALS, ASSESSMENTS, AND INSPECTIONS

The DOE Site Office, the DOE Oak Ridge Operations Office, and various Commonwealth and local authorities provide external oversight of the Jefferson Lab EP Program. Actions of note are described here.

DOE Review of Jefferson Lab Self-Assessment

The DOE Site Office's Overlay Report, produced in conjunction with SURA's annual Lab-wide self-assessment, covers EH&S topics, contains Site Office observations and reviews, DOE appraisal results, and other information. The Report provides an overall performance assessment for the year. For FY 2003, the Overlay Performance Evaluation Report yielded a rating of "Outstanding" in the EH&S category.

External Inspections

There was one external environmental inspection during 2003. HRSD staff performed the annual Jefferson Lab site inspection on February 12th. The inspection covered buildings 19 (Forestry), 31 (Acid Storage Building), and 87 (Accelerator Maintenance Support), as well as the new meters that were installed since the 2002 inspection. Jefferson Lab permit records and HRSD meter information were also reviewed. Information regarding the change in hazardous waste vendors was requested and provided. No deficiencies were identified.

There were two other major audits in 2003 - one conducted by the Occupational Safety and Health Administration (OSHA) and another by the Nuclear Regulatory Commission (NRC). The purpose of these audits was to help establish the cost of transitioning DOE Office of Science laboratories to external regulation by these two agencies.

- A twelve person OSHA team performed a site inspection during the week of August 12, 2003. The following principal hazards covered by OSHA were reviewed: mechanical, electrical, chemical, thermal, and radiation.
- A four person NRC team reviewed implementation of the Lab's radiological program from July 28 through July 31.
- The two reviews summarized that there were no factors present that would prevent the transition of the Lab to external regulation.

Line Self-Assessments

Line managers perform annual line self-assessments (LSAs) of their organizational elements. The LSAs are broad in scope, covering the accomplishment of the elements' goals, including EH&S. The Self-Assessment/Quality Assurance (SA/QA) Group performs independent assessments of four or more of the Lab's organizational units each year, focusing on EH&S. Deficiencies identified through these independent assessments are tracked by SA/QA until the corrective actions are completed.

2.4 NEPA ACTIVITY

NEPA, as amended, outlines the Federal policy to restore and enhance the environment and to attain the widest range of beneficial use without degradation. NEPA-related actions are handled in conjunction with the DOE, which is committed to following the related EPA regulations. Jefferson Lab assists the DOE by preparing documents and performing assessments of existing documentation. NEPA actions performed in 2003 were as follows.

- Thirteen Categorical Exclusions (CXs) pertaining to regular activities, including the "Management of Radioactive Waste at TJNAF", were reviewed and renewed.
- The internal approval process for very small-scale construction projects and other minor activities that are covered under site Environmental Assessments (EAs) and CXs continued.

2.5 OTHER SIGNIFICANT ENVIRONMENTAL ACTIVITIES IN 2003

2.5.1 Issues and Actions

Awards Received

Jefferson Lab received the HRSD "Gold Award for Pretreatment Excellence" for CY 2003. The Lab has been the recipient of six Gold Awards and two Silver Awards since the program was initiated in 1994.

Activities

- In January 2003, redesigned winter weather procedures were successfully used during the significant snowfall event.
- In April 2003, Jefferson Lab hosted an Open House, which is one of the Lab's primary public outreach activities, and attracted about 4000 visitors. Jefferson Lab Security partnered very successfully with the local police and Department of Transportation experts.
- In July, a table-top exercise and orientation was conducted involving several new people in key roles who needed familiarization with the Director's Command Staff process.
- In September, Hurricane Isabel caused a complete Lab shutdown. Effective planning and early preparation were implemented. Thanks to excellent information sharing throughout the site, preparations were very effective in keeping Jefferson Lab property damage to a minimum.

Environmentally Harmful Material Spills

There were three minor petroleum product releases - a gasoline leak from an employee's car and two oil releases in a storage yard. There were also three small propylene glycol/water spills from site cooling systems, one due to a line freezing. The instances were minor and quickly cleaned up and corrected by line management and EH&S staff.

Spill Prevention, Control, and Countermeasure (SPCC) Plan

All oil workers received SPCC training in 2003 through a new online course that focused on prevention, recent spills, and the implications of new regulatory requirements.

2.5.2 Recycling

The Lab continues to implement waste reduction strategies and to educate and encourage staff on the proper disposition of recyclable materials. Through a collaborative effort between EH&S Reporting and Facilities Management, office product recycling centers continued to be established and operated. Products collected are: aluminum cans, small batteries, cardboard, CDs/diskettes, copier/fax/inkjet/laser cartridges, greeting cards, paper wastes, packing peanuts, telephone books, transparencies, Tyvek® envelopes, and plastic bottles. The small amount of money received from recycling the laser/inkjet cartridges and aluminum cans is returned to the recycling budget to help pay for subsequent recycling activities. The presence of local recycling centers has considerably increased staff recycling awareness. Lab-wide response and participation in recycling continued to grow. The improved awareness resulted in a 37% increase in toner cartridge recycling from FY02 to FY03.

Communication channels, such as the Lab's *On-Target* newsletter and EarthWise web page, and personal interactions by EH&S Reporting and local recycling center coordinators continued to inform people about recycling activities.

The quantities or ranges of materials recycled in FY 2003, and, for comparison, the two largest recycling streams for FY 2002, as reported to the DOE, are shown in Exhibit 2-1.

2.5.3 Hazardous and Special Wastestreams

Improvements in hazardous waste generation rates have been recognized and documented with the use of Performance Measures. Jefferson Lab has made notable progress in meeting hazardous waste minimization objectives. Accelerator Division EH&S staff, in particular, continued to emphasize substitution, reduction, and reuse of hazardous materials in the workplace.

EXHIBIT 2-1
QUANTITIES OF ITEMS RECYCLED OR REUSED IN FISCAL YEAR 2003

Description	Quantity: FY 2003 tons (kilograms)*
Paper Products (office paper & cardboard)	43.2 (39,200) [compared to 39.9 tons in FY02]
Scrap Metal (reclaimed through GSA#)	69.6 (63,200) [compared to 85.1 tons in FY02]
Circuit Boards and Electronics	14.9 (13,500)
Aluminum cans, plastic bottles, used oil and coolant, large car-type batteries, fluorescent lamps, toner cartridges, transparencies, small batteries, and new/used all occasion cards	between 10 lb. and 1 ton
Computer Disks	10 lb or less

*Quantities for FY02 are shown for the two largest recycling streams.
#GSA – General Services Administration

SECTION 3
ENVIRONMENTAL COMPLIANCE AT JEFFERSON LAB

Compliance with applicable EP and public health-related laws and regulations is an important part of operations at Jefferson Lab.

Assurance that on-site processes do not adversely affect the environment is achieved through self-assessments, routine inspections, and oversight by the DOE, DEQ, and the HRSD. Jefferson Lab complies with all applicable laws, regulations, and permits.

3.1 AIR QUALITY

The Clean Air Act and its 1990 Amendments (CAAA) regulate the air emissions of DOE's processes and facilities. Though Jefferson Lab has no processes, such as open burning or furnaces, that require air permitting, air emission reports are provided to the DEQ upon request.

Compliance with all applicable clean air standards was maintained in 2003.

3.1.1 National Ambient Air Quality Standards (NAAQS)

The EPA has established NAAQS for sulfur oxides, particulate matter, carbon monoxide, ozone, nitrogen dioxide, and lead. The Hampton Roads area, which includes Newport News, remained in attainment for all NAAQS pollutants in 2003, but was recently reclassified as non-attainment for ozone. Examples of how Jefferson Lab complies with NAAQS follow.

- Vehicles are leased through the General Services Administration (GSA) so maintenance is performed offsite by GSA-approved facilities.
- Fuel dispensing on-site is limited to one diesel fuel tank for forklifts.
- Subcontractors operating machinery on-site may have temporary diesel fuel storage tanks that have appropriate fittings to minimize air emissions.

3.1.2 National Emission Standards for Hazardous Air Pollutants (NESHAPs)

NESHAPs govern air emissions that contain hazardous components, such as radionuclides and asbestos.

3.1.2.1 Radionuclide Emissions

The EPA administers the radionuclide program in Virginia. Radionuclide emissions generated during CEBAF and FEL testing and operations, including emissions resulting from interactions of the accelerator beams with experimental targets and physics research equipment, fall under NESHAPs requirements. (Refer to Section 4 for discussion of direct radiation, the primary form of radiation generated on-site.)

To address NESHAPs requirements, Jefferson Lab uses sampling results and calculations to demonstrate that Lab operations remain below the EPA-defined 10 millirem (mrem)/yr potential effective dose equivalent to any member of the public. As effluent concentrations are below monitoring thresholds, routine monitoring of radioactive airborne effluents at the site boundary is not required. However, the Lab does make periodic confirmatory measurements to verify low emissions.

Based on common DOE practice, Jefferson Lab, although under the reporting threshold, voluntarily furnishes an annual report to the EPA.

3.1.2.2 Asbestos Removal

The NESHAP standard requires trained and licensed individuals conducting asbestos-related activities to follow approved procedures and to adopt specific work practices to prevent release of asbestos to the air. There were no asbestos-related activities in 2003.

3.1.3 Non-radiological Emissions

Jefferson Lab complies with Virginia regulations regarding sources of potential air pollution. Some notes of interest regarding air pollution follow**.**

- The Lab's air emissions remained below reporting thresholds.
- The Lab typically uses seven natural gas-fired boilers and fin-tube convectors for building heating. Boiler information, including fuel consumption data, is provided to the DEQ.
- The Lab minimizes releases of potentially polluted air by using scrubbers and by implementing preventive maintenance. The Lab uses an air scrubber for the small emissions from a new electropolish cabinet.
- The last DEQ inspection occurred in September 2002 with no concerns identified.

3.1.4 Stratospheric Ozone-Depleting Substances (ODSs)

To support the CAAA and EO 13148, *Greening the Government through Leadership in Environmental Management* objectives, Jefferson Lab strives to minimize the use of ODS by using safe, cost-effective, environmentally preferable alternatives. ODS-containing items used at Jefferson Lab include refrigerants, degreasers, cleaners, and spray can propellants. Phase out of these substances will have a moderate impact on the site.

Some accomplishments in reducing ODS items on-site include:

- Trained and licensed subcontractors and Facilities Management staff perform all work involving plant ODS-containing refrigeration and air conditioning equipment.
- Jefferson Lab has one ODS recovery machine on-site.
- Two of the three remaining chlorofluorocarbon (CFC)-based chillers on-site were replaced with high efficiency non-CFC units in 2003. The one remaining unit continues to be effectively maintained by mechanical staff to ensure optimal performance and minimal CFC losses.
- Vehicle air conditioning units are serviced offsite by GSA-approved shops.

3.2 WATER QUALITY

Both groundwater and surface water quality protection are high priorities at Jefferson Lab. Groundwater quality is a focus area primarily due to operating the underground CEBAF accelerator. Preventing surface water pollution is another focus area during both general site usage and civil construction actions.

Standards used to provide protection of the water quality are applicable laws, such as the Clean Water Act (CWA) and Virginia regulations. Permits cover groundwater monitoring, cooling water discharges, storm water pollution prevention (for both industrial and construction concerns), groundwater withdrawals, and discharges to the sanitary sewer. (Refer to

Exhibit 3-1 on the next page for a list of all site permits.) The Lab also has an SPCC Plan that presents the site oil management program.

Some of the radiological monitoring results under these programs are provided in Section 4.2. There were no water-related compliance issues in 2003.

3.2.1 VPDES Permits

Facilities in Virginia that directly discharge to waters of the United States must obtain a VPDES Permit. This program addresses the requirements of the National Pollutant Discharge Elimination System. The Virginia program is designed to protect surface waters by limiting primarily non-radiological releases of effluents into streams, lakes, and other waters, including wetlands.

Groundwater Monitoring - VPDES Permit No. VA0089320

The Permit covers the quality of groundwater flowing across the site, including the groundwater that is discharged in a dewatering operation.

Because of the potential for activation of groundwater from accelerator operations, "baseline" water quality values for certain parameters have been obtained. This Permit includes the Lab's long-term groundwater quality limits. The Permit also includes a well monitoring program that enables the comparison of current and "baseline" values to verify that Jefferson Lab site activities are not degrading the quality of either on-site or offsite groundwater.

Throughout 2003, groundwater sampling to monitor designated wells for all permit-defined parameters was performed under a subcontract with an accredited laboratory. One special notice was provided to the DEQ in May 2003 regarding an unexpected construction dewatering activity on the accelerator site. The DEQ acknowledged the notification.

EXHIBIT 3-1
JEFFERSON LAB PERMITS

Discussed in Section	Permit Number	Description	Permit Dates
3.2.1	VA0089320	VPDES Permit – Specifies allowable groundwater and surface water quality on-site during accelerator operations. Assures groundwater unaffected at and beyond site boundary.	7/16/2001 - 7/16/2006
3.2.1	VAG250018	VPDES - General Permit that authorizes cooling water discharges within identified discharge limitations.	3/2/2003 - 3/1/2008
3.2.1	VAR040079	VPDES – General Permit that authorizes storm water discharges from small municipal separate storm sewer systems	12/9/2002 - 12/9/2007
3.2.1	VAR103277	VPDES – General Permit that authorizes storm water discharges from construction activities	6/30/1999 - 6/30/2004
3.2.2	GW0030800	Permit to Withdraw Groundwater - Authorizes maximum quantities of water to be withdrawn by dewatering of area under the experimental	11/1/1994 - 10/30/2004

		halls	
3.2.2	HRSD No. 0117	Industrial Wastewater Discharge Permit - Limits wastes to be discharged to sewerage.	3/1/2002 - 3/1/2007
None	4727-45-01	South Carolina Radioactive Waste Transport Permit - authorization to transport low level radioactive waste (LLW) within the State	Effective to 12/31/2003

Cooling Water Discharges - General Permit No. VAG250018

This Permit, which contains water quality limits, covers the surface discharges from the cooling tower adjacent to the Central Helium Liquifier. The discharge from a small tower adjacent to the Test Lab that flowed to surface water in early 2003 was changed to flow to the sanitary sewer in June 2003. Modifications to remove this discharge stream from the permit are underway.

Sampling is performed by an accredited laboratory. The special construction dewatering activity noted above was also reported to the DEQ under this Permit.

Small Municipal Separate Storm Sewer System (MS4) – VPDES Permit No. VAR040079

This new Permit, which became effective June 13, 2003, authorizes operators of small municipal separate storm sewer systems to discharge storm water to surface waters within Virginia.
The Permit's intent is to keep surface waters free of sediment and other pollution. To meet this intent, Jefferson Lab has identified a number of BMPs and measurable goals. One of these BMPs is to provide storm water pollution prevention information to all Jefferson Lab staff, subcontractors, and vendors.

General Permit for Storm Water Discharges of Storm Water from Construction Activities VPDES Permit No. VAR103277

This new Permit became effective December 22, 2003. It authorizes storm water to be discharged from construction sites when the terms of the permit, including the preparation and implementation of a project SWP3, are met.

Jefferson Lab had an SWP3 in place in early 2004, before the start of the first land disturbing project that met the permit criteria of affecting greater than one acre of land. The Lab's Facilities Management Department oversees the subject civil construction projects and ensures that subcontractors adhere to the permit and other standards that are called out in the contract specifications.

3.2.2 Other Water Program Standards

Permit to Withdraw Groundwater No. GW0030800

To maintain water table levels to prevent the partially buried experimental halls from flooding, water table control via pumping will be necessary for the life of the facility. To accomplish this, the water is collected, pumped, and discharged to the surface. This Permit authorizes the quantity of groundwater that can be withdrawn.

All withdrawal quantities, both monthly and annually, were well within permit requirements. Note that the total quantity of water withdrawn in 2003 was 5.5 million gallons, well below the 23 million gallon annual limit. The Lab voluntarily reports its annual water usage to assist the DEQ in determining total regional water usage. The affected groundwater is sampled for water quality parameters under Permit No. 0089320.

Industrial Wastewater Discharge - Permit No. 0117

Discharges to the HRSD are subject to the Industrial Wastewater Discharge Permit and its associated regulations. Very limited quantities of activated water are also authorized for release under this Permit.

Sampling for pH and radionuclides is performed according to the terms of the permit. Subcontractors and/or RadCon staff perform the sampling at prescribed sampling points. HRSD independently performs periodic sampling for metals and other water quality indicators at some of the sampling points to validate Jefferson Lab compliance with permit and regulatory requirements.

HRSD performed its annual inspection on February 12, 2003, with no concerns found. All permit and regulatory criteria were met in 2003, resulting in receipt of the HRSD Gold Award mentioned earlier.

SPCC Plan

The Jefferson Lab SPCC Plan is reviewed annually and was last updated in 2001. This Plan addresses all storage tanks and oil-containing equipment, such as transformers, on-site. The Lab maintains a used oil collection area to assist in managing the resulting used oil. See Section 3.5.5 for more information on this plan.

3.3 WASTE MANAGEMENT

Waste streams at the Lab include both Resource Conservation and Recovery Act of 1976 (RCRA) (hazardous and non-hazardous solid) and non-RCRA (low-level radioactive and medical) wastes. Site programs address applicable Federal and Virginia regulatory requirements. The Lab endeavored to reduce its waste generation and made progress in some areas. Lab staff encourage the reuse or recycling of previously used or discarded materials wherever possible. Waste generation and recycling quantities are tracked and reported annually to the DOE.

There have been no waste management activities associated with spills or cleanup actions under other Federal programs such as the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA). There were no waste-related compliance issues in 2003.

3.3.1 Resource Conservation and Recovery Act

RCRA promotes the protection of health and the environment and the conservation of valuable material and energy resources. RCRA provides the EPA authority to regulate solid waste, from minimization and recovery to collection and disposal.

RCRA wastes include our hazardous and non-hazardous special waste streams and waste that is recycled or sent to a landfill. The last RCRA-related inspection, by the DEQ, was on September 5, 2002.

Refer to Exhibit 3-2 for the volumes of RCRA wastes generated by Jefferson Lab in 2003. The wastes are managed for disposal by the appropriate staff in the Facilities Management Department and the Accelerator Division's EH&S Department. The increase in hazardous waste was due to additional activity to support the recent FEL upgrade, the SNS project, and the new R&D electropolish cabinet. This wastestream will be reduced significantly as the new neutralization system has begun processing used acid streams. There is no known explanation for the reduction in dumpster/landfill waste, but might be due to normal fluctuations and improved waste minimization and recycling practices.

EXHIBIT 3-2
RCRA WASTE GENERATION QUANTITIES (BY FISCAL YEAR)

Waste Type	FY 2003 (tons)	FY 2002 (tons)
Hazardous waste	7.8	5.6
Dumpster/landfill waste	264.5	337.8

Here is some general information about our site RCRA program.

- The Lab remained a Small Quantity Generator (SQG) of hazardous waste. During the 2002 inspection, as hazardous waste generation was increasing, the DEQ approved the possibility of the Lab having two or three 'episodic' incidents of exceeding the SQG monthly limits, which never occurred.
- A new elementary acid neutralization system, that has significantly reduced the Lab's generation of hazardous waste, was put into use in August. The hazardous waste generation quantity for FY 2003 would have been higher if not for this new system.
- Jefferson Lab neither transports hazardous wastes nor operates any regulated treatment or disposal units. All wastes are disposed of through licensed waste handling facilities.
- The hazardous waste generated in the largest volumes was a waste acid mixture used for niobium cavity processing and waste solvents from cleaning operations.
- Non-hazardous waste streams consisted of non-regulated chemical wastes, non-recyclable office and production materials, and debris resulting from construction activity.
- Universal waste items, such as batteries and fluorescent lamps, are recycled offsite.

3.3.2 Other Wastes

Other wastes generated at the Lab, those not covered under RCRA, include radioactive, medical, and toxic wastes. There were no compliance issues for any of these programs in 2003.

These "other wastes" are managed for disposal by the appropriate RadCon, Facilities Management, and Medical Services staff. Refer to Exhibit 3-3 for the volumes of these wastes generated by Jefferson Lab.

EXHIBIT 3-3
NON-RCRA WASTE GENERATION QUANTITIES (BY FISCAL YEAR)

Waste Type	FY 2003	FY 2002
Low Level Waste (solid)	7.2 m^3	10.92 m^3
Low Level Waste (liquid)	0.10 m^3	0.01 m^3
Mixed Low Level Waste	None	None
Medical Waste	Minimal	Minimal
Insecticides, Fungicides and Rodenticides	None	None

m^3 – cubic meters

Here are a few items about this part of our site waste management program.

- Radioactive Waste
  - The Lab generates only low-level radioactive wastes (LLW); thus, there is no source of special nuclear materials.

- Other Waste and Recycling Items
  - Only a small amount of medical waste is disposed of under the site program.
  - There has been no mixed (a mixture of hazardous and radioactive) waste generated to date.
  - Other non-hazardous wastes are disposed of in landfills, reused on-site, recycled, or used for other purposes offsite.
  - Items recycled offsite include scrap metal, transparencies, and toner cartridges.
  - The practice of reusing or recycling construction debris is maximized to the extent possible.
  - Domestic wastewater discharges include some cooling tower and neutralization system effluents.
  - State-certified subcontractors manage any FIFRA wastes offsite.

3.4 RADIOLOGICAL PROTECTION

This site program is managed by RadCon. Programs responsive to on-site and offsite radiation protection requirements have been instituted. Jefferson Lab shipped radioactive waste for disposal in July 2001 and July 2002.

The following are some 2003 items of interest.

- Site programs involving offsite radiation protection requirements, including storage of activated materials, surface and groundwater protection, and emergency response are addressed in the Jefferson Lab EH&S Manual or RadCon procedures.
- Jefferson Lab staff participated in DOE-sponsored Occupational Radiation Protection regulatory activities that included attendance at several workshops and participation in an Oak Ridge Operations Office Price-Anderson Amendments Act conference call. (Occupational Radiation Protection regulations can be found in 10 CFR 835.)
- The Lab remained well within EPA annual dose limits for radionuclide emissions.
- An update of the Jefferson Lab's Radiological Control Manual was initiated.

3.5 COMPLIANCE WITH SPECIFIC ENVIRONMENTAL STANDARDS

3.5.1 Clean Air Act

The estimated dose equivalent from airborne releases in conjunction with the Lab's accelerator operations during 2003 was 0.013 mrem. The collective effective dose equivalent for CY 2003 was estimated to be 0.025 person-mrem. The annual emission report for CY 2003 is to be submitted to the EPA by the end of June 2004.

3.5.2 Clean Water Act

The total radioactivity discharged to the sanitary sewer in 2003 was 1.0 Curie (Ci) of tritium (or about 20% of the total allowed under the site industrial wastewater discharge permit), and 0.00003 Ci of other gamma-emitting radionuclides (or 0.003% of the total allowed under the same permit).

3.5.3 RCRA

The last DEQ inspection of the hazardous waste program occurred in September 2002, with no deficiencies identified. Refer to section 3.3.1 for more information on Jefferson Lab's RCRA program.

3.5.4 Emergency Planning & Community Right to Know Act (EPCRA)

Under EPCRA, which is aligned with the Superfund Amendments and Reauthorization Act (SARA), Jefferson Lab is responsible for planning and responding to chemical emergencies as well as completing applicable reporting requirements. Jefferson Lab files an annual SARA Tier II report (an accounting of hazardous substances and extremely hazardous

substances (EHSs) used or stored on-site in quantities greater than a given threshold) with three emergency planning groups (EPGs). The EPGs are the EPA, the State DEQ, and a local planning group. The items reported for 2003 were nitric, hydrofluoric, and sulfuric acids, bromine, argon, helium, nitrogen, lead, and hydraulic oil. The Lab has not used any chemicals that are either toxic or on the persistent, bioaccumulative, or toxic (PBT) list in quantities that exceed Toxic Release Inventory reporting thresholds.

Other EPCRA-related standards that apply to Jefferson Lab include those requiring notification to the EPGs of the presence of an EHS that exceeds the regulatory threshold amount, and that the Lab must have an MSDS (Material Safety Data Sheet) available for every chemical on-site.

Jefferson Lab has had no releases to date that meet the reporting criteria to the EPGs.

Chemical Inventory

3.5.5 Oil Spill Prevention

Oil inventory at Jefferson Lab mainly consists of numerous oil-filled electrical transformers ranging in volume from 2 gallons to about 4,800 gallons. None of these units meet the definition of an aboveground storage tank. The total volume of oil on-site is estimated to be about 34,000 gallons, with about 6,000 gallons under the control of Dominion Virginia Power.

Potential oil spill sources are located such that surface water discharge spillways and the sluice gates located at the site boundary can be effectively used to prevent any oil spills from leaving the site. Most DOE transformers utilize secondary containment, while the Dominion Virginia Power transformers have none.

Both Jefferson Lab and Dominion Virginia Power maintain an SPCC Plan for all oil-containing items. The Jefferson Lab Plan is periodically reviewed and updated as required.

There were two minor SPCC-related spills in 2003, both of which were promptly contained and cleaned up. Neither of these releases had an impact on the environment or public health.

3.5.6 Toxic Substances Control Act (TSCA)

TSCA requirements involve the regulation of asbestos and polychlorinated biphenyls (PCBs). There was no TSCA activity at Jefferson Lab in 2003.

3.5.7 Federal Insecticide, Fungicide, and Rodenticide Act

In 2003, the storage and use of pesticides and herbicides at Jefferson Lab was handled in accordance with FIFRA guidelines.

3.5.8 National Environmental Policy Act

NEPA requires that projects with potentially significant environmental impacts be evaluated and alternative actions explored. These evaluations are to be performed and reported as EAs or Environmental Impact Statements. Jefferson Lab met these requirements by continuing to implement a program of reviewing construction activities for compliance. There was one project CX involving some work in the vicinity of CEBAF Center that was approved in September. The 13 ongoing DOE-approved CX actions were reviewed for continued applicability in 2003.

All EA's conducted thus far have resulted in a FONSI. There were no NEPA compliance issues identified by DOE in 2003 for the Lab.

3.5.9 Safe Drinking Water Act of 1974 (SDWA)

The SDWA ensures that drinking water is safe for public consumption. These regulations set maximum contaminant levels on bacteriological, chemical, physical, and radiological contaminants for public water systems. Jefferson Lab receives its drinking water through three public water supply lines provided by Newport News Waterworks. Jefferson Lab has no monitoring responsibilities under this Act.
An annual backflow prevention device test was performed on June 19, 2003, as required by the City of Newport News and the DEQ. No compliance issues regarding backflow prevention have ever been identified.

The water quality limits for the groundwater monitoring wells in VPDES Permit (No. 0089320) include one value that is one-quarter of the State's drinking water standard. There were no compliance issues regarding the SDWA in 2003.

3.5.10 Endangered Species Act of 1973

This Act protects endangered wildlife, fish, plants, and their ecosystems. Studies have found no listed or concern species or potential terrestrial or aquatic habitats. No compliance issues were identified in 2003.

3.5.11 Migratory Bird Treaty Act of 1918

This Act prohibits unauthorized taking, possessing, importing, or other listed actions, of any migratory bird or their eggs. Because the site lies within a disturbed industrial and commercial area, only a small number of these species is expected to be found. There were no compliance issues identified in CY 2003.

3.5.12 National Historic Preservation Act (NHPA)

The NHPA protects archeological and historical resources. Compliance with this Act has been accomplished through the NEPA review process. Area surveys in 1987 and subsequent reviews by the Commonwealth of Virginia's Department of Historic Resources have uncovered no trace of historic or archaeological resources. No compliance issues were identified in 2003.

3.5.13 Coastal Zone Management Act (CZMA)

The CZMA establishes the policy "to preserve, protect, develop, and where possible, to restore or enhance, the resources of the Nation's coastal zone for this and succeeding generations." The DOE and Jefferson Lab are addressing CZMA requirements by implementing programs and action items identified in NEPA documents. In 2003, two new storm water permits were obtained by the Lab addressing the non-point source pollution control elements of the CZMA. Other storm water management issues, including improving the Lab's erosion and sediment control practices, were also addressed by Jefferson Lab.

3.6 ENVIRONMENTAL STEWARDSHIP

There were numerous activities conducted throughout the Lab in 2003 that furthered efforts to be an environmental steward, especially in WMin/P2.

Some actions were related to EO requirements, others were staff-initiated, and some a combination of the two. First, information on how the Lab addresses the applicable EOs is presented. Later, some general ways that the Lab is implementing WMin/P2 are presented.

3.6.1 Applicable Executive Orders

3.6.1.1 EO 11990 Protection of Wetlands

EO 11990 ensures that adverse impacts to wetlands from construction activities are avoided or responsibly mitigated. Evaluation of Jefferson Lab activities involving potential wetlands is accomplished through the NEPA review process. There were no concerns involving wetlands in 2003.

3.6.1.2 EO 11998 Floodplain Management

EO 11988 relates to the occupancy and modification of floodplains. There is localized flooding during significant rain events, but no part of the site is within the 100-year floodplain. There were no compliance issues in 2003.

3.6.1.3 EO 13101 Greening the Government through Waste Prevention, Recycling and Federal Acquisition

EO 13101 encourages agencies to implement AP by promoting the purchase of products made with recycled materials. The purchase of these materials helps "close-the-loop" in the recycling process.

To comply with this EO, the DOE has set goals and performance standards, including a DOE complex-wide FY 2005 procurement target of 100% for purchasing recycled content EPA-listed products. Jefferson Lab self-defined a goal of 95% by FY 2005. The Lab is making progress, as its compliance level rose to 93.3% for FY 2003. The Business Services Department's procurement staff has made great progress in meeting the intent of the EO since tracking began in 1995.

3.6.1.4 EO 13123 Greening the Government through Efficient Energy Management

This initiative focuses on energy efficiency (E2) as a means of P2. The DOE seeks a long-term energy use reduction of 15% for buildings and industrial facilities, with Jefferson Lab documenting a 25.76% reduction in all standard (non-industrial) buildings from the 1995 baseline year through FY 2003**.** This improvement was primarily due to the installation of new heating, cooling, and lighting systems in the VARC and in the Lab's primary administration building, CEBAF Center. The site's industrial buildings and the CEBAF Center's Computer Center are considered to be exempt from reporting at this time.

To better our E2 implementation, Facilities Management continues to analyze buildings and their support systems to look for ways to reduce energy consumption in the long term. Facilities Management, which is also responsible for new building construction, is also taking E2 into account during the design process. Refer to section 2.2.2 for other ways in which the Lab has worked to become more energy efficient.

3.6.1.5 EO 13148 Greening the Government through Leadership in Environmental Management

This EO identifies a number of actions for Federal Agencies to implement. These goals include the need to develop an EMS, to reduce the use of ODS and toxic chemicals, and to report under EPCRA. Jefferson Lab's progress in meeting these EO requirements follows.

Environmental Management System

At the end of 2003, Jefferson Lab had committed to developing and implementing a site EMS by December 2005. The plan is to develop the EMS as an integral part of the Lab's ISM System Plan. (See 3.6.2)

To help track how the various DOE institutions were progressing toward the December 2005 goal, a 'DOE scorecard' that shows key EMS milestones and proposed accomplishment dates was issued. At the end of 2003, Jefferson Lab had successfully accomplished one of the three FY 2003 milestones. An additional milestone was accomplished in early 2004, and the Lab made a commitment to complete all FY 2003 and two of the FY 2004 milestones by December 31, 2004.

Environmentally and Economically Beneficial Landscaping Practices

Jefferson Lab implements this requirement in conjunction with the objectives identified in the new MS4 permit regarding preventing the pollution of storm water.

To accomplish these beneficial landscaping practices on the facility grounds, Jefferson Lab uses qualified subcontractors. The Lab's intent is to maintain grass cover in open areas, to the extent practicable, to prevent runoff. Fertilizers and herbicides are applied locally on an as needed basis and not when rain is imminent in order to prevent surface water contamination.

For 2003, Jefferson Lab only used about two-thirds of the water that we would normally use. The Lab continued the use of mulch, a standard recycled content product, to reduce the amount of water needed at managed beds. In 2003, the subcontractor was directed to use more environmentally preferable products, such as compost, where suitable.

ODS Usage Reduction

The compliance status of this EO requirement is discussed in Section 3.1.4.

EPCRA Reporting and Toxic Chemical Usage Reduction

This EO requirement covers emergency planning, including reporting certain chemical inventory information, toxic chemical usage, and any releases to the environment. Compliance status is included in Section 3.5.4.

As Jefferson Lab uses only minimal to small amounts of a few toxic chemicals, there were no major toxic chemical reduction initiatives pursued in 2003. The use of cyanide was prohibited from full use in 2002.

3.6.2 Other Environmental Stewardship (including P2) Topics

Integrated Safety Management

Jefferson Lab integrates safety (EH&S collectively) principles and functions into all work processes through the application of ISM. The ISM System objective is to make safety, health, and environmental protection a routine part of business at Jefferson Lab. EMS core elements and principles, as identified under EO 13148, will be developed and meshed with the ISM System Plan. To aid ISM implementation, a new on-line Accelerator Division EH&S Tracking system was offered for use throughout the Lab.

A few other ISM related items that are important to note for 2003 follow.

- With pending external worker safety regulation possibilities, two site inspections, one by the NRC (July 28 through August 1) and the other by Federal OSHA (August 11 through 15) were conducted to evaluate Jefferson Lab cost impacts if DOE external safety regulation legislation was approved.
- A biennial Emergency Management Peer Review was conducted at Jefferson Lab on August 6 and 7. There were no compliance issues noted during this peer review.

2003 P2 Activities

Jefferson Lab addressed EO 13148 and general P2 goals by minimizing chemical use; reusing and recycling various items from chemicals to cardboard boxes (to the extent practical); and, by disposing of wastes in the most environmentally safe manner.

Listed below are some activities identified in 2003 that are worth noting.

- Due to the increased need for cryomodules for CEBAF, the FEL, and especially SNS, more cryomodule fabrication resulted in increased hazardous waste generation. However, to offset this projected increase, the Institute for SRF Science and Technology staff selected and installed a long-term waste minimization tool, an elementary neutralization system that processes waste acid for normal sanitary sewer disposal.
- Improvement toward meeting the Lab's waste minimization goal was a collaborative effort among Lab staff that has resulted in expanding our number of recycling centers. At the end of 2003, there were a total of 19 recycling centers, 10 of which collect all types of office wastes and 9 that collect a smaller range of items.
- EH&S Reporting staff continue to inform and encourage staff about "earth-friendly" activities at work and at home though the *EarthWise* web page at **www.jlab.org.intralab/earthwise/**.
- The Business Services Department is maintaining a web page specific to the AP program to address staff concerns. Refer to **www.jlab.org/div_dept/admin/business/green/overview.html.**

Secretarial P2 and E2 Goals and Other DOE Commitments

Jefferson Lab is committed to meeting site targets to address ten of the DOE-identified P2 and E2 goals, but additional funding will be needed to meet some targets. The Lab has made progress in meeting some of these goals, such as improving recycling performance, which will be refined with the institution of an EMS in the next two years.

Other DOE commitments included those that address the management of radioactive waste and the new Environmental Protection Program guidance that provides direction for EMS implementation. There are also four contractual performance measures that address environmental issues.

Auditing for Environmental Compliance

Audits to review the Lab's compliance with environmental standards are performed by program area by regulatory agencies or by the DOE. Except for one HRSD inspection that was noted in 3.2.2 and four internal assessments that took into account environmental protection factors, there were no other environmental compliance audits in 2003.

SECTION 4
ENVIRONMENTAL RADIOLOGICAL PROGRAM

Equipment that generates radiation, and a variety of radioactive materials, are used in research activities at Jefferson Lab. The impacts of operating this equipment and of working with and around these materials have been taken into account in Lab procedures. Any potential impacts have been significantly reduced by applying standard control measures and by implementing ALARA, or "as low as reasonably achievable", principles. The resultant potential effective dose equivalents to members of the public from various pathways, such as inhalation, ingestion, and skin absorption, are evaluated by RadCon to demonstrate compliance with EPA and DOE regulatory limits.

Jefferson Lab protects the environment and the public from exposure to radiation by implementing a number of both physical and administrative controls. The radiological monitoring program is the primary means used at Jefferson Lab to verify accomplishment of this protection objective. Exposure reduction support activities include: using permanent and temporary shielding; using active and passive controls at activated water locations; and, following proper protocols when handling radioactive materials and wastes.

The radiological monitoring program is designed to verify that radiation exposures, both for on-site radiation workers and for members of the general public, are below permissible levels and are ALARA. The program also assures that Lab support activities and accelerator testing and operations, as described within the approved operational safety envelope, will result in minimal impacts to the environment and have minimal to no effect on public health.

4.1 RADIATION EXPOSURE PATHWAYS

Accelerator operations produce three different pathways of radiation exposure that can impact the general public: direct or prompt radiation; radiation from induced airborne radioactivity; and, radiation from induced waterborne radioactivity. Jefferson Lab performed extensive environmental monitoring in 2003 to measure these three forms of accelerator-produced radiation. Pathways to the general public are modeled and monitored when appropriate or as required by law. The decision to monitor a particular pathway is based on the:

- type of operations
- radionuclides released
- potential hazard
- experience from previous monitoring results at Jefferson Lab
- experience at other nuclear and high-energy physics laboratories

radioactivity – a natural and spontaneous process by which the unstable atoms of an element emit or radiate excess energy from their nuclei and, thus, change (or decay) to atoms of a different element or to a lower energy state of the same element.

4.1.1 DIRECT RADIATION AND ITS EFFECTS

Direct or prompt radiation results from the interaction of the accelerator beam with matter. This radiation is produced within the beam enclosure and stops when the accelerator is turned off.

Almost all direct radiation is stopped by shielding – any exposure to this radiation is at a maximum on-site and decreases with distance. During 2003, Jefferson Lab continued regular accelerator operations in support of physics experiments in the three experimental halls. Accelerator operations and related activities produced significant amounts of direct radiation; however, these amounts were restricted within constraints as managed by RadCon and were performed within an approved safety envelope.

The Jefferson Lab areas where direct radiation can be produced are not accessible during accelerator operations. There are approximately 50 electronic radiation detectors and a series of associated passive integrating detectors deployed around the accelerator site with the primary purpose of measuring on-site radiation. The majority of the electronic detectors are connected to a central computer system that automatically records the radiation levels for subsequent examination. When appropriate, Jefferson Lab employees, subcontractors, and visitors wear detection devices to monitor their on-site radiation exposure.

Shielding Blocks at the Hall C Truck Ramp Entrance

Six dual-channel microprocessor-based instruments for monitoring gamma and neutron radiation levels collected direct radiation data (see Section 4.1.2 below) at the site boundary in 2003. (Refer to Exhibit 4-1 for their locations.) Radiation data collected prior to January 1995 serve as the statistical baseline for comparison to that collected since the accelerator became fully operational.

4.1.2 Direct Radiation and Resultant Airborne Radioactivity

In addition to the accelerator's production of direct radiation, the interaction of the accelerator beam with matter can cause the formation of radioactive materials through activation of the matter. The beamlines, magnets, beamline-components, targets, detectors, other experimental area equipment, and the energy dissipating devices (beam dumps) used to contain the beam's energy may become activated. Cooling and ground waters,

lubricants, and air in the beam enclosure may also become activated. These activated air, water, and particulates are possible sources of airborne and waterborne radioactivity (refer to Section 4.1.3). Though the direct radiation stops when the accelerator is turned off, the activated equipment, water, and air continue to emit radiation. All material exposed to the beam is monitored for radioactivity prior to being removed from the beam enclosure.

Controls are in place to minimize the effects of both direct radiation and radiation from activated materials on Lab personnel, the environment, and the public. The monitoring of airborne radioactivity is carried out locally to validate calculations and estimates of radiation dose.

4.1.3 Direct Radiation and Resultant Waterborne Radioactivity

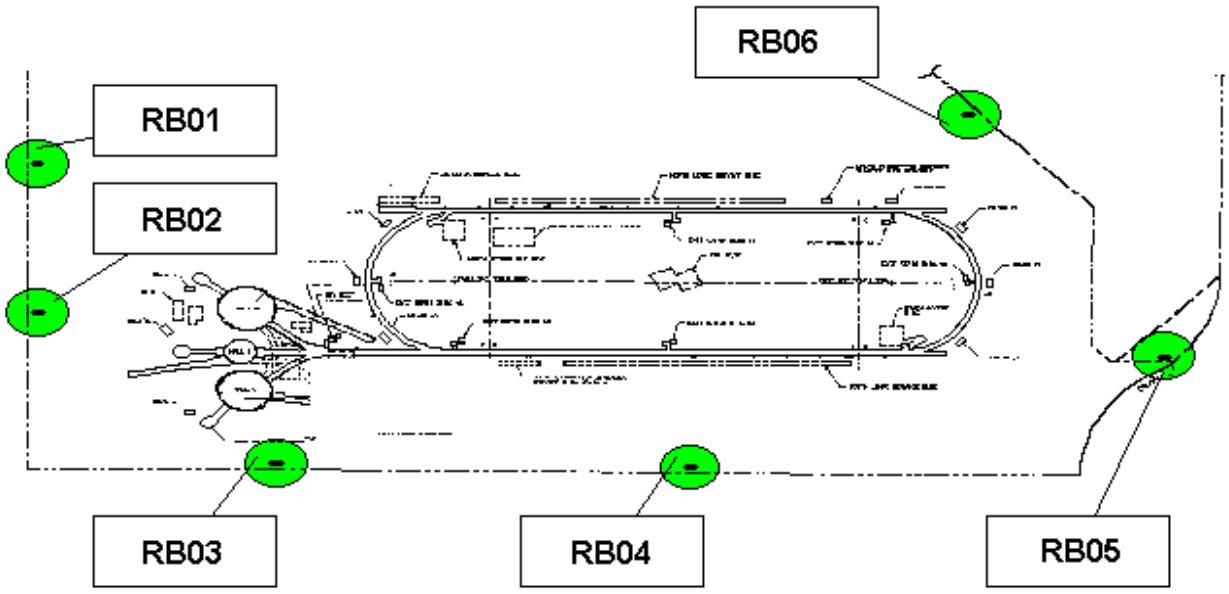
Jefferson Lab is situated in the central section of Newport News, Virginia, at an average elevation of about 35 feet above mean sea level. The site is in a Zone C area on the local flood maps, so is not considered to be within the 100-year floodplain. The site is located in the watershed of Brick Kiln Creek, which discharges to Big Bethel Reservoir. As water is a vital natural resource, contamination could present potential problems to the general population. Because of this, both the Federal government and the Commonwealth of Virginia regulate both groundwater and surface water.

4.1.3.1 Groundwater

The Jefferson Lab Groundwater Protection Management Program provides a strategy to minimize impact to groundwater resources and is used as a management tool to guide program implementation. The Program ensures compliance with Federal, State, and local regulations, other identified standards, and effective resource management practices. The Program includes a groundwater monitoring plan that serves to assess the effect of Jefferson Lab activities on groundwater quantity and quality. (Refer to Section 4.2)

Soil activation is a potential source of groundwater contamination at Jefferson Lab. Groundwater quality in the soil surrounding the accelerator complex is the Commonwealth's largest concern about site operations. The monitoring of VPDES-permitted wells for particular groundwater quality parameters continued in 2003. From controls designed into the CEBAF and FEL facilities, including in-place shielding measures, and through calculations, a minimal amount of soil or groundwater activation is expected on-site and no offsite effect is anticipated. There were no soil or groundwater activation concerns in 2003.

EXHIBIT 4-1
BOUNDARY MONITOR LOCATIONS



Note: RB03 is the same as RBM-3 (also referred to in Section 4.4)

4.1.3.2 Surface Water

The surface water sampling program commenced at the time construction of the experimental halls was completed. Quarterly sampling of the groundwater dewatering surface discharge under the VPDES groundwater quality permit continued. In addition, automated sampling equipment is used to analyze the discharged water for tritium and gross beta activity. (Refer to Section 4.2 for information on Jefferson Lab's radiological monitoring program.) There were no concerns involving surface water in 2003.

RadCon addresses any activated water spills, thus minimizing potential surface and the less likely potential groundwater impacts. Collected water that did not meet immediate disposal criteria was transferred to a temporary storage area and released only after measurements indicated it was safe to do so - that it met regulatory permit release requirements. There were no worker safety, environmental, or public health concerns as there were no water spills or leak events in 2003 involving these activated water systems.

Surface water quality is maintained by discharging only unpolluted waters, such as rainwater, to the environment. Control measures identified for the site include:

- Using proper procedures, such as secondary containment, around containers where activated water may be temporarily stored.

- Water within the tunnels and experimental halls may become activated from exposure to radiation. RadCon procedures that address activated water management provide for sampling and monitoring of water (before release) from any potential source within the accelerator and experimental halls.

For information about other non-radiological surface water quality issues at Jefferson Lab, refer to Section 2.2.

4.2 ENVIRONMENTAL RADIATION MONITORING

Jefferson Lab uses environmental monitoring to assess local and offsite environmental conditions. The site environmental monitoring program verifies that any radiation exposures, and radioactive and non-radioactive effluent releases, comply with applicable regulations and other requirements.

While radiation dose rates offsite, from direct and airborne radioactivity, are expected to be well below limits set for the general public, monitoring ensures that the established controls are effective. Jefferson Lab operations had minimal radiological dose impact to the public and the environment. Lab programs and outside advisory committees ensure that the Lab continues to function within regulatory and established administrative limits for direct radiation and airborne emissions. There has been no offsite release of radioactivity in any water effluents beyond the small quantities allowed to be discharged under our HRSD permit.

The overall effects on the environment and the public from Jefferson Lab operations are summarized in Exhibit 4-2. There were no non-routine releases so all values shown result from routine operations. The ambient external dose measured was on the order of 1% of natural background levels or 1.1 mrem (11 μSv (microSieverts)). In summary, the maximum dose impact to the individual from both the air and direct pathways combined was 1.1 mrem (11 μSv). This is 1.1% of the DOE regulatory dose limit for members of the public from all pathways (air, water, and others), which is 100 mrem (1 mSv) MilliSievert. Information about the air program is provided in Section 4.2.1 and the water program is described in Section 4.2.2.

4.2.1 Monitoring: Air

Airborne radionuclide concentrations at the site boundary have been too low to accurately measure. Annual calculations, using EPA-approved computer modeling codes, have indicated that Jefferson Lab operational emissions remain several orders of magnitude lower than the EPA 10 mrem/yr reporting limit. Despite this very low calculated release rate, Jefferson Lab continued being proactive in 2003 by making continuous measurements to verify the calculations. (Refer to Exhibit 4-3) A report, documenting that the dose to the maximally exposed individual of the public (someone who would be standing year-round at a prescribed distance from Hall C) was 0.013 mrem/yr (0.13 μSv/yr) due to airborne releases, was sent to the EPA in 2003. This dose is insignificant when compared to the EPA regulatory public air-dose limit of 10 mrem/yr (100 μSv/yr).

EXHIBIT 4-2
JEFFERSON LAB RADIOLOGICAL DOSE REPORTING TABLE FOR 2003

Pathway	Dose to Maximally Exposed Individual mrem / (mSv)	% of DOE 100 mrem/yr Limit	Estimated Population Dose (person-rem) / (person-Sv)	Population within 80 km	Estimated Background Radiation Population Dose (person-rem)/(person-Sv)
Air	0.013 (1.3 E-04)	0.013	0.025 (2.5 E-04)	-	0.023
Water	0	0	N/A	-	N/A
Other Pathways	1.1 (1.1 E-02)	1.1	Unknown/ Unknowable	-	N/A
All Pathways	1.1 (1.1 E-02)	1.1		214,000 est.	0.023

Notes: $0.007 = 7 \times 10^{-3} = 7$ E-03

Values presented in Exhibits 4-2, 4-3, & 4-7 are presented in Scientific Notation (example, 2 E-05 is 0.00002)

mSv = MilliSievert

EXHIBIT 4-3
JEFFERSON LAB RADIOLOGICAL ATMOSPHERIC RELEASES FOR 2003

Radionuclide [half-life]	Tritium [12.26 yr]	Be-7 [53 .6 days]	C-11 [20.3 m]	N-13 [9.96 m]	O-15 [123 sec]	Cl-38 [37.29 m]	Cl-39 [55.5 m]	Ar-41 [1.83 hr]
Ci (Bq) in CY 2003	3.49 E-01 (1.3 E+10)	3.88 E-03 (1.4 E +08)	1.21 (4.5 E+10)	9.19 (3.4 E+11)	4.9 (1.8 E+11)	5.14 E-02 (1.9 E+09)	6.2 E-01 (2.3 E+10)	2.51 E-03 (9.3 E +07)

Notes: $1\ pCi = 1 \times 10^{-12}\ Ci = 0.037\ Bq$

m: minutes

4.2.2 Monitoring: Water

Groundwater

Activation of groundwater, as a result of direct or secondary radiation, is possible in certain locations around the accelerator complex. Massive concrete and steel shields within the accelerator beam enclosures and in the beam deceleration areas minimize groundwater activation. The monitoring conditions in VPDES Permit No. VA0089320 serve as the basis for evaluating accelerator-produced radioactivity in groundwater. The "baseline" values obtained during the term of the original Virginia Pollutant Abatement Permit helped define the operational groundwater quality limits that are included in the above Permit. Note that the water quality beyond the Lab boundary must remain well below the regulated drinking water limit of 1 mrem/year. The annual effective dose equivalent to an individual consuming water activated at this level is so negligible it can not be measured.

This VPDES groundwater quality permit specifies EPA-approved sampling and analysis protocols, which were the basis of groundwater monitoring in 2003. Fifteen wells were sampled at quarterly, semi-annual, or annual intervals. The permitted wells included the "A", "B", and "C" Ring wells (labeled as to proximity to the accelerator) and the upgradient well. (Refer to Exhibit 4-4) Along with the A-ring wells, the groundwater dewatering

effluent at the experimental halls was also monitored quarterly in 2003 and reported under this permit.

Water samples have been drawn and analyzed since 1987. The data collected, through the completion of facility construction in 1995, provide a groundwater quality baseline for comparisons during long-term facility operation. The background samples were analyzed for naturally occurring radionuclides, as well as accelerator-produced radionuclides, and selected chemical parameters. The radionuclides analyzed in 2003 are those known to relate to operations associated with electron accelerators. They include H-3 (Tritium), Be-7, Na-22, Mn-54, and gross beta. Total manmade radioactivity was also analyzed. The general water quality parameters measured were pH, conductivity, TSS and TDS.

Exhibit 4-5 lists the VPDES groundwater quality action and permit levels for radiological parameters with values in picocuries per liter (pCi/l). These values are representative of normal background radionuclides, which are also generated through Jefferson Lab activities. Note that if an action level should be reached at an A-Ring well, it would not result in a permit violation, but would trigger an internal investigation of potential causes.

The maximum radiological results obtained from monitoring the wells in the accelerator vicinity during 2003 are presented in the first part of Exhibit 4-6. The results from the other locations described in the permit are shown in the second half of the exhibit. All measurements were within permit levels. No accelerator-produced activity has been detected. All values represent natural background, and variations are normal.

Other Water Monitoring

The Cooling Water Tank (Building 92) and the floor drain sump (FDS) pit (Building 97) are considered one HRSD sampling point. Sampling at the FDS pit, which collects various discharges, including low-level activated dehumidification condensate from air conditioning systems located in the experimental halls, and at the Cooling Water Tank, that contains activated water from various accelerator apparatus, continued in 2003. Sampling and analysis for tritium are performed prior to any discharges to the sanitary system. The results are recorded and monthly and quarterly concentration values are provided to HRSD. The total quantity of radioactivity released to HRSD in 2003 is presented in Exhibit 4-7. Some regulatory values (that are not required to be regularly reported) are tracked and documented by RadCon staff, such as the total amount of activity discharged to the sanitary sewer system. Monthly and composite quarterly results for 2003 are provided in Exhibit 4-8. The concentrations varied based on the quantity of beam dump cooling water discharged during the reporting period.

On a periodic basis in 2003, other water sampling and analysis for tritium and gross beta activity were performed on various discharges from potential radiological areas, such as from sump pumps. Any water identified as a potential concern was collected and discharged according to the terms of the HRSD permit.

EXHIBIT 4-4
MONITORING WELL LOCATIONS

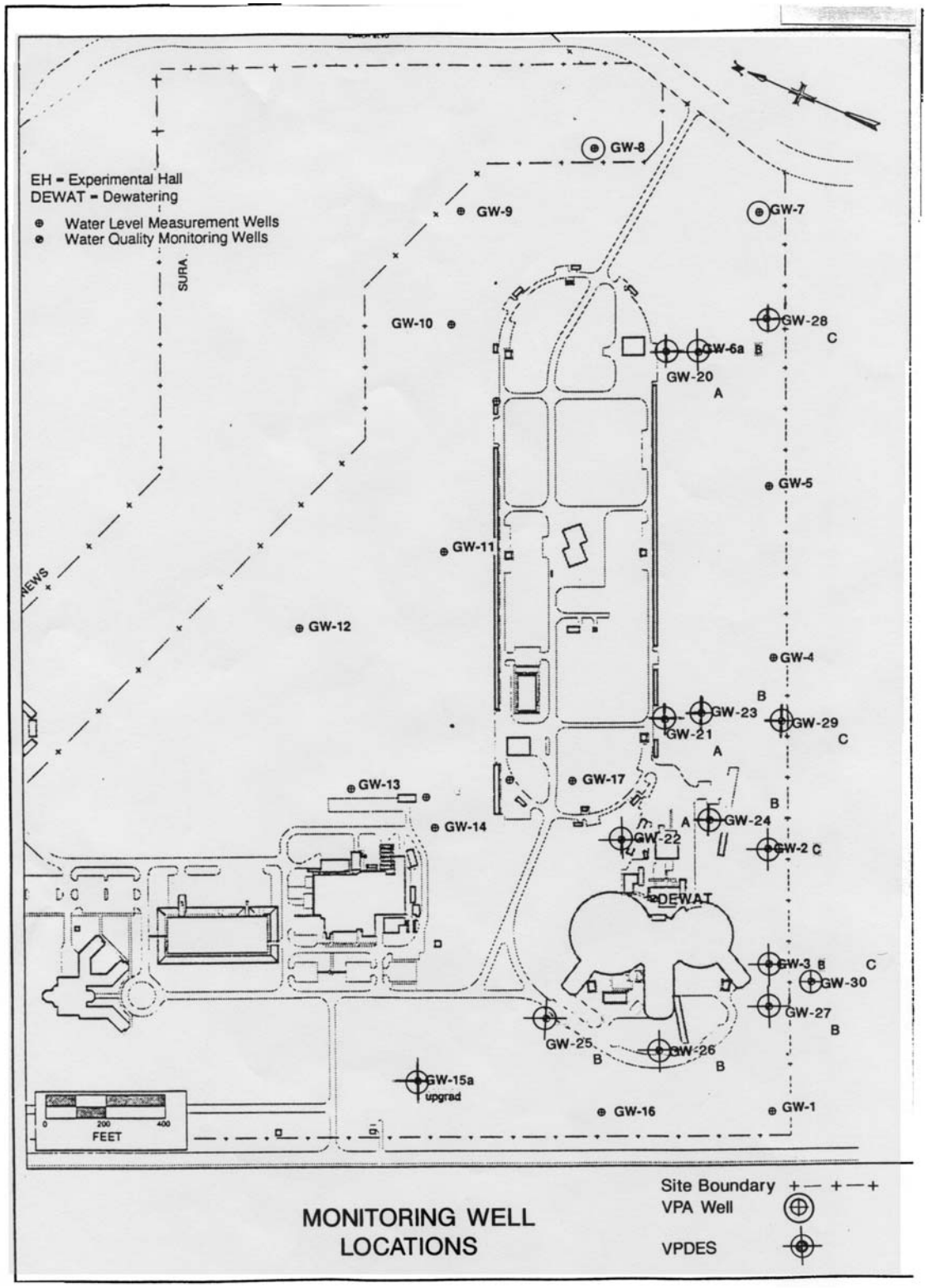


EXHIBIT 4-5
VPDES PERMIT LEVELS FOR RADIONUCLIDES*

Analyte	A-Ring (Action Level)	B-Ring (Permit Level)	C-Ring (Permit Level)	Sensitivity & Precision (Permit Value)
Gross Beta	50 pCi/l	50 pCi/l	153 pCi/l	4 pCi/l
Manmade Radioactivity	1 mrem/yr.	1 mrem/yr.	-	-
Tritium	5000 pCi/l	5000 pCi/l	1000 pCi/l	1000 pCi/l
Sodium-22	-	-	61 pCi/l	40 pCi/l
Beryllium-7	-	-	835 pCi/l	600 pCi/l
Manganese-54	-	-	51 pCi/l	30 pCi/l

Notes: *Those radionuclides determined to be relevant to Jefferson Lab operations.

A-ring levels are action levels only.

Numbers are representative of pre-operational measurements plus 2 standard deviations, which represent a 99% certainty that deviations above this level are not random.

Conversion: 1 pCi = 0.037 Bq, 1 mrem = 0.01 mSv

EXHIBIT 4-6
MAXIMUM GROUNDWATER MEASUREMENTS FOR RADIONUCLIDES*
JANUARY 2003 THROUGH DECEMBER 2003

Radionuclides at Associated Wells Relevant to Accelerator Operations (in pCi/l unless noted otherwise)

Analyte	A-Ring	B-Ring	C-Ring
Gross Beta	13.25	8.09	21.84
Manmade Radioactivity	< 0.150 mrem/yr.	< 0.164 mrem/yr.	not applicable
Tritium	ND at < 618	ND at < 592	ND at < 592
Sodium-22	ND at < 10.8	ND at < 12.2	ND at < 9.9
Beryllium-7	ND at < 97	ND at < 103	ND at < 91.7
Manganese-54	ND at < 10.7	ND at < 11.2	ND at < 10.2

Radionuclides At Other Permit Locations (in pCi/l)

Analyte	Upgradient Well	Discharge 001
Gross Beta	2.56	15.59
Tritium	ND at < 592	ND at < 618
Sodium-22	ND at < 6.05	ND at < 10.2
Beryllium-7	ND at < 54.6	ND at < 82.6
Manganese-54	ND at < 5.71	ND at < 9.81

Notes: *Those radionuclides determined to be relevant to Jefferson Lab operations.

No accelerator-produced activity has been detected.

ND: Not detectable above permit-required sensitivity limits

Conversion: 1 pCi = 1 x 10^{-12} Ci = 0.037 Bq

EXHIBIT 4-7
JEFFERSON LAB LIQUID EFFLUENT RELEASES OF RADIOACTIVE MATERIAL FOR 2003

Radionuclide	Tritium	Be-7	Na-22
Ci (Bq) in CY 2003	1.03 Ci: (5.8 E+10)	2.55 E-05 (9.4 E+05)	5.39 E-06 (2.0 E+05)

Notes: Permit level is 5 Ci for Tritium and 1 Ci for all other gamma-emitting radionuclides.

EXHIBIT 4-8
ANALYTICAL RESULTS FOR DISCHARGES TO HRSD IN 2003

Monthly Values

Reporting Period	Tritium Concentration (pCi/l)	Reporting Period	Tritium Concentration (pCi/l)
January	230	July	28,000
February	21,000	August	35,000
March	46,000	September	16,000
April	34,000	October	52,000
May	30,000	November	30,000
June	51,000	December	20,000

Quarterly Values

Reporting Period	Tritium Concentration (pCi/l)	Other Gamma-Emitting Radionuclides Concentration (pCi/l)	
First Quarter	20,000	None detected	Be-7 at 0.1.8
Second Quarter	39,000	None detected	Be-7 at 0.79
Third Quarter	26,000	Na-22 at 0.67	None detected
Fourth Quarter	9500	Na-22 at 0.67	Be-7 at 0.81

Notes:

These effluent concentrations are well below the 0.1 µCi/ml (100,000,000 pCi/l) permit limit.

Radionuclides are analyzed at EPA sensitivity levels or better.

Conversion: $1pCi = 1 \times 10^{-12}$ Ci = 0.037 Bq

4.3 OTHER SUPPORT ACTIVITIES

Permanent shielding in the form of thick concrete walls and earth berms protect the environment from exposure. Additionally, labyrinth entrances further minimize exposure and monitoring equipment at ventilation ports tracks exposure values.

RadCon installs shielding blocks and detection devices that are used to identify potential problem areas as needed to either minimize impacts or identify opportunities to minimize impacts both inside and outside the facility.

Various accelerator-related water systems have the potential for becoming activated. All areas where activated water could be present have controls in place. Locations with a high potential

for activation have secondary containment or other physical measures installed and administrative lockout/tagout controls. Other areas with less or even minimal potential for activation are monitored periodically to ensure levels are within expected values.

RadCon establishes access-controlled areas to temporarily store radioactive materials, including those being stored for decay, and wastes. There is no impact to the environment or public health from the small quantity of materials stored on-site.

4.4 ASSESSMENTS OF POTENTIAL DOSE TO THE PUBLIC AND TO BIOTA

The six electronic radiation measurement devices noted in Section 4.1.1, installed along the accelerator site boundary, continued to be used to determine offsite dose to the public due to Jefferson Lab operations. These electronic detectors - radiation boundary monitors (RBMs) - measure and log radiological information. In addition, passive integrating detectors are used for a number of measurements. All measured dose values were within statutory and administrative limits. For 2003, the highest site boundary direct (prompt) radiation level was about 1.1% of the DOE annual dose limit of 100 mrem (1 mSv), or 11% of the site administrative dose limit of 10 mrem (0.1 mSv).

Exhibit 4-9 displays the radiation doses in mrem for 2003 at RBM-3. RBM-3 is the detector that sees the largest dose from a combination of accelerator and experimental hall operations. A comparison with natural background radiation is made, which indicates the relatively low levels of Jefferson Lab's contribution to the public dose. These background levels do not include contributions to dose from naturally occurring radon, which typically doubles natural radiation dose to the public.

Jefferson Lab does not release any residual radioactive material, such as concrete or soil, so there are no resulting dose impacts to the public. The absorbed dose to any local aquatic animals, or terrestrial plants or animals, from Jefferson Lab operations will not exceed the internationally recommended dose limits for terrestrial biota. As there are no potential releases of a magnitude that could result in doses exceeding 0.1 rad/day to terrestrial animals, the lowest limit for any biota, no dose limits will be exceeded.

Jefferson Lab did not contribute significantly to the radiation dose received by the public through either airborne or waterborne pathways. The direct radiation exposure was again measurable in 2003, but was found to be about 11% of the Jefferson Lab design goal of one-tenth of the DOE limit.

4.5 QUALITY ASSURANCE

Regular quality assurance (QA) efforts are being made to ensure that Jefferson Lab's environmental monitoring program is performed in accordance with the principles of the Jefferson Lab QA Program Manual.

EXHIBIT 4-9
RADIATION BOUNDARY MONITOR #3 (RBM-3) RESULTS FOR 2003

Period	Neutron (mrem)	Gamma (mrem)	Total (mrem)
Jan-Mar	0.05 ± 0.01	0.02 ± 0.01	0.07 ± 0.02
Apr-June	0.32 ± 0.01	0.08 ± 0.01	0.40 ± 0.02
July-Sept	0.46 ± 0.01	0.12 ± 0.01	0.58 ± 0.02
Oct-Dec	0.04 ± 0.01	0.01 ± 0.01	0.05 ± 0.02
TOTAL	0.87 ± 0.02	0.23 ± 0.02	1.10 ± 0.02
Natural Background	~1.8	~110	~112

Notes:
Statistical errors are quoted at 1 sigma.
Systematic errors including calibration (not included) are approximately 20% for neutrons.
Gamma dose equivalent rates are estimated based on best known statistical correlation techniques.
RBM-3 received the highest dose.
Conversion: 1 mrem = 0.01 mSv

QA in Sampling Procedures

The Jefferson Lab QA Program includes qualification of the laboratories that provide analytical services, verification of certification to perform analytical work, and review of performance test results. Also included in this review is the adequacy of their internal quality control (QC) practices, recordkeeping, chain of custody, and the relevant portions of the QA program itself.

RadCon and other program management are involved in the qualification process for environmentally sensitive services, including offsite analytical laboratories, and are responsible for auditing their own QA practices and implementing relevant QA procedures. The Jefferson Lab SA/QA function performs independent assessments of all functional areas, including those for EP activities. The DOE oversight organizations, in their independent overview capacity, also perform periodic audits and surveillance of Jefferson Lab. No QA concerns were noted for CY 2003 regarding sampling protocols or results.

Universal Laboratories, Inc. (Universal Labs) collected most VPDES and HRSD permit-related water samples. BWX Technologies, Inc. (BWX), their subcontractor, performed all radiological analyses on identified samples. Several field audits were performed and showed Universal Labs' collection procedures were satisfactory.

Other sample collection that involves radiochemicals, including some required by the HRSD permit, is performed by RadCon and analyzed in the RadCon radiological analysis lab (Building 52).

QA in Analysis

Samples are analyzed for radiological (and non-radiological) attributes using standard EPA-approved analytical procedures. A continuing program of analytical laboratory quality control, participation in interlaboratory crosschecks, analysis of various blanks, and replicate sampling and analysis verifies data quality. RadCon, Accelerator Division EH&S staff, and other responsible staff review all analytical data for samples analyzed under their subcontracts. The analytical results are reviewed relative to the accompanying QA/QC results and compared with regulatory limits for acceptability. These reviews include inspection of chain-of-custodies, sample stewardship, sample handling and transport, and sampling protocols. When applicable to the analysis requested, analytical labs must be appropriately certified. Inspection visits are made to both Universal Labs and BWX on a biennial basis. These visits confirm that analytical practices being performed are satisfactory.

Ongoing precision and accuracy are monitored by analysis of the following with each batch of samples: laboratory standards, duplicate determinations, matrix spikes, and matrix spike duplicates. These data are used to calculate the relative standard deviation on all applicable parameters. The quality of the data is then evaluated and compared to regulatory limits to determine acceptability. In addition, a range of radiochemical spikes is used to test the vendor's ability to achieve the required sensitivity for each parameter, and their reliability in detecting accelerator-produced radionuclides at or below the concentration guide standards. This enables compliance with permit requirements that QA is performed.

Independent QA under the DOE

The Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP) is an external, independent performance evaluation program designed to test the quality of environmental radiological measurements and provides DOE with complex-wide comparability of environmental radiological analysis. Under this program, four matrices of various radionuclides are distributed semi-annually to DOE-subcontracted laboratories for analysis, with the labs required to analyze only the parameters for which they analyze under contract.

In 2003, BWX and Jefferson Lab's RadCon lab participated in the EML's QAP, performed semi-annually, for radionuclides. The results, for the parameters analyzed by BWX and Jefferson Lab that are applicable at Jefferson Lab, are provided as Exhibits 4-10 and 4-11. These selected results, for the parameters that may be found at Jefferson Lab, are presented in these exhibits. Results indicated as warnings mean they are near the limits of acceptability. BWX's overall results for QAP 58 were 82% acceptable and 18% acceptable with warning. It also shows that 100% of the results for the water program, which is of greatest importance for Jefferson Lab, were acceptable or acceptable with warning. Selected results for both BWX and Jefferson Lab under QAP 59 were 100% acceptable for the water programs. For the air results, Jefferson Lab had 89% acceptable and 11% acceptable with warning and BWX had 100% acceptable.

BWX participated in a QA program for analysis of samples under the Environmental Resource Associates (ERA). Performance results for RAD53 and RAD55 were received. Results for radionuclides of interest to Jefferson Lab are shown in Exhibits 4-12 and 4-13. The selected sample results for RAD53 were 83% acceptable and 100% acceptable for RAD55.

EXHIBIT 4-10
QUALITY ASSURANCE PROGRAM (QAP 58)
SELECTED RESULTS FOR 2003

Matrix	Analyte	Reported Value (Bq/l)	Error	EML Known Value (Bq/l)	Error	Ratio Rep/EML	Result
Water	Gross Alpha	335.000	23.000	377.500	10.000	0.887	W
(BWX)	Gross Beta	612.000	24.000	627.500	10.000	0.975	A
	H-3	479.000	25.000	390.000	3.400	1.228	A
	Co-60	232.000	14.000	234.000	8.400	0.991	A
	Cs-134	28.700	3.0000	30.500	1.090	0.941	A
	Cs-137	65.900	6.100	63.800	3.400	1.033	A
Water	Co-60	233.200	9.170	234.000	8.400	0.997	A
(Jlab)	Co-60	233.200	8.520	234.00	8.400	0.997	A
	Co-60	230.600	8.420	234.00	8.400	0.985	A
	Cs-134	27.780	3.130	30.500	1.090	0.911	A
	Cs-134	25.080	2.570	30.500	1.090	0.822	W
	Cs-134	27.800	2.520	30.500	1.090	0.911	A
	Cs-137	61.600	5.710	63.800	3.400	0.966	A
	Cs-137	66.980	5.360	63.800	3.400	1.050	A
	Cs-137	59.900	5.280	63.800	3.400	0.939	A
		(Bq/filter)		**(Bq/filter)**			
Air	Gross Alpha	0.945	0.055	1.170	0.120	0.808	W
(BWX)	Gross Beta	1.560	0.060	1.500	0.150	1.040	A
	Co-60	34.200	1.100	33.500	0.870	1.021	A
	Cs-137	104.000	3.000	99.700	2.300	1.043	A
	Mn-54	44.000	7.800	43.800	1.130	1.005	A
Air	Co-60	34.800	1.250	33.500	0.870	1.039	A
(Jlab)	Co-60	35.600	1.130	33.500	0.870	1.063	A
	Co-60	35.800	0.970	33.500	0.870	1.069	A
	Cs-137	110.200	4.280	99.700	2.300	1.105	A
	Cs-137	108.800	4.100	99.700	2.300	1.091	A
	Cs-137	108.200	3.910	99.700	2.300	1.085	A
	Mn-54	48.100	1.750	43.800	1.130	1.098	A
	Mn-54	47.800	1.920	43.800	1.130	1.091	A
	Mn-54	47.900	2.100	43.800	1.130	1.094	A

BWX: BWX Technologies, Inc.; JLab: Jefferson Lab

Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.

A: Acceptable; W: Acceptable with Warning; N: Not acceptable

EXHIBIT 4-11
QUALITY ASSURANCE PROGRAM (QAP 59)
SELECTED RESULTS FOR 2003

		Reported		EML Known			
Matrix	**Analyte**	**Value (Bq/l)**	**Error**	**Value (Bq/l)**	**Error**	**Ratio Rep/EML**	**Result**
Water	Gross Alpha	517.000	30.000	622.000	62.000	0.831	A
(BWX)	Gross Beta	1700.000	49.000	1948.000	195.000	0.873	A
	H-3	489.000	26.000	446.300	2.200	1.096	A
	Co-60	514.000	12.000	513.000	18.000	1.002	A
	Cs-134	58.500	1.850	63.000	2.000	0.929	A
	Cs-137	82.500	2.790	80.300	4.100	1.027	A
Water	Co-60	495.300	6.600	513.000	18.000	0.965	A
(JLab)	Co-60	493.400	6.900	513.000	18.000	0.962	A
	Co-60	493.500	7.300	513.000	18.000	0.962	A
	Cs-134	57.300	1.000	63.000	2.000	0.910	A
	Cs-134	57.100	1.200	63.000	2.000	0.906	A
	Cs-134	59.500	1.500	63.000	2.000	0.944	A
	Cs-137	78.000	6.600	80.300	4.100	0.971	A
	Cs-137	78.600	2.500	80.300	4.100	0.979	A
	Cs-137	78.500	2.600	80.300	4.100	0.978	A
		(Bq/filter)		**(Bq/filter)**			
Air	Gross Alpha	2.910	0.110	3.110	0.310	0.936	A
(BWX)	Gross Beta	3.840	0.110	3.890	0.390	0.987	A
	Co-60	56.600	2.500	55.100	1.100	1.027	A
	Cs-137	56.600	3.700	54.800	1.100	1.033	A
	Mn-54	58.500	5.400	58.000	1.300	1.009	A
Air	Co-60	60.100	1.000	55.100	1.100	1.091	A
(JLab)	Co-60	60.450	1.100	55.100	1.100	1.097	A
	Co-60	61.490	1.100	55.100	1.100	1.116	A
	Cs-137	63.170	1.300	54.800	1.100	1.153	A
	Cs-137	61.030	1.500	54.800	1.100	1.114	A
	Cs-137	64.000	1.500	54.800	1.100	1.168	W
	Mn-54	67.540	1.400	58.000	1.300	1.164	A
	Mn-54	66.550	1.500	58.000	1.300	1.147	A
	Mn-54	67.330	1.500	58.000	1.300	1.161	A

BWX: BWX Technologies, Inc.; JLab: Jefferson Lab

Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.

A: Acceptable; W: Acceptable with Warning; N: Not acceptable

EXHIBIT 4-12
ERA QA PROGRAM, RAD53
AVERAGE PARAMETER RESULTS FOR 2003

Matrix	Analyte	Reported Value (pCi/L)	Experimental Deviation (pCi/L)	Assigned Value (pCi/l)	Control Limits (pCi/L)	Performance Evaluation
Water	Co-60	60.2	4.45	63.8	55.1 - 72.5	A
(BWX)	Cs-134	63.5	3.49	75.7	67.0 - 84.4	NA
	Cs-137	151.0	4.00	150.0	137 - 163	A
	Gross Alpha	68.4	2.69	70.3	39.9 - 101	A
	Gross Beta	316	6.25	363	269 - 457	A
	H-3	1,520	51.3	1,250	678 - 1820	A

BWX: BWX Technologies, Inc.

EXHIBIT 4-13
ERA QA PROGRAM, RAD55
AVERAGE PARAMETER RESULTS FOR 2003

Matrix	Analyte	Reported Value (pCi/L)	Experimental Deviation (pCi/L)	Assigned Value (pCi/l)	Control Limits (pCi/L)	Performance Evaluation
Water	Co-60	28.0	0.569	27.7	19.0 - 36.4	A
(BWX)	Cs-134	19.9	0.416	23.4	14.7 - 32.1	A
	Cs-137	63.9	4.35	64.2	55.5 - 72.9	A
	Gross Alpha	59.4	5.43	54.2	30.7 - 77.7	A
	Gross Beta	150	13.7	168	124 - 212	A
	H-3	14,400	493	14,300	11,800 - 16,800	A

BWX: BWX Technologies, Inc.

SECTION 5
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APPENDIX A

ACRONYMS and ABBREVIATIONS

ACRONYMS and ABBREVIATIONS

These acronyms and abbreviations reflect the typical manner in which terms are used for this specific document and may not apply to all situations.

ALARA	As Low As Reasonably Achievable	**EPA**	Environmental Protection Agency
AP	Affirmative Procurement	**EPCRA**	Emergency Planning and Community Right-to-Know Act
ARC	Applied Research Center	**EPGs**	Emergency Planning Groups
BMP	Best Management Practice	**EPP**	Environmentally Preferable Purchasing
Bq	Becquerel	**ERA**	Environmental Resource Associates
BWX	BWX Technologies, Inc.	**FDS**	Floor Drain Sump
CAA	Clean Air Act	**FEL**	Free Electron Laser
CAAA	Clean Air Act Amendments	**FIFRA**	Federal Insecticide, Fungicide, and Rodenticide Act
CASA	Center for Advanced Studies of Accelerators	**FONSI**	Finding of No Significant Impact
CEBAF	Continuous Electron Beam Accelerator Facility	**FY**	Fiscal Year
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act	**GeV**	Billion (Giga-) electron Volts
CFC	Chlorofluorocarbon	**GSA**	General Services Administration
Ci	Curie	**HRSD**	Hampton Roads Sanitation District
CLAS	CEBAF Large Acceptance Spectrometer	**IR**	Infrared
CWA	Clean Water Act	**ISM**	Integrated Safety Management
CX	Categorical Exclusion	**kW**	Kilowatt
CY	Calendar Year	**LEED**	Leadership in Energy and Environmental Design
CZMA	Coastal Zone Management Act	**LLW**	Low Level Radioactive Waste
DEQ	(Virginia) Department of Environmental Quality	**LSA**	Line Self-Assessment
DOD	U.S. Department of Defense	**µSv**	MicroSievert
DOE	U.S. Department of Energy	**M^3**	Cubic Meters
E2	Energy Efficiency	**MCM**	Minimum Control Measures
EA	Environmental Assessment	**mrem**	Millirem
EHS	Extremely Hazardous Substance	**MS4**	Municipal Separate Storm Sewer Systems
EH&S	Environment, Health, and Safety	**MSDS**	Material Safety Data Sheet
EML	Environmental Measurements Laboratory	**mSv**	MilliSievert
EMS	Environmental Management System	**NAAQS**	National Ambient Air Quality Standards
EO	Executive Order of the President of the United States	**NASA**	National Aeronautics and Space Administration
EP	Environmental Protection	**NEPA**	National Environmental Policy Act

ACRONYMS and ABBREVIATIONS (continued)

NESHAPs	National Emission Standards for Hazardous Air Pollutants	**SDWA**	Safe Drinking Water Act
NHPA	National Historic Preservation Act	**SER**	Site Environmental Report
NRC	Nuclear Regulatory Commission	**SNS**	Spallation Neutron Source
ODS	Ozone-Depleting Substance	**SPCC**	Spill Prevention, Control, and Countermeasure
OSHA	Occupational Safety and Health Administration	**SQG**	Small Quantity Generator
P2	Pollution Prevention	**SRF**	Superconducting Radiofrequency
PBT	Persistent, Bioaccumulative, or Toxic	**SURA**	Southeastern Universities Research Association, Inc.
PCard	Purchase Card	**Sv**	Sievert
PCB	Polychlorinated biphenyl	**SWP3**	Storm Water Pollution Prevention Plan
pCi/ l	Picocuries per liter	**TDS**	Total Dissolved Solids
QA	Quality Assurance	**TJNAF or Jefferson Lab**	Thomas Jefferson National Accelerator Facility
QAP	Quality Assessment Program	**TSCA**	Toxic Substances Control Act
QC	Quality Control	**TSS**	Total Suspended Solids
RadCon	Radiation Control Group	**Universal Labs**	Universal Laboratories, Inc.
RBM	Radiation Boundary Monitor	**UV**	Ultraviolet
RCRA	Resource Conservation and Recovery Act	**VPDES**	Virginia Pollutant Discharge Elimination System (Permit)
R&D	Research and Development	**WMin/P2**	Waste Minimization/Pollution Prevention
SA/QA	Self-Assessment / Quality Assurance	**WSS**	Work Smart Standards
SARA	Superfund Amendments and Reauthorization Act		