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JEFFERSON LAB
SITE ENVIRONMENTAL REPORT
For Calendar Year 2002

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JEFFERSON LAB SITE ENVIRONMENTAL REPORT FOR CALENDAR YEAR 2002

Executive Summary

Purpose

*T*his report presents the results of environmental activities and monitoring programs at the Thomas Jefferson National Accelerator Facility, known as Jefferson Lab, for calendar year 2002. The objective of this annual Site Environmental Report is to document Jefferson 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 operations at Jefferson Lab. The report also summarizes environmental programs, initiatives, and assessments that were undertaken in 2002.

Jefferson Lab's main purpose is to make available a research facility to support the nuclear physics community and the nation. The Continuous Electron Beam Accelerator Facility (CEBAF) at Jefferson Lab provides an electron beam to three experimental halls, where a variety of physics experiments are conducted. Correlative programs where environmental protection is also considered are: the Free Electron Laser (FEL); Superconducting Radiofrequency (SRF) research and development; and, cryomodule development for the DOE's Spallation Neutron Source (SNS) project.

Major Site Programs

CEBAF: The accelerator continued to deliver polarized electron beams at energies up to nearly 6 GeV (billion electron volts) to meet a variety of needs of experimenters in Halls A, B, and C. By the end of calendar year 2002, Jefferson Lab had completed 66 experiments and partially completed another 34. Major experiments were conducted in all three halls during 2002, as well as preparation and logistics work for large-scale experiments planned for two of the halls during 2003.

A group of Hall A physicists studied strange matter called "kaons" and how energy becomes matter, while another Hall A collaboration used photons (light particles) to study the proton's structure. Preparation work was underway for two large magnet systems scheduled for experimental use in Hall A during 2003, namely the septum magnet and a magnet dubbed "BigBite".

Results from earlier research into the shape of the proton (conducted in Hall A) were reported in popular publications like *USA Today* and *The New York Times*. Experimental data indicate that the proton isn't necessarily round - it can take on a variety of shapes such as a peanut, egg or even a football.

An experiment in Hall C studied the spin-structure functions of nucleons - precisely how quarks arrange themselves to form protons and neutrons - and in turn make up all matter. The research is helping to determine why quarks are bound up in nucleons and not free-floating particles. Researchers using Hall C during 2001, who measured the charge distribution of the neutron, published their results. While the particle's overall charge is neutral, it actually has a positively charged interior and a negatively charged surface. Hall C collaborators made the most precise measurements ever made of this charge distribution.

Hall C physicists, engineers, and technicians also readied a large, new freestanding detector system and electric magnet for an experiment called "G-Zero". Accelerator scientists made significant adjustments to CEBAF's electron beam for this experiment, which is designed to quantify the lightest of the six types of quarks - the elusive strange quark.

Hall B delved into the resonance levels of the neutron, comparing the properties of fast and slow moving neutrons.

During 2002, analysis, research, and development work continued on the proposed upgrade of Jefferson Lab's accelerator to 12 GeV. This upgrade in electron beam energy levels would also include the building of a fourth experimental hall, which would be named Hall D. In the DOE and National Science Foundation's jointly published April 2002 Long-Range Plan "Opportunities in Nuclear Science", the Nuclear Science Advisory Committee rated Jefferson Lab's upgrade as one of the science programs it most highly endorses, supports, and recommends.

FEL: By year's end, work neared completion on the upgrade to Jefferson Lab's Free Electron Laser. The first machine, the Infrared (IR) Demo FEL, was shutdown November 18, 2001, and decommissioned to make way for the major upgrade project. At that time it was a 1,000 watt (kilowatt) level light source with output in both the IR and ultraviolet (UV) wavelengths. Once the upgrade is complete in 2003, the machine will be able to produce more than 10,000 watts of IR light and 1,000 watt levels of UV light. The FEL supports basic science research and serves universities, private industry, NASA, the U.S. Navy, and the U.S. Air Force. Before shutting down in 2001, FEL experiments included: investigation into the production of coatings and thin films for electronics and microcomponents, and production of carbon nanotubes.

SNS: The Spallation Neutron Source project involves a team of six Federal laboratories including - Argonne, Brookhaven, Lawrence Berkeley, Los Alamos, Jefferson Lab, and Oak Ridge - assisting 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 built the prototype SNS cryomodule during 2002 and provided extensive expertise, guidance, and production effort in developing the SNS refrigeration plant. After testing the 19-foot-long, five ton prototype cryomodule, it was loaded onto a flatbed semi for a trial road trip to ensure the rigors of travel wouldn't damage the extremely sophisticated and sensitive mechanisms within the cryomodule. After a final round of tests ensured its road-worthiness, the cryomodule was delivered to Oak Ridge, and Jefferson Lab's cryomodule production line moved into high gear.

By year's end, work on several cryomodules was well underway in Jefferson Lab's cryomodule assembly area. The Lab will produce 23 cryomodules for the SNS.

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

Organization and Management: Ultimate responsibility for protection of the environment and public health rests with the Lab Director, while line management implements the goals within their areas of responsibility. EH&S staff provide support to their line management and share their expertise with the Lab as a whole.

Integrated Safety Management (ISM) System: Through ISM, Jefferson Lab incorporates EH&S requirements into all work procedures, striving towards continuous improvement in EH&S and in the nuclear physics research program.

Jefferson Lab Work Smart Standards (WSS) Process: The goal of the WSS process at Jefferson Lab is to enable an EH&S system that is both effective and cost-efficient. The WSS Set, identified through the process, 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 hazard issues that are relevant to Jefferson Lab. The WSS Set and other associated obligations are reviewed and adjusted on a regular basis to address changes in either site activities or regulations. Compliance information is provided in Section 2.

EH&S Performance Measures: The DOE/SURA (Southeastern Universities Research Association, Inc.) contract-based measures, used to evaluate Jefferson Lab's EH&S performance, include items such as recycling and hazardous waste minimization. These are discussed in Section 2.

Inspections and Appraisals: The Virginia Department of Environmental Quality (DEQ) and the Hampton Roads Sanitation District (HRSD) performed inspections in 2002. Section 2 presents the minor concerns identified in these inspections. Most of the deficiencies identified during a 2002 ISM review were closed in 2002. The DOE Site Office's Overlay Report included an "outstanding" rating for SURA in the EH&S category. These are discussed further in Section 3.

Implementation of 10 CFR 835: This DOE Code of Federal Regulations (CFR) worker radiation protection rule is enforced at Jefferson Lab and identified in the WSS Set mentioned above. The Jefferson Lab Radiation Protection Program Plan is used to implement the rule on-site, and is revised as identified by the responsible line management. Compliance is addressed in Section 2.

Implementation of NEPA: Most facility additions and modifications are subject to review under the National Environmental Policy Act (NEPA). The initial Jefferson Lab construction and an upgrade to CEBAF were addressed in the 1987 and 1997 Environmental Assessments (EAs). Some important new buildings were addressed in a 2002 EA. Routine Lab activities are covered under site-specific Categorical Exclusions (CXs). New activities that occurred in 2002 received NEPA CX authorizations. NEPA is discussed further in Section 2.

Environmental Management System (EMS) Implementation: The primary objective of ISM is to make safety, health, and environmental protection a part of routine business at Jefferson Lab. EMS implementation is addressed through the Lab's ISM System Plan, and is the subject of the 6700 series of chapters in the Jefferson Lab EH&S Manual. Chapter 6710, *Environmental Protection Program*, is being upgraded to clarify management roles regarding the protection of the environment and public health. Jefferson Lab incorporated some EMS elements that were to broaden the scope of the ISM System Plan during fiscal year 2002.

Summary of Environmental Results in 2002

Compliance

Jefferson Lab complied with applicable Federal, State, and local environmental laws, regulations, and DOE guidance during 2002. As a consequence, Jefferson Lab operations had no discernable impact on public health or the environment. Radiation-related issues, especially those dealing with water

resources and public health, are highlighted in this report. The Jefferson Lab EH&S Manual, which addresses many environmental topics, was updated to ensure that new compliance initiatives were incorporated in 2002.

Radiological Monitoring

Water: Radiation measurements are made at the groundwater dewatering sump and groundwater monitoring wells located near the CEBAF accelerator and the experimental halls. Sampling intervals vary from quarterly to annually. There were no readings above background in 2002. Note that gross beta was detected, but at normal background levels. Therefore, no accelerator-produced radionuclides were present in our groundwater.

Radioactive water is generated inside the underground accelerator complex and a small quantity is discharged under permit to the sanitary sewer system. Sampling is routinely performed prior to any discharge to ensure permit limits are maintained. Sampling results are reported both monthly and quarterly.

Airborne: Radiological airborne emissions at the site boundary are addressed under the Environmental Protection Agency's (EPA) National Emission Standard for Hazardous Air Pollutants (NESHAPs) requirements. Jefferson Lab is below emission levels that trigger monitoring or reporting, but continuous measurements are made to verify emission calculations. Though not required, calendar year 2002 values were reported to the EPA. One result reported to the EPA for 2002 was that the estimated total maximum offsite dose from radiological airborne releases was 0.011 millirem/year (mrem/yr). This amount is insignificant when compared to the EPA regulatory public air-dose limit of 10 mrem/yr, which is the amount of exposure that is comparable to one typical chest x-ray.

The accelerator site boundary monitors are used to determine offsite direct radiation dose to the public due to Jefferson Lab operations. The dose values for 2002 were within Jefferson Lab's allowable limits - the highest direct radiation level measured was only 7% of the DOE annual dose limit of 100 mrem.

Since these doses are well under any regulatory or site administrative limits, there are no impacts on the public from any of these radiation sources. A complete discussion is provided in Section 4.

Non-radiological Monitoring

Jefferson Lab's non-radiological environmental monitoring program also verified compliance with applicable environmental program requirements. The program included quarterly industrial wastewater monitoring, groundwater sampling at the dewatering sump and at some of the monitoring wells, and cooling water discharge sampling.

Items of Interest in 2002

Highlights in Jefferson Lab's environmental protection and pollution prevention program included:

- Recycling of about 1,000 pounds of fluorescent lamps and about 14,600 pounds of used oil/coolant;
- Going from two to eleven fully-functioning office product recycling centers;
- Maintaining a top rating in the Lab's performance measure that addresses recycling compared to disposing of waste in a landfill;

- Improving performance in the procurement of EPA-designated recycled-content products, 87% purchased in fiscal year 2002, an improvement over 2001 figures; and,
- Successfully accomplishing the site's second shipment of low-level radioactive waste.

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SECTION 1
INTRODUCTION

1.1 PURPOSE OF THIS REPORT

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

This document marks the tenth year that Jefferson Lab has been preparing an annual Site Environmental Report (SER). This SER addresses the status and results of the Lab's environmental protection (EP) program, which also addresses public health items, for calendar year (CY) 2002. The SER is prepared in accordance with DOE guidance. SERs inform Jefferson Lab staff, DOE, regulators, and the public, and provide a historical record of the environmental condition of the site.

Addressed within Section 2 is the Lab's compliance status with applicable requirements, standards, and contractual commitments. Section 3 summarizes the site's major EP-related programs. Sections 4 and 5 address the active site radiological and non-radiological monitoring programs. Section 6 presents information about the site's groundwater protection program and Section 7 describes how Jefferson Lab ensures that the data used to monitor environmental conditions are of high quality and accuracy. The appendices include acronyms and abbreviations, technical terms used herein, and applicable laws and regulations.

EP is an integral element of the Lab's Integrated Safety Management (ISM) program. Note that the term "safety", in the ISM program, includes EP, public health, and worker safety and health, all of which are generally termed EH&S.

The SER is available in a downloadable pdf file. Look for this CY 2002 SER under 'Safe and Secure First' on the Jefferson Lab web page at **http://www.jlab.org**.

1.2 JEFFERSON LABORATORY MISSION

Jefferson Lab, formerly known as CEBAF (Continuous Electron Beam Accelerator Facility), is a national accelerator facility managed by SURA (Southeastern Universities Research Association, Inc.) for the DOE. The accelerator complex portion of the Lab still retains the name CEBAF. This complex 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 the 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. Since then, Jefferson Lab has developed a mission statement that addresses quality and excellence in research, community partnership, and environment, health, and safety (EH&S).

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. Information about other site program areas that support the Lab's mission is noted in Section 1.3.

Jefferson 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, as built by DOE, is one of four major basic research facilities in High Energy and Nuclear Physics in the United States. Jefferson Lab is operated for the DOE by SURA. 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 all over the world participate in scientific collaborations. By the end of CY 2002, Jefferson Lab/SURA held 40 patents on specialized processes and components developed by Lab staff, with an additional 43 patent applications being processed.

Jefferson Lab's annual budget is approximately $100 million. Most of this budget 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 facility that serves primarily as a research and development (R&D) center for SRF accelerator cavities; 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. Additional information on the listed facilities that have EP or public health implications is provided in Section 1.7.

1.4 HISTORY AND DESCRIPTION

Prior to Jefferson Lab, there were several users of this general area. In 1942 and 1943, the U.S. Department of Defense (DOD) acquired most of the Oyster Point area that included all of the land presently used by Jefferson Lab. The U.S. Air Force acquired the land in 1950 and installed a BOMARC missile site on a portion of the land immediately to the east of the current Jefferson Lab site. The DOD started disposing of the property after closure of the BOMARC missile base in 1963. Some land was conveyed to the Commonwealth of Virginia, the National Aeronautics and Space Administration (NASA), and others. In January 1987, ownership of the 110 acres of NASA property, including 100 acres of wooded, undeveloped land, was conveyed to the DOE. An additional 52 acres of land were transferred to the DOE from various 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 December 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.

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 Jefferson Lab. This area, the DOE-owned site, and other nearby properties are considered part of the City's Jefferson Center for Research and Technology.

Front Entrance to CEBAF Center

1.5 LOCATION

Jefferson Lab is located in Newport News, Virginia. Newport News is bounded on the east by York County and the city of Hampton; on the north by James City County and the city of Williamsburg; on the west by the James River; and, on the south by the Hampton Roads waterway. Jefferson Lab is located just east of Jefferson Avenue, a main area thoroughfare, and is less than one mile to the west of Interstate 64. The site is just south of Oyster Point Road and just north of Middle Ground Boulevard. The Jefferson Lab Vicinity Plan is included as Exhibit 1-1. Two schools, a cemetery, and railroad tracks serving the local rail system are located within one mile of the site. Newport News-Williamsburg International Airport is located two miles to the north. Exhibit 1-2 shows the Jefferson Lab site proper.

Jefferson Lab is sited in the central section of Newport News at an average elevation of 35 feet above mean sea level (MSL). The site elevation ranges from 32 to 37 feet above MSL, which is above the 100-year floodplain level of 13 feet above MSL. The Jefferson Lab site is located in the coastal plain of the lower York-James Peninsula. All but a small portion of the site is in the Brick Kiln Creek watershed, which discharges into the Big Bethel Reservoir. The U.S. Army operated the Big Bethel Reservoir for part of 2002. The reservoir no longer serves as a drinking water source for Fort Monroe, Langley Air Force Base, or the NASA-Langley Research Center, but still remains a recreation area. The westernmost portion of the DOE site is in the Deep Creek watershed, which discharges into the James River.

1.6 CLIMATE AND DEMOGRAPHICS

The meteorology of the Jefferson Lab site is strongly affected by the nearby marine environment. The Chesapeake Bay moderates the climate and weather of the site, with land-sea breezes dominating the wind patterns during much of the year. The mean monthly temperature for the Newport News area

Exhibit 1-1
Jefferson Lab Vicinity Plan

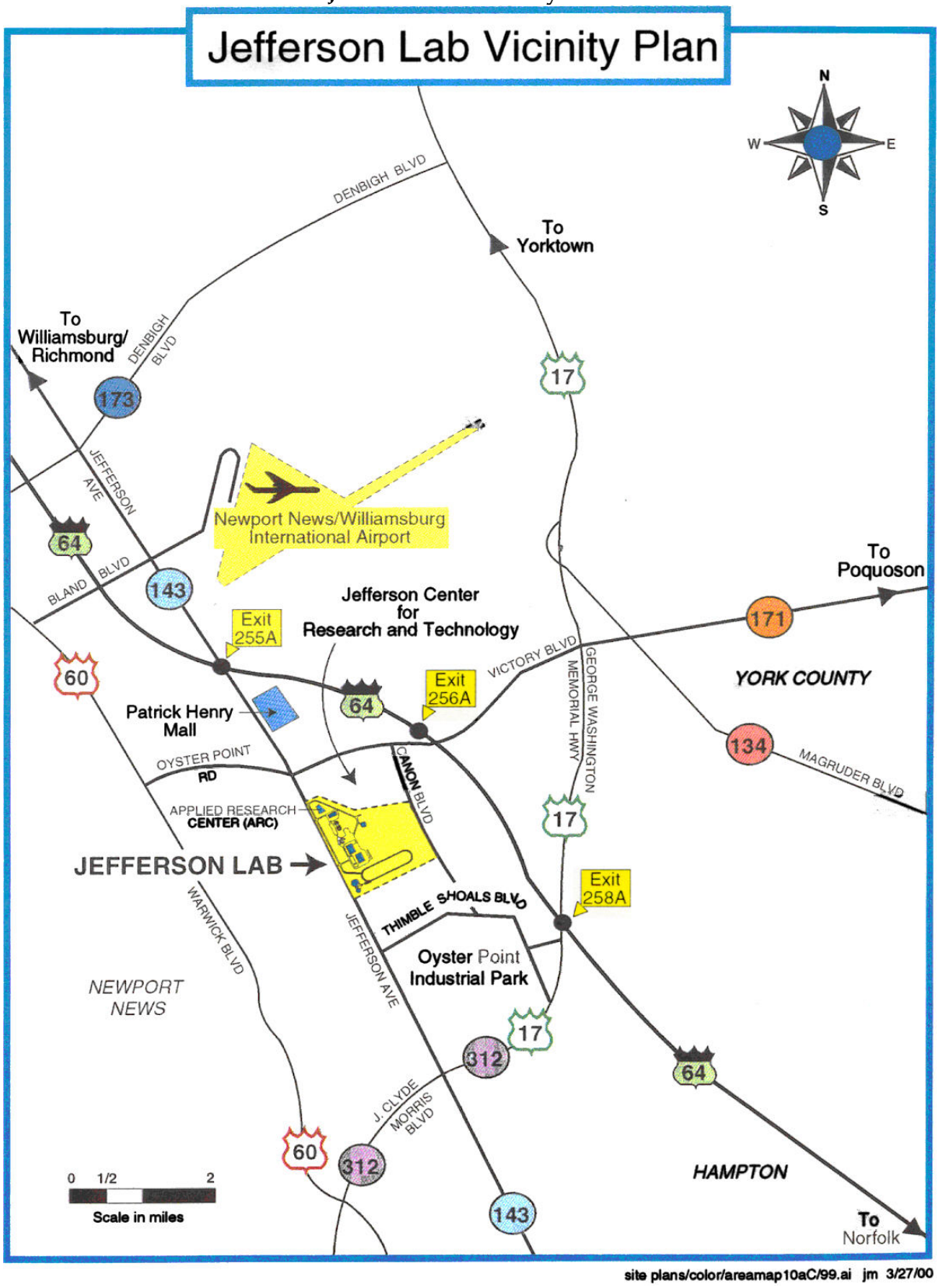
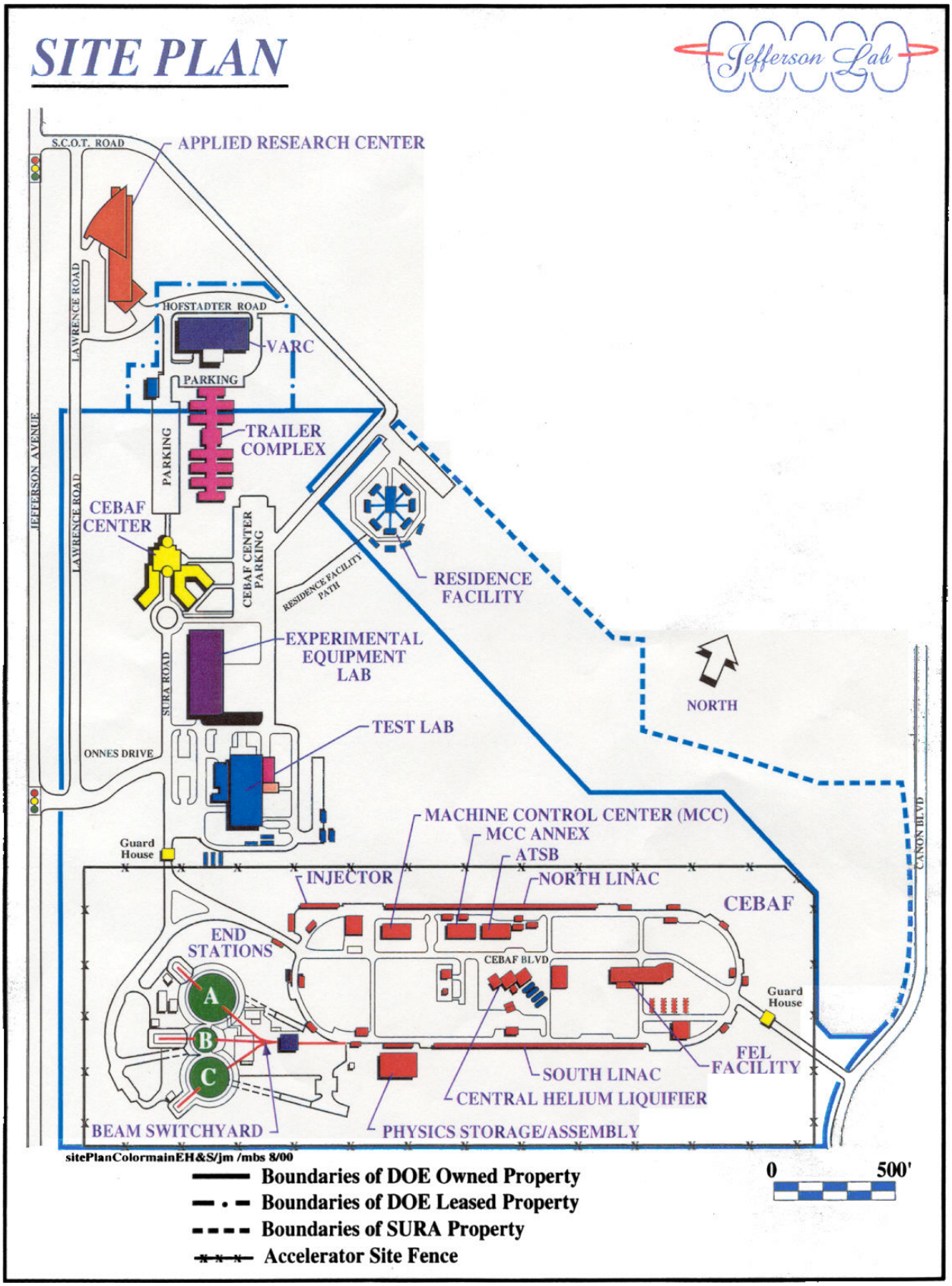


Exhibit 1-2
Site Plan



ranges from 4°C (40°F) in January to 26°C (79°F) in July. The record low temperature is -19°C (-3°F) and the record high is 40°C (105°F). [Information is taken from the International Station Meteorological Climate Summary, Version 4.]

Normal annual precipitation is 112 cm (44 in.), spread evenly throughout the year. Extreme precipitation events, caused by hurricanes or tropical cyclones, have deposited as much as 29 cm (11.5 in.) of rain in a 24-hour period. Average snowfall is 23.1 cm (9.1 in.), but up to 35 cm (14 in.) has fallen in a month. Because of the proximity to the Chesapeake Bay, fog is a common occurrence in the area. Severe weather, in the form of thunderstorms, averages 37 days/year. Tornadoes are rare in coastal Virginia but may be spawned by severe thunderstorms or when associated with hurricane or tropical cyclone activity. Hurricanes average less than one per year in Virginia, but have caused both wind and flooding damage to the area since colonial times. [Information is taken from DOE/EA-1384.]

The population of Newport News grew steadily between 1980 and 2000. The 2000 census showed that 180,150 people lived inside Newport News versus 144,903 in the 1980 census. The growth rate for that period was 24%.

1.7 FACILITIES AND 2002 ACTIVITIES

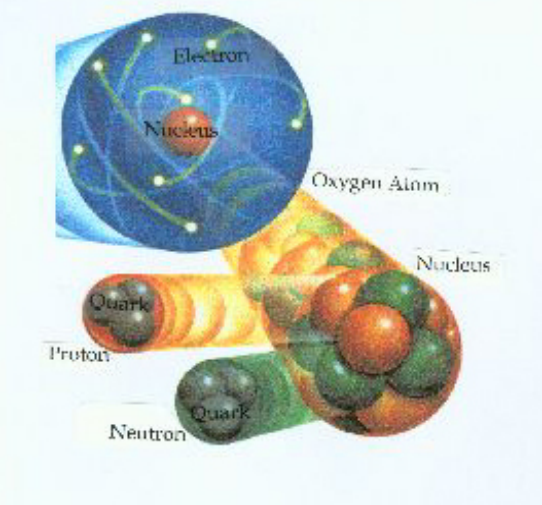
The 163-acre DOE site is primarily divided into two areas, one with R&D, fabrication, administrative offices, and such, and the second is about a 40-acre fenced area, termed the accelerator site, where all accelerators and related experiments are housed. It is located in the south portion of the site, and access is restricted, through one entrance that is staffed 24-hours/day, to authorized staff or subcontractors, or as escorted by an authorized person.

The four major Jefferson Lab facilities that have EP or public health-related implications are CEBAF, its End Stations, the SRF Facility, and the FEL User Facility. A short description and at least one note of interest for each is shown below.

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 between the regime 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.

Improvements in CEBAF operations to support the physics experimental program continued through the calendar year. These improvements included:

- The delivery of electron beams at energies close to 6 GeV to meet the variety of needs of the experimenters in Halls A, B, and C.
- CASA, the Center for Advanced Studies of Accelerators, contributed to the success of CEBAF by providing simulations and operations support during the setup and execution of ongoing experiments.



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.
- Hall B houses the CEBAF Large Acceptance Spectrometer (CLAS) that supports studies of both electron and photon-induced particle reactions.
- 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.

In 2002, each of the halls focused on different research areas. Hall A examined how energy becomes matter. Hall B used CLAS to gather new insights on several fundamental questions about the neutron. Hall C researchers took a closer look at matter's blueprints with a study of the spin-structure functions of the proton and neutron, collectively known as nucleons.

Since the Lab began operations, through the end of 2002, researchers had completed 66 experiments and partially completed another 34 using all three halls.

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 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 and production capability.

Major activities in 2002 involved continued R&D on cavity development, to support CEBAF and the FEL, and to finalize the design on the SNS cavities. Jefferson Lab is also providing expertise on the refrigeration system needed to provide supercooled liquids to the SNS that is being constructed in Oak Ridge, Tennessee.

FEL User Facility: The FEL is an accelerator that was initially designed to provide 1,000 watt (1 kW) of infrared (IR) light with picosecond pulse length for use by Jefferson Lab, industrial, DOD, and university partners. This demo machine was shutdown in November 2001 for a scheduled upgrade. Upgrade work continued through 2002.

Activities included:

- An experiment which demonstrated how to produce a highly useful form of light, called terahertz radiation - 20,000 times brighter than ever before - was published in the November 2002 issue of *Nature*.
- Installing the upgrade will enable operation in a wider wavelength range to 10,000 watt (10 kW). Scientists expect to be lasing again in 2003.

Future planning: Analysis and R&D work on the proposed upgrade of CEBAF to 12 GeV continued in 2002. 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.

1.8 ENVIRONMENTAL REVIEW

An environmental assessment, termed EA, performed under National Environmental Policy Act (NEPA) procedures, was conducted prior to the construction of CEBAF (February 1987), resulting in a Finding of No Significant Impact (FONSI). 1997 and 2002 EAs, which also yielded FONSIs, addressed a CEBAF upgrade, FEL and potential HELIOS-related activities, and five building construction projects. Existing NEPA-related documentation has been reviewed periodically. Refer to Section 3.4 for additional information about site NEPA activities.

1.9 ECOLOGICAL RESOURCES

Jefferson Lab is located on what was a hardwood-pine forest. The majority of the remaining wooded areas on this property are considered a mixed pine-deciduous forest. The Lab is still partially surrounded by small oak-loblolly pine forests. The overall site remains a temporarily wet, upland area in the city of Newport News. Vegetation at Jefferson Lab is in various stages of succession, reflecting the history of disturbances to the site. As identified in a 2001 survey, the growth in previously cleared areas is dominated by younger pines showing the trend for these areas to be returning to a pine-dominated canopy like the surrounding wooded areas.

The 1987 EA reported that 257 species of terrestrial vertebrate fauna had geographic ranges that encompassed the site, though only a fraction would be expected to actually exist on the property. Prior studies and correspondence with various government agencies indicated that no Federal or State listed threatened or endangered species or other protected species exist on the site. A site survey of flora and fauna conducted in 2001 documented the site status during the preparation of DOE/EA-1384.

DOE/EA-1384, approved in July 2002, reviewed site conditions for terrestrial and aquatic resources as well as threatened and endangered, and other state and local species of concern that had the potential to be found on-site. The key results follow.

- Rare plant species and their typical habitats were studied. None of the identified plants or conditions suitable for their propagation were found.
- Federal and State listed fauna, such as the bald eagle and canebrake rattlesnake, and potential suitable habitats were also surveyed. No Federal or State listed species nor any other species of concern were found. As well, no suitable nesting or roosting habitats were identified.
- The 2001 survey found no aquatic resources and no permanent aquatic habitats. There are, however, small drainage channels that move water across and off the site, with a few channels just beyond the DOE site limits. The few channels that almost always contain water pass under Canon Boulevard to eventually flow into Brick Kiln Creek. Refer to Section 6.2 for more information on area drainage patterns.
- More information on the flora and fauna considered in this EA is provided in Section 2.7.1.

1.10 SITE EH&S RESOURCES

The facility makes available a variety of EH&S resources to serve the Jefferson Lab community. The Lab community includes SURA and DOE staff, Commonwealth of Virginia employees, subcontractors, visiting experimenters, and students of all ages that participate under various programs. To ensure that staff, employees, subcontractors, and users are aware of and utilize environment, health,

and safety principles, EH&S responsibilities are incorporated into each position description as described in the Jefferson Lab ISM System Plan, which was validated by DOE in 1999. (See Section 3.1 for more information on ISM.)

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 or 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, generally through the DOE Site Office, the Oak Ridge Operations (ORO) Office, and the DOE Headquarters Office of Science; 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 2002 to support the continued development and implementation of EP and public health-related programs at Jefferson Lab.

SECTION 2
COMPLIANCE SUMMARY

2.1 INTRODUCTION

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 Site Office and outside regulators, including staff from the Virginia Department of Environmental Quality (DEQ) and the Hampton Roads Sanitation District (HRSD). Assurance is also obtained through guidance from the DOE ORO Office, with additional program support by the DOE Office of Science.

Applicable EP and public health-related requirements are identified in the DOE/SURA contract. They are divided into three groups:

- the Work Smart Standards (WSS) Set;
- the Administrative Laws and Regulations (AL&R); and,
- other contractual commitments.

These groupings actually include all Jefferson Lab EH&S obligations and are described in Appendix C. Compliance with EP and public health-related requirements is maintained as follows.

2.2 WASTE MANAGEMENT

Waste streams at the Lab include hazardous, low-level radioactive, and medical wastes (discussed below). The Lab endeavored to reduce waste generation in 2002 and did make progress in some areas. Though waste reduction considerations are taken into account, new actions, including the commencement of special processes, such as SNS cryomodule fabrication and the addition and use of more experimental and support equipment, often involve identifying as waste older materials and equipment that are no longer needed. The Lab has encouraged the reuse or recycling of old or discarded materials wherever possible. (Refer to site-specific program information in Section 3.5.2.) Waste disposal and recycling quantities are tracked and reported annually to the DOE.

There have been neither waste management activities associated with spills or cleanup actions under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) nor have there been any waste storage or management actions that involved NEPA authorizations.

2.2.1 Hazardous Waste under RCRA, related VA Regulations, and EH&S Manual Chapter 6761, *Hazardous Waste Management*

40 Code of Federal Regulations (CFR) Subchapter I, *Waste Programs*, implements the Resource Conservation and Recovery Act of 1976 (RCRA), also called the Solid Waste Disposal Act (SWDA). RCRA covers waste management and the promotion of "Resource Recovery and Reuse". The Act promotes the protection of health and the environment and the conservation of valuable material and energy resources.

RCRA further provides the Environmental Protection Agency's (EPA) authority to regulate solid waste, from minimization and recovery to collection and disposal. The EPA has delegated authority to the DEQ to regulate solid wastes that include hazardous waste. As such, the Virginia Waste Management Act and regulations under the Virginia Administrative Code Sections 9 VAC 20-80, et seq. (*Waste Regulations)* apply. Applicable requirements for safe storage, transport, treatment, and disposal of hazardous waste for generators, transporters, and owners and operators of hazardous waste treatment, storage, and disposal facilities are implemented through the Jefferson Lab EH&S Manual.

Jefferson Lab has been registered as a RCRA Small Quantity Generator (SQG) since 1987. (Note that SQGs are not required to file a biennial report to the DEQ.) To maintain SQG status, a facility cannot generate more than 1 kilogram (kg) of acutely hazardous waste and/or 1000 kgs (about 2200 pounds or about 300 gallons maximum) of hazardous waste in any given month, and the facility must not accumulate more than 6000 kgs of hazardous waste on-site at any given time. Jefferson Lab generated about 5100 kgs of hazardous waste in Fiscal Year (FY) 2002. The increase in generation this year (from 4300 kg in FY 2001) was due to increased cryomodule production to support SNS and the FEL requirements, which were in addition to the normal fabrication activities needed to maintain CEBAF operations.

The hazardous wastes generated in the largest volumes in 2002 were waste buffered chemical polish (an acid mixture) used for niobium cavity processing and waste solvents (acetone, methanol, and isopropanol) from cleaning operations. One special initiative, the elimination of cyanide use, occurred in 2002. Refer to Section 3.2.2 for other waste minimization efforts.

The most recent DEQ inspection of this program was performed in September 2002**.** Refer to Section 3.3 for more information on that event.

The Jefferson Lab Hazardous Waste Coordinator (HWC) manages the site program and follows the guidance in EH&S Manual Chapter 6761 to maintain compliance. Hazardous wastes are temporarily stored at Jefferson Lab; however, no permitting is required because the wastes are properly disposed of within the regulatory time frame. Jefferson Lab neither transports hazardous wastes nor operates any regulated treatment or disposal units. All wastes are disposed of through licensed waste handling facilities. There are two elementary neutralization units, but they are not regulated as treatment devices. Some environmentally

harmful materials (EHMs) are recycled and/or reused prior to final disposal. Full compliance with requirements was maintained through 2002.

2.2.2 Low-Level Radioactive and Mixed Waste under DOE Order 435.1 and the AEA

The Radiation Control (RadCon) Group implemented the applicable sections of DOE Order 435.1, *Radioactive Waste Management,* in 2002. The program enables more efficient separation and categorization of the Lab's low-level radioactive wastes (LLW). In 2002, the Lab identified more waste than would normally be expected in a year, but was less than that identified in the first year of the program. As there is no waste generated that carries either the source materials or special nuclear materials subject to the Atomic Energy Act of 1954 (AEA), as amended, its conditions are not applicable.

Roughly 11 cubic meters (m^3) of LLW were disposed of in FY 2002. This rather large amount of waste, compared with our proposed goal of 3.5 m^3/year by 2005, was not generated solely in 2002, but included items that had slowly been generated and accumulated since 1992. The second shipment of Jefferson Lab LLW material was turned over to a certified subcontractor for disposal in July 2002. [Note: Permit No. 4727-45-01, to transport waste within South Carolina, was obtained in 2001, and will be reapplied for as needed.]

Though Jefferson Lab is required to follow the RCRA requirements that apply to mixed waste, which exhibits both hazardous and radioactive characteristics, there has been no mixed waste generated to date. Jefferson Lab was in compliance with all applicable standards in 2002.

2.2.3 Non-Hazardous Waste under DEQ Standards and the EH&S Manual

Non-hazardous wastestreams generally contain non-regulated chemical wastes, non-recyclable office and production waste materials, and debris resulting from construction activity. The DEQ is responsible for regulating such waste programs. Jefferson Lab line management is responsible for proper administration of the wastestreams covered under this category according to EH&S Manual Chapter 6760, *Waste Management*. There were no compliance issues in 2002.

2.2.4 Other Non-Hazardous Waste-Related Compliance Items under RCRA

There are other forms of liquid and solid non-hazardous wastes, including domestic wastewater. Two water collection sump pits are located in the Counting House (Building 97), with one pit discharging to surface water and the contents of the other pit being pumped to the HRSD system. The permits for these water discharges are discussed in Section 2.5.2.

Other non-hazardous wastes are disposed of in a landfill, reused on-site, recycled, or used for other purposes offsite. In 2002, Jefferson Lab collected and disposed of cadmium, nickel cadmium, and lithium ion batteries and crushed fluorescent lamps as universal wastes. Approved waste management plans and procedures prevent or minimize impacts to the environment, both at the site generation area and at the final usage or disposal point. Jefferson Lab minimizes the generation of waste by using source reduction as the primary means of reducing environmental impacts, thereby lowering purchase and disposal costs.

The Lab utilizes licensed subcontractors for collection, separation, and permanent disposal (aluminum cans and paper goods are recycled separately).

2.2.5 Regulated Medical Waste under the EH&S Manual

The Lab's EH&S Manual Chapter 6850, *Regulated Medical Waste Management* and Appendix 6850-T1, *Regulated Medical Waste Handling Procedures,* apply and include RCRA and Virginia requirements. There were no compliance issues with this program in 2002.

2.2.6 Federal Facility Compliance Act

This Act, which amends the SWDA, gave the EPA authority to enforce actions against branches of the Federal government for violation of Federal, State, interstate, or local solid or hazardous waste regulations. There were no compliance issues at Jefferson Lab during 2002.

2.2.7 Toxic Materials under TSCA

The Toxic Substances Control Act (TSCA) and its implementing regulations, 40 CFR Subchapter R, require that specific chemicals such as polychlorinated biphenyls (PCBs) and asbestos be controlled and their use restricted.

PCBs

Since 1987, SURA has been removing PCBs and PCB-contaminated items from the site. There were no PCBs in use or on-site during 2002. As such, there were no PCB compliance issues in 2002.

Asbestos

Most asbestos-containing material (ACM) was removed from the site prior to 1992. In July 1992, an Asbestos Management Plan identified the remaining ACMs in Buildings 28 and 58 as non-friable and in fair to good condition; therefore, abatement is not required by current regulations.

Jefferson Lab complies with the training requirements identified in the Asbestos Hazard Emergency Response Act of 1986 (Title II of TSCA) and the emission control requirements in the National Emission Standards for Hazardous Air Pollutants (NESHAPs) and in 40 CFR 763. EH&S Manual Chapter 6681, *Asbestos Management,* implements the ACM requirements at Jefferson Lab.

During 2002, the tower located atop Building 28 which contained non-friable asbestos, was removed intact by a licensed abatement contractor. The tower was handled and disposed of as a Type II non-friable material. There were no compliance issues in 2002.

2.2.8 FIFRA

The Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) applies to the storage and use of herbicides and pesticides at Jefferson Lab. 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. All pesticides used in 2002 were EPA-registered and applied according to product instructions and Federal, State, and local guidelines. Jefferson Lab's Facilities Management (previously called Plant Engineering) Department subcontracts monthly preventive pest control.

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 addressed included kitchens, laboratories, and other areas throughout the site. No industrial-strength herbicides or pesticides are prepared, mixed, stored, or disposed of on 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. See

Section 5.1.6 for specific use information. There were no FIFRA compliance issues at the Lab in 2002.

2.3 RADIOLOGICAL PROTECTION REQUIREMENTS

This section summarizes the Lab's compliance with radiological EP and public health requirements.

2.3.1 Energy: Title 10 Part 71, Packaging & Transportation of Radioactive Material

Jefferson Lab made its first shipment of radioactive waste in July 2001 and second in July 2002. There have been no compliance issues. (Additional transportation compliance information is provided in Section 2.7.5.)

10 CFR 834 (Draft), Environmental Radiological Protection Program

Programs responsive to offsite radiation protection and other 10 CFR 834 (Draft) requirements have been instituted. Implementation measures have been incorporated into the EH&S Manual chapters discussed in Section 2.3.3 below.

10 CFR 835, Occupational Radiation Protection

The Price-Anderson Amendments Act (PAAA) of 1988, including the 1992 amendment, was enacted to provide broad indemnification coverage for DOE contractors with worker radiological-related activities and requires reporting of non-compliances. DOE PAAA worker radiation protection regulations are codified in 10 CFR 835 and address: radioactive contamination, storage of radioactive materials, and radiological emergency response.

Jefferson Lab made a worker radiation protection report in the PAAA notification system following an August 2001 event, which involved having an unposted high radiation area for a short period in the Test Lab (Building 58). No worker radiation exposure resulted and no actual or potential environmental impacts were associated with this event. Test Lab staff resolved the interlock problem that created the short duration radiation event. The DOE Headquarters Office of Price-Anderson Enforcement approved closure of the event and corrective actions in May 2002 with no further action required. There were no significant 10 CFR 835 compliance issues in 2002.

2.3.2 40 CFR 61 Subpart H

This subpart, the National Emission Standards for Emissions of Radionuclides Other Than Radon from Department of Energy Facilities, sets an annual public dose limit for radionuclide emissions. The Lab complied with these requirements and there were no compliance issues in 2002. Refer to Section 2.4.2.1 for more information.

2.3.3 EH&S Manual Chapters 6310 and 6315

Chapters 6310, *Ionizing Radiation Protection,* and 6315, *Environmental Monitoring of Ionizing Radiation,* describe site programs for offsite radiation protection, storage of radioactive materials, emergency response, and release of materials to uncontrolled areas. Chapter 6315 addresses radiological air emissions, surface water, and the potential for radioactive contamination of other water-containing systems and groundwater. There were no compliance issues in 2002.

2.3.4 DOE Order 5400.5

Applicable sections of DOE Order 5400.5, *Radiation Protection of the Public and the Environment,* are implemented by Jefferson Lab's Radiological Control (RADCON)

Manual. There were no compliance issues in 2002.

2.4 AIR QUALITY AND PROTECTION STANDARDS

The Clean Air Act (CAA) and its 1990 Amendments (CAAA) regulate the air emissions of DOE's processes and facilities. The DEQ, as delegated by the EPA, issues permits for owners and operators of stationary sources that could emit threshold amounts of fugitive dust, odor, or other designated pollutants. At this time Jefferson Lab has no processes that require air permitting.

Applicable regulations are contained in 40 CFR Subchapter C, and in Virginia's 9 VAC 5 series, Air Quality. Standards include Executive Order (EO) 13148 and EH&S Manual Chapter 6720, Air Quality Management.

2.4.1 National Ambient Air Quality Standards (NAAQS)

Under the authority of the CAAA, 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 2002, but continues as a maintenance area for ozone.

Jefferson Lab complies with all Commonwealth ambient air quality requirements. The Lab leases its vehicles through the General Services Administration (GSA) and vehicle maintenance is performed offsite by GSA-approved facilities. There is no gasoline dispensing facility on-site, but there is one diesel fuel tank for forklifts. Subcontractors operating machinery may have temporary diesel fuel storage tanks with secondary containment basins. There were no NAAQS compliance actions in 2002.

2.4.2 NESHAPs

NESHAPs governs air emissions that contain hazardous components, such as radionuclides or asbestos. The EPA administers the radionuclide portion of this program in Virginia. Jefferson Lab began "operations" as defined by NESHAPs in October 1995.

2.4.2.1 Radionuclide Emissions

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. DOE-owned facilities which emit radionuclides to the air are required to sample, monitor, and assess dosage per the NESHAPs requirements in 40 CFR 61 Subpart H and report to the EPA as applicable. (Refer to Section 4.3.1 for discussion of direct radiation, the primary form of radiation generated on-site.)

Jefferson Lab used sampling results and calculations to demonstrate that the Lab remained under the EPA-defined 10 mrem/yr potential effective dose equivalent to any member of the public during 2002. 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.

Currently, no major radiological NESHAP point sources, such as stacks or vents, exist at Jefferson Lab that meet the 40 CFR 61.93(b) threshold monitoring criterion of 1% of the 10 mrem/yr. Consequently, continuous point source monitoring is not required.

Since no EPA-reportable radiological or non-radiological air emissions have occurred in previous years, Jefferson Lab had a reporting exemption under this Subpart. Based on common DOE laboratory practice, even among DOE facilities that are under the reporting threshold, Jefferson Lab voluntarily furnishes an annual report to the EPA. This is discussed further in Section 4.3.1. No notifications for construction or modifications were necessary in 2002.

2.4.2.2 NESHAP Asbestos Removal

While the NESHAP standard does not set a numerical threshold for asbestos fiber emissions, it requires those conducting asbestos-related activities, such as demolition and renovation, to follow approved procedures and to adopt specific work practices to prevent release of asbestos to the air. Regulations require that licensed, trained personnel perform any work. There were no asbestos-related NESHAP issues in 2002. Compliance with other asbestos standards is described in Section 2.2.7.

2.4.3 Non-radiological Emissions

Under the Virginia Regulations for the *Control and Abatement of Air Pollution* (9 VAC 5-10 et seq.), Jefferson Lab is required to notify the DEQ of sources of potential air pollution. Jefferson Lab minimizes releases of polluted air by implementing preventive maintenance and scrubbers. The Lab's air emissions remain below reporting thresholds as there were no new emission sources installed in 2002. The new electropolish cabinet, to begin operation in early 2003, will have a small amount of emissions. Discussions with the DEQ are forthcoming.

Jefferson Lab has seven natural gas-fired boilers and a fin-tube radiator for building heating. Boiler information, including fuel consumption data, is provided to the DEQ. For more information, refer to Section 5.2. No requirements for permits are anticipated. The last DEQ inspection occurred in September 2000, with no concerns identified. There were no air emission violations at Jefferson Lab in 2002.

2.4.4 Stratospheric Ozone-Depleting Substances (ODS)

EO 13148, Greening the Government through Leadership in Environmental Management, reinforced Federal agency commitments to use safe, cost-effective, environmentally preferable alternatives to ODSs. The ODS substances that have been used at Jefferson Lab include refrigerants, degreasers, cleaners, spray can propellants, and fire suppressants. The phase out of these substances will have a moderate impact on the site.

Section 608 of Title VI of the CAAA, *National Recycling and Emission Reduction Program,* prohibits intentional venting of Class I and Class II compounds from air conditioning and cooling units. Jefferson Lab has one recovery machine, a National Reference Products Model MINILU (for R-12, -22, -502, and -134a) on-site. Also, the subcontractor who performed all service, repair, and maintenance on Jefferson Lab refrigeration/air conditioning equipment during 2002, was EPA-certified and effectively captured and recycled these ODS compounds. Four Jefferson Lab Facilities Management employees have received certification training, ensuring that Lab staff understand the EPA requirements.

The Lab has three chlorofluorocarbon (CFC)-based chillers on-site, one uses R-11 and two use R-113. They are effectively maintained by mechanical staff to ensure optimal performance and minimal CFC losses. The two aging R-113 units will be replaced with two state of the

art non-CFC energy-efficient units in 2003. A unit in Building 28, which contained R-22, was replaced in 2002.

There was one 480 pound release of R-22 at a unit located in Hall C - the result of a thermal relief malfunction. There were a number of other small releases in 2002, all recorded by Facilities Management.

The site is phasing out the use of CFCs to the extent possible. R-12, however, is the highly preferred material for use in some physics experiments but there are no State or Federal regulations that address the small amounts of R-12 involved. Halon 1211 is stored in the experimental halls for use as a fire-extinguishing agent of last resort to protect certain types of specialized equipment. The Halon is contained in manually operated fire extinguishers, with hall staff trained in precautions and use.

Section 609 of the CAAA lists the requirements for the *Servicing of Motor Vehicle Air Conditioners*. All vehicle air conditioning units are serviced offsite by shops approved by the GSA.

Jefferson Lab is committed to minimizing and/or eliminating the use of ODSs. The Lab's CFC and Halon Use Policy is included in the EH&S Manual Appendix 6720-T3.

2.5 WATER QUALITY AND PROTECTION

Both groundwater and surface water protection are high priorities at Jefferson Lab. Applicable standards include: the Clean Water Act (CWA); Virginia's State Water Control Law; regulations that include parts of 40 CFR Subchapter D and Virginia's 9 VAC 25 Series, Water Quality; site permits; and, cited EH&S Manual chapters.

Facilities in Virginia that directly discharge to waters of the United States must obtain a Virginia Pollutant Discharge Elimination System (VPDES) permit. The VPDES program is designed to protect surface waters by limiting primarily non-radiological releases of effluents into streams, lakes, and other waters, including wetlands. Regulatory and program concerns relating to construction and industrial activities, including the potential for radiological contamination of groundwater and the quality of cooling water discharges, are discussed in Section 2.5.1 below.

The concrete halls, which house the experimental apparatus that accepts accelerator beam, are partially buried. As the floors of the halls lie below the water table, a built-in drainage system was installed under each of the halls to prevent the structures from floating. Groundwater collects in this drainage system and is pumped to a surface water channel (a process termed dewatering). Compliance with the related permits is described in Sections 2.5.1 and 2.5.2.

Jefferson Lab has a variety of on-site activities that result in water discharges to the sanitary sewer system. Other associated wastewater standards included in the WSS Set are discussed in Section 2.5.2.

There is a significant aggregate quantity of oil present on the site, primarily in transformers and compressors that are in continual use. Consequently, Jefferson Lab has a Spill Prevention, Control, and Countermeasure (SPCC) Plan that is discussed further in Section 2.5.2.3.

2.5.1 VPDES Permits

2.5.1.1 Construction Activity

Jefferson Lab strives to keep pollutants, such as sediments, out of surface waters during earth disturbing activities. No VPDES permits involving construction have been required through 2002. The Lab's Facilities Management

Department oversees the civil construction and ensures that subcontractors adhere to the standards set forth in the *Virginia Erosion and Sediment Control Handbook*. EH&S Manual Chapter 6733, *Storm Water Pollution Prevention,* identifies the site program to address erosion and sediment control during earth-disturbing activities.

2.5.1.2 Industrial Activities

Groundwater Monitoring - VPDES Permit No. VA0089320

This permit covers groundwater resources, including groundwater flowing across the site, and groundwater discharged in the dewatering operation (refer to Section 2.5.2.2). An earlier DEQ permit quantified water quality "baseline" values for certain parameters and set long-term groundwater quality limits. A well monitoring program under this permit enables the comparison of current and "baseline" values. Jefferson Lab verifies that accelerator operations and other activities, such as groundwater dewatering, do not degrade the quality of either on-site or offsite groundwater. Refer to Section 6 and EH&S Manual Chapter 6731, *Groundwater Protection,* for additional information.

Throughout 2002, groundwater sampling to monitor all permit-defined parameters was performed under a subcontract with an accredited laboratory and submitted to the Commonwealth at the end of each quarter. There were no compliance issues involving groundwater in 2002.

Cooling Water Discharges - General Permit No. VAG253002

This Permit, which contains water quality limits, covers the surface discharges from the cooling towers adjacent to the Central Helium Liquifier (Building 8) and a small tower adjacent to the Test Lab (Building 58).

Sampling is performed under a subcontract with an accredited laboratory and is submitted to the Commonwealth at the end of each quarter. During the fourth quarter of 2001, the chlorine level at one sampling site was above the non-detect level, though below the water production utility's maximum chlorine residual levels. No explanation was ever found for the elevated level at the sampling point. During the second quarter of 2002 there was no measurable flow at either sampling point, so no samples could be taken. This was due to the drought conditions occurring throughout Hampton Roads and the rest of the United States.

A May 2, 2002 DEQ inspection found two administrative deficiencies. One was that a large city water leak on the site, an unusual event, had not been appropriately documented at the time of the inspection, and although it was noted on the regular quarterly report, it had not been reported promptly to the DEQ. The second was that failure to follow standard information transfer procedures resulted in the reporting of incorrect information. The response to the May 22, 2002 Notice of Deficiency provided the requested water leak documentation, assurance that the Lab would make prompt notification of an unusual condition, and that standard information transfer procedures would be followed and provided in advance of the DEQ action date.

2.5.2 Other Water Program Standards in the WSS Set

2.5.2.1 Industrial Wastewater

40 CFR 403, General Pretreatment Regulations for Existing and New Sources of Pollution

This regulation contains National Pretreatment Standards for pollutants that pass through or interfere with offsite treatment processes. Jefferson Lab's sanitary sewage is discharged to an offsite publicly owned treatment works operated by the HRSD. The Lab is categorized as a Non-significant Industrial User with no pretreatment requirements. In 2002, as we had two administrative violations, as noted below, no HRSD award was received.

Industrial Wastewater Discharge Permit No. 0117 and the District's Industrial Wastewater Discharge Regulations (IWDR)

Discharges to the HRSD are subject to the Industrial Wastewater Discharge Permit and the IWDR. EH&S Manual Appendix 6730-T1, *Discharges to the Sanitary Sewer System,* presents implementation practices at Jefferson Lab. The pretreatment requirements of 40 CFR 403 are not applicable.

Quarterly pH values are recorded by a subcontractor at prescribed sampling points and provided to the HRSD. HRSD independently performs regular sampling for metals and other water quality indicators at some of the sampling points to validate Jefferson Lab's compliance with permit and regulatory requirements.

Two minor administrative Notices of Violation were recorded in 2002 for the late submittal of routine pH information, due to lack of knowledge that the samples had been taken during that reporting month. This was acknowledged by all parties and new procedures are in place to ensure information is received and provided on a timely basis. All pH data were within our permit limitations. There were no violations that had any effect on the environment in 2002.

Permitted discharges of activated water at one HRSD sampling point continued in 2002. Discharges are controlled manually, after sampling has confirmed that all values are within identified limits. Either Jefferson Lab staff or a subcontractor performs monthly and quarterly radiological analyses from this sampling point and provides the analytical reports for transmittal to the HRSD. All radiological permit and regulatory criteria were met in 2002 and are discussed further in Section 4.3.2.

To illustrate the relative quantity of radioactivity being discharged, the Lab is permitted to discharge no more than 5 Ci (Curies) of tritium and 1 Ci of other gamma-emitting radionuclides in one year. The total radioactivity discharged to the sanitary sewer in 2002 was 1.06 Ci of tritium (*or about 21% of the total allowed*) and 0.00032 Ci for other gamma-emitting radionuclides (*or 0.032% of the total allowed*).

Laboratory staff participated in the March 7, 2002 annual inspection by the HRSD - no compliance issues were identified at that time.

2.5.2.2 Permit to Withdraw Groundwater No. GW0030800

To maintain water table levels consistent with the experimental hall structural design, water table control via pumping will be necessary for the life of the facility. This DEQ Permit places monthly and annual limitations on the amount that can be pumped. It is

important to note that this type of "no usage" withdrawal is unusual. Groundwater is normally withdrawn for irrigation or drinking water.

Quarterly reporting of withdrawal quantities continued in 2002, and all monthly values were within permit requirements. The total quantity of water withdrawn in 2002 was 4.9 million gallons, which was well below the roughly 23 million gallon annual limit. The Lab voluntarily reports its annual water usage to assist the DEQ in determining total regional water usage.

Permit compliance was maintained in 2002. Water quality sampling is performed as noted in Section 2.5.1.2.

2.5.2.3 SPCC Plan – Above Ground Storage Tank Issues

Jefferson Lab has transformers and other operating machinery on-site that use various oils for lubrication, hydraulics, and cooling. The Lab maintains a used oil collection area to assist in managing the resulting used oil. The Lab has an approved SPCC Plan as required by 40 CFR 112, which was reviewed and updated in 2001. The SPCC Plan covers handling, storage, and transportation activities and is implemented by EH&S Manual Chapter 6732, *Oil-Spill Prevention, Control, and Countermeasures*.

There are two oil-storage tanks on-site that meet Federal and State above ground storage tank definitions, but the total quantity stored is under the notification threshold. There were no compliance issues in 2002. See Section 3.5.1 for more information on oil-related items.

2.6 PUBLIC HEALTH

The Safe Drinking Water Act of 1974 (SDWA) ensures that drinking water is safe for public consumption. Compliance is achieved via the EPA's National Primary Drinking Water Regulations that apply to public water supplies. These regulations set maximum contaminant levels on bacteriological, chemical, physical, and radiological contaminants for public water systems.

The Virginia Department of Health regulates drinking water quality and enforces compliance with all Federal and State drinking water-related permits and standards. Jefferson Lab receives its drinking water through three public water supply lines provided by Newport News Waterworks. No monitoring by Jefferson Lab is required.

The SDWA applies to two areas at Jefferson Lab: the Backflow Prevention Program and the surface discharges under the three DEQ permits. Jefferson Lab had no SDWA compliance issues during 2002.

2.6.1 Backflow Prevention

An annual backflow prevention device inspection is required by the City of Newport News and the DEQ on all intra-building main supply connections. This program ensures that untreated industrial wastewater or contaminants from cross-connected chemical processes and building equipment are mechanically prevented from contaminating the drinking water supply. Jefferson Lab engages locally approved plumbing firms to ensure all backflow prevention devices function as designed. Annual inspection reports (the last in June 2002) are sent to the city's Public Utilities Department. No issues have ever been identified.

2.6.2 Surface Water Quality

The site drainage system primarily flows to the Big Bethel Reservoir which served as a drinking water source for local military installations until mid-2002. A small

portion of the site flows to the west to the Deep Creek watershed. The groundwater dewatering discharge is monitored for quality under VPDES Permit No. VA0089320, and the cooling tower effluent is monitored under VPDES General Permit No. VAG253002. These effluents are discharged into surface water channels that lead offsite. Fort Monroe environmental staff are provided annual information on the quantity of groundwater discharged, with information collected under the Permit to Withdraw Groundwater. This notice may be discontinued in 2003 as Big Bethel no longer serves as a drinking water reservoir. There were no compliance issues involving surface water quality in 2002. Refer to Sections 3.2.3 and 4.3.2 for further discussion on the site's monitoring programs.

2.6.3 Drinking Water Quality

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 wells or drinking water standards in 2002. Groundwater is further discussed in Section 4.3.2.

2.7 OTHER ENVIRONMENTAL STANDARDS

2.7.1 Endangered Species Act (ESA)

The ESA protects endangered wildlife, fish, plants, and their ecosystems. The 1987 EA reported that 257 species of terrestrial vertebrate fauna had geographic ranges that encompassed the site, though only a fraction would be expected to actually exist on the property. As well, correspondence with various government agencies indicated that no Federal or State listed threatened or endangered species or other protected species existed on the site at that time. DOE/EA-1384, completed in 2002, evaluated terrestrial and aquatic resources, including threatened and endangered species identified as having the potential to reside on-site. The previous findings, that there were no listed or concern species or potential terrestrial or aquatic habitats, were confirmed.

No ESA compliance issues were identified in 2002.

2.7.2 Migratory Bird Treaty Act (MBTA)

The MBTA of 1918 prohibits any unauthorized taking, possessing, importing, or other listed actions, of any migratory bird or their eggs. The 1987 EA found that 150 avian species have ranges that encompass the Jefferson Lab site, including both permanent and summer residents. Because the site lies within a disturbed industrial and commercial area, only a small fraction of these species are expected to be found on-site. No suitable breeding sites for any of the birds assessed in a 2001 survey were identified. There were no concerns involving the MBTA in 2002.

2.7.3 National Historic Preservation Act (NHPA)

The NHPA of 1966, Section 106, protects archaeological and historical resources. Area surveys in 1987 and major construction since that time have uncovered no trace of historic or archaeological resources. On October 16, 1992, the Commonwealth of Virginia's Department of Historic Resources (VDHR) determined that all Section 106 conditions had been met and no further assessments were required. A follow-up with the VDHR was performed during the preparation of an EA in 2002 with no concerns identified. The EA noted that the VDHR would be notified if anything unusual was encountered during any construction.

2.7.4 Coastal Zone Management Act (CZMA)

Congress declared the CZMA as the policy, among other things, "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 CZMA implemented the Chesapeake Bay Preservation Act (CBPA) under the Chesapeake Bay Preservation Area Designation and Management Regulations (CBPADMR). Although the DOE property does not fall within the purview of this law, and is not in any designated resource protection area, the DOE intends to be consistent with CZMA programs by obtaining all applicable permits and approvals, and by complying with the Act's terms and conditions, as well as with the goals and objectives of the CBPADMR to the maximum extent practicable. Here are the means by which DOE and Jefferson Lab are addressing CZMA requirements.

- Coastal Lands Management: The Jefferson Lab property has not been designated as a Chesapeake Bay Resource Protection Area or a Resource Management Area (RMA) under the CBPA. The average site elevation, roughly 35 feet above MSL, places the Jefferson Lab site outside of the nearest RMA.
- Wetlands Management: The 2001 Wetland Delineation and Threatened and Endangered Species Survey revealed that there are no wetlands, except as identified earlier, on the Jefferson Lab site.
- Non-point Source Pollution Control: All construction projects are managed for erosion and sediment control, following, at a minimum, the Virginia Erosion and Sediment Control Law. Permits are and will be obtained as applicable.
- Stormwater Management: The DOE implements control measures consistent with the performance standards identified in the CBPADMR. Stormwater best management practices (BMPs) will be implemented with new projects in order to minimize runoff concerns.
- Point Source Pollution Control: Jefferson Lab's only actual or potential point source discharges are from construction dewatering, cooling towers for equipment, and accidents. No more than minor impacts would be expected for any new source as the discharges would be no different from those already addressed under existing programs.
- Air Pollution Control: No local or regional impact to NAAQS parameters from construction activity, building use, or from site accelerator operations is expected.

2.7.5 Transportation Standards

Transportation-related hazards at the Lab arise as a consequence of the receipt, packaging, and transportation of: hazardous and radioactive materials and waste; compressed gases; cleanup materials used in response to on-site spills; and, regulated medical wastes. Many of the regulations applicable to transportation also apply to other environmental or public health topics.

Requirements include the Department of Transportation (DOT) regulations identified in 49 CFR Subchapter C, *Hazardous Materials Regulations*; the Jefferson Lab RADCON Manual; EH&S Manual Chapters 6150, *Compressed Gases,* 6310, *Ionizing Radiation Protection,* Appendix 6750-T4, *Packaging EHMs for Transport*; and, identified industry standards. Compliance with some of these standards is addressed below.

49 CFR Regulations

49 CFR 171 through 178 cover hazardous and radioactive materials transportation and contain DOT packaging and transport requirements to protect the environment or public health in case of accidents. The delivery of hazardous or radiological materials to or from the site is contingent upon compliance with appropriate DOT and other requirements. RadCon manages the radiological portion of this program and the HWC manages non-radiological DOT requirements. There were no compliance issues in 2002.

EH&S Manual Chapters 6150, 6310, 6750, and 6850; RADCON Manual; and, Handbook of Compressed Gases

These requirements provide for the safe packaging and transport of hazardous and radioactive materials on Jefferson Lab property. Properly trained staff perform on-site transport of hazardous materials in accordance with the EH&S Manual. The RadCon Group, in accordance with the Jefferson Lab RADCON Manual and other internal procedures, manages radioactive materials. All medical wastes are handled by specially trained staff and managed by Medical Services. There were no compliance issues regarding these transportation standards in 2002.

10 CFR 71, 40 CFR 112; EH&S Manual Appendix 3510-T3 and Chapter 6732; and, the Virginia Emergency Operations Plan

These transportation-related standards are also directly applicable to activities at Jefferson Lab. 40 CFR 112 covers oil and oil-product issues while 10 CFR 71 encompasses packaging and transport of radiological materials. The Virginia Emergency Operations Plan and EH&S Manual Appendix 3510-T3 and Chapter 6732 contain response actions in the event of a transportation emergency. There were no compliance issues regarding these transportation standards in 2002.

2.7.6 Environmental Protection Standards

The Lab EHM program is identified in EH&S Manual Chapter 6750, *Environmentally Harmful Materials,* and its appendices. The objective is to prevent spills or unintentional releases. Protection measures include secondary containment and the location of EHM storage areas away from floor drains. Though there was a leaking fuel line at the diesel tank and one minor coolant spill in 2002, there were no releases that had an impact on the environment or public health.

2.8 EXECUTIVE ORDERS AND POLLUTION PREVENTION (P2)

The following EOs, discussed below, primarily address P2 strategies: EO 13101, Greening the Government through Waste Prevention, Recycling and Federal Acquisition; EO 13123, Greening the Government Through Efficient Energy Management; and, EO 13148, Greening the Government through Leadership in Environmental Management. Information on the applicable Pollution Prevention Act (PPA) of 1990 is included in the discussion under EO 13148. EO 13149, Greening the Government Through Federal Fleet and Transportation Efficiency is not applicable as all vehicles are leased through the GSA. Implementation of EO 13221, Energy Efficient Standby Power Devices, was explored in 2002.

2.8.1 EO 11988 "Floodplain Management"

This EO relates to the occupancy and modification of floodplains. Since Jefferson Lab is not in a 100-year floodplain, the specific EO 11988 requirements do not apply; however, localized flooding during significant rain events, including hurricanes, does occur. Facilities Management coordinates drainage

modifications to ensure appropriate drainage is maintained.

2.8.2 EO 11990 "Protection of Wetlands"

This EO ensures that adverse impacts to wetlands from construction activities are avoided or responsibly mitigated. During original site investigations, the Corps of Engineers determined that the forested temporary wetlands to be disturbed by the construction of Jefferson Lab were not sufficiently permanent to qualify as wetlands, and, therefore, did not require the protection specified by EO 11990.

EO 11990 and 10 CFR 1022, *Compliance with Floodplain/Wetlands Environmental Review Requirements,* contain notification requirements to be considered when proposing new work beyond the scope of the original site EA and FONSI. Evaluation of Jefferson Lab activities involving potential wetlands is accomplished through the NEPA review process. A 2001 survey found no wetlands at any of the sites proposed for construction projects in the then draft DOE/EA-1384. There were no concerns involving wetlands in 2002.

2.8.3 EO 13101 "Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition"

EO 13101 encourages agencies to make more efficient use of natural resources by recycling and practicing waste prevention measures. This is accomplished in part by promoting the procurement of products made with recycled materials, termed Affirmative Procurement (AP), by Federal agencies. 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 on a variety of product classes. The DOE's complex-wide FY 2005 procurement target for purchasing EPA-listed products was 100%. Jefferson Lab's compliance level was 87% for FY 2002, a major improvement from the 58.2% reported in FY 2000 but only a small improvement over the 84% in FY 2001. Refer to Section 3.2.1 for more information on this topic.

2.8.4 EO 13123 "Greening the Government Through Efficient Energy Management"

This initiative, effective November 4, 1999, 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 - a 7% reduction was documented for Jefferson Lab in FY 2000. Facilities Management analyzed buildings and their support systems in 2002 to look for ways to reduce energy consumption in the long term. Information on site-specific goals developed in response to the Secretary of Energy's P2 and E2 initiatives in early 2001 is provided in the next section.

2.8.5 EO 13148 "Greening the Government Through Leadership in Environmental Management"

EO 13148 integrates environmental accountability into Federal agency policies, operations, planning, and management. The primary P2 goal is that pollution should be prevented or reduced at the source. Jefferson Lab complies with Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA) requirements, uses only a few toxic chemicals, and complies with the other requirements of this EO to the extent practicable.

The Lab complies with EPCRA as follows. Section 2.8.5.2 reports how Jefferson Lab uses P2 and other activities to maintain environmental compliance. Specific Lab P2 and E2 initiatives are discussed in Section 3. The results from environmental compliance reviews are provided in Section 2.8.5.3. Section 2.8.5.4 reports on

the Lab's progress in implementing environmentally beneficial landscaping practices. Results from DOE's EMS self-assessment questionnaire are provided in Section 2.8.5.5, and a summary of the Lab's progress in meeting DOE and site-identified goals is presented in Section 2.8.5.6.

As stated, Jefferson Lab is committed to being environmentally accountable through day-to-day decision-making and long-term planning processes, across all missions, activities, and functions.

2.8.5.1 EPCRA Compliance

EPCRA, also known as the Superfund Amendments and Reauthorization Act (SARA) Title III, created a system for planning responses to emergencies involving CERCLA hazardous substances (HSs) and EPCRA extremely hazardous substances (EHSs). EPCRA requires that information regarding the use and storage of these hazardous chemicals be made available to the public. This is done through reports to the EPA (which posts some information on their website) and local response agencies. Jefferson Lab is responsible for planning and responding to chemical emergencies as well as completing applicable reporting requirements as noted in Exhibit 2-1.

The Commonwealth of Virginia Emergency Response Council administers the EPCRA program for the EPA. Local emergency response agencies that serve Jefferson Lab are the Peninsula Local Emergency Planning Committee and the Newport News Fire Department. Transportation-related standards pertaining to emergency planning are discussed in Section 2.7.5.

Besides EO 13148, other EPCRA-related planning and response standards that apply to Jefferson Lab are discussed below. EH&S Manual Appendix 6710-T2, *Emergency Planning and Community Right-to-Know*, and the Virginia Emergency Operations Plan also apply.

Exhibit 2-1
EPCRA Reporting Status

EPCRA Section	Description of Reporting	Status of Applicability
EPCRA Sec. 302 (40 CFR 355)	Planning notification	Yes
EPCRA Sec. 303 (40 CFR 300)	Comprehensive Emergency Response Plans	Not applicable
EPCRA Sec. 304 (40 CFR 355)	EHS Release Notification	No reporting required to date
EPCRA Sec. 311-312 (40 CFR 370)	MSDS/Chemical Inventory	Yes, 312
EPCRA Sec. 313 (40 CFR 372)	TRI Reporting	No reporting required to date

Emergency Planning Standards

40 CFR 300, National Oil and Hazardous Substances Pollution Contingency Plan (NCP)

This regulation primarily addresses DOE's role in the NCP. Jefferson Lab complies with 40 CFR 300 by having emergency response procedures in place to respond to oil and hazardous substance releases, as identified in

EH&S Manual Chapters 3510, *Emergency Management Plan,* and 6732, *Oil-Spill Prevention, Control, and Countermeasures.*

EPCRA Section 302, Emergency Planning and Release Reporting

Under EPCRA Section 302, (refer to 40 CFR 355) Jefferson Lab is required to notify the Commonwealth and local emergency planning and response groups (EPGs) within sixty days of the receipt of an EHS that exceeds its Threshold Planning Quantity (TPQ). Jefferson Lab's EPCRA Section 302 notifications to date include hydrofluoric acid, nitric acid, and bromine. Due to increased SNS activity, sulfuric acid was identified as exceeding its TPQ and its presence was reported to the EPGs in early 2003.

Jefferson Lab is also required to notify the Commonwealth and local EPGs of accidental offsite releases of any HS listed under CERCLA or any EHS listed under EPCRA. The release levels that trigger the EPCRA Section 304 notification requirements are the reportable quantity values listed in the regulations for each substance. Jefferson Lab has had no releases that meet identified reporting criteria to date. (For discussion about the permitted release of activated water to the sanitary sewer system, refer to Section 2.5.2.)

EPCRA Sections 311 and 312, Hazardous Chemical Inventories

Under EPCRA Sections 311 and 312, Material Safety Data Sheets (MSDSs) (refer to 40 CFR 370), or a list of those chemicals, must be submitted to EPGs for each hazardous chemical that exceeds the TPQ identified in the regulations. Inventory information is obtained through an annual sitewide chemical inventory coordinated by the Jefferson Lab Industrial Hygienist. Jefferson Lab's submittal of the annual Tier II Report, a hazardous chemical inventory form, to the EPGs satisfies this reporting requirement. Refer to Exhibit 2-2 for the list of chemicals reported for 2002.

Exhibit 2-2
Chemicals Reported for 2002

Compound	Hazard Class				
	Fire	Sudden Release of Pressure	Acute Health Hazard	Reactive	Chronic Health Hazard
Argon (liquid)		√	√		
Helium (liquid		√	√		
Nitrogen (liquid)		√	√		
Nitric Acid			√	√	
Hydrofluoric Acid			√	√	
Sulfuric Acid			√	√	
Hydraulic Oil (Various including vacuum oil)	√				√
Lead (Sheeting)					√
Bromine			√	√	

Helium Container Near Building 98

In addition, upon request, the Lab's Emergency Manager provides MSDSs or other materials to the local Fire Chief for their records.

Chemical Inventory

EPCRA Section 313, Toxic Release Reporting

This section (refer to 40 CFR 372) requires the submission of information to the EPA relating to the release of toxic chemicals, including an annual toxic chemical release report, the Toxic Release Inventory (TRI), by any facility that manufactures, imports, processes, or otherwise uses more than a threshold amount of any of approximately 360 EPA-identified toxic chemicals. Jefferson Lab does have "otherwise use" activities and reviews its chemical usage annually. For CY 2002, it was verified that lead, the only material that could have triggered reporting, was not "otherwise used" in a quantity exceeding its low 100 pound threshold. It was also noted that no other listed toxic chemicals were "otherwise used" in quantities exceeding the 10,000 pound threshold. Thus, no TRI reporting was required.

Emergency Response Standards

Two environmental emergency response-related hazards exist at Jefferson Lab. One hazard involves releases resulting from the storage or transport of EHMs. Emergency response standards that apply to EHMs are CERCLA, the portions of 40 CFR noted above, and the Virginia Emergency Operations Plan. The second hazard is a radiological release, as addressed in 10 CFR 835.

There was one minor coolant spill in a parking lot and a small leak at the line at the diesel fuel tank in 2002. Both spills were mitigated promptly, and did not impact the environment. There were no releases subject to CERCLA or other emergency response regulations in 2002.

2.8.5.2 P2 and Other Activities to Support Compliance

ISM

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 part of routine business at Jefferson Lab. In 2002 it was noted that the format of the ISM System Plan did not support broadening it to better incorporate Environmental Management System (EMS) core elements and principles, as identified under EO 13148. A few related improvements were made. Refer to Section 3.1 for more information.

General P2 Activities

Jefferson Lab complies with EO 13148 and the PPA P2 goals by minimizing use (source reduction), reusing to the maximum extent, recycling to the extent practical, and, as a last resort, disposing of any wastes in the most environmentally safe manner. The Lab continues to establish P2 goals to make reductions in standard sanitary, hazardous waste, and LLW generation, and to improve recycling performance. A contractual Performance Measure addresses this and is noted in Section 2.9.2. Specific Lab P2 and E2 initiatives are discussed in Sections 3.2 and 3.5. There were no P2 compliance concerns in 2002.

2.8.5.3 Results of Environmental Compliance Reviews

There was one internal environmental compliance review involving ISM in 2002 (refer to Section 3.1). The results of inspections from regulators are provided in Section 3.3. The minor compliance-based issues identified during one inspection were either promptly addressed or resolved as possible. No issues resulted in any impact on the environment.

2.8.5.4 Progress on Implementing Environmentally and Economically Beneficial Landscaping Practices

Jefferson Lab uses qualified subcontractors to take care of the facility grounds. One beneficial practice is that grass cover is maintained in open areas to prevent runoff. Fertilizers and herbicides are applied locally on an as needed basis and not when rain is imminent to prevent surface water contamination.

A new subcontract in FY 2002 required limiting the watering of beds to weekly and encouraged the use of environmentally preferable products such as compost, mulch, and items with recycled content. Governor Warner's ban on watering in 2002 due to the region-wide drought impacted landscape watering; however, over-seeding at CEBAF Center and the ARC buildings did proceed, along with the subcontractor taking advantage of rain events and heavy morning dew.

2.8.5.5 EMS Self-Assessment Questionnaire

A self-assessment of Jefferson Lab's EMS status was provided to the DOE on September 21, 2001. Jefferson Lab does not have a separate EMS but implements the EMS principles through the Lab's ISM System Plan. Some of the items that make up an EMS, such as significant environmental requirements, goals, and timeframes are spelled out within the DOE/SURA operating contract and the Jefferson Lab EH&S Manual.

The Lab's EH&S programs, especially those in the EH&S Manual, will be enhanced to incorporate EMS principles and core elements. Other site documents will be reviewed and improved to better incorporate EMS principles and practices.

2.8.5.6 Secretarial P2 and E2 Goals

Jefferson Lab is committed to meeting ten targets that address seven out of the sixteen DOE-identified P2 and E2 goals. Additional funding will be needed to meet some targets. The Lab's progress status is depicted in Exhibit 2-3.

Of the ten applicable targets, nine are being measured, and one (Item 13) will be evaluated in the future. Of the nine measured, four met objectives and five did not. Of those five, three (Items 6, 7,

and 10) are progressing towards meeting the Lab goals.

2.9 OTHER OBLIGATIONS IDENTIFIED IN THE CONTRACT

Jefferson Lab has other environmental protection and public health-related obligations. These obligations are incorporated into site programs, including subcontractual agreements, exclusive of direct legal requirements, e.g., Jefferson Lab's participation in DOE's NEPA process and implementing EO 13123.

2.9.1 NEPA

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 assists the DOE in implementing the NEPA process on the site, including helping to prepare the appropriate NEPA documents.

An EA for the proposed Newport News site for Jefferson Lab (formerly CEBAF) was completed in 1987, prior to the construction of the facility, and resulted in a FONSI. In 1997, an operations-related EA for the CEBAF and FEL was completed, also resulting in a FONSI. A new EA covering the construction of five new structures to support Lab operations resulted in a FONSI in CY 2002. Refer to Section 3.4 for more NEPA information. Jefferson Lab will respond to any requirements identified by the DOE with respect to NEPA compliance issues, of which there were none in 2002.

2.9.2 DOE Guidance

The current performance-based DOE/SURA Contract identifies DOE EP and public health requirements in either a Performance Measure or in the Environment, Safety, and Health (ES&H) Responsibilities portion in Appendix E of the Contract.

Since incorporation of the WSS Set into the Contract, the only DOE environmental documents specifically identified in either the WSS Set or the Contract are DOE Orders 435.1, 5400.1, and 5400.5; DOE Notice 441.1; and, DOE Standard 1023-95.

Exhibit 2-3
Targets and Progress Projections

DOE Goal	Action	DOE Goal FY 05 / FY 10	Lab 2005 Target	End FY 2002 Lab Status
	Goal 1: based on FY 93 baseline			
1	**Routine Hazardous Waste Generated**	90%	46% to 5.0 MT	Not Met (5.06 MT)
1	**LLW Generated**	80%	63% to 3.5 M^3	Not Met (10.9 M^3)
1	**Low Level Mixed Radioactive Generated**	80%	0	Met (None to date)
2	**TRI Chemical Releases**	90%	Remain under reporting threshold	Met for CY 2002
3	**Sanitary Waste from Routine Operations Generated**	75%/ 80%	Not to exceed 1995 baseline (274 MT)	Not Met (307 MT)
4*	**Routine and Non-routine Sanitary Wastes Recycled (%recycled vs. disposed)**	45%/ 50%	20% of by FY05 25% by FY10	Met (40% includes all recycled solids and liquids)
5	Reduce wastes from cleanup	10% annually	N/A	N/A
6	**Increase purchases of EPA designated items w/recycled content**	100%	95%	Not Met, but Progress (87% from 58.2% in FY00)
7	**Reduce energy consumption in buildings and laboratories**	40%/45% bldgs. 20%/30% labs	15% by FY05 using a 1992 baseline	Not Met (No values available for FY02)
8	Purchase 'clean' electricity	Increase purchases	None	-
9	Retrofit chillers made before 1984 using class I refrigerants	Complete by FY 05	N/A	N/A
10	**Eliminate use of Class I ODSs to extent practicable**	Complete by FY 10	Chiller replacement by FY05, others under review.	Not Met (1 unit replaced in FY02)
11	Reduce greenhouse gas emissions	25%/30%	None	-
12	Reduce vehicle fleet annual petroleum use	20% (vs. FY99)	None	-
13	Acquire 75% of light duty vehicles as alternative fuel vehicles	Annually	Evaluate options with GSA	(future)
14	Increase usage rate of alternate fuel vehicles	80%/90%	None	-

NOTES: * Note that this uses a different formula than use for Performance Measure 5.3, which uses the ratio of [recycled / (recycled + disposed)]
Bold indicates items where goals have been defined.

MT: metric ton (2204 pounds)
M^3: cubic meters

There are other orders in the Contract that do not apply to EH&S. A process for reviewing new or revised DOE Orders for applicability at Jefferson Lab has been implemented since 1999. In 2002, Jefferson Lab continued to comply with applicable DOE documents, guidance, and related contractual commitments.

2.9.3 Performance Measures

Performance Measures are incorporated into the DOE/SURA Contract. Four of

Exhibit 2-4
Contract Performance Measure Results

I. D.	Performance Measure Description	FY 2002 Score Received by the Lab*
5.0b	Minimizing Environmental Exceedances	100%
5.3	Fraction of Solid Waste Recycled	100%
5.4a	Fraction of Radioactive Waste Produced for Useful Purposes	95%
5.4b	Ratio of Hazardous Waste Generated compared with the quantity that could have been generated if Waste Minimization was not practiced	95%

*The calculations used for scoring are in the contract. (100% being optimal)

them reflect EP issues. Exhibit 2-4 highlights relevant FY 2002 scores.

2.9.4 AL&R LIST

Administrative environmental protection and public health requirements are on the AL&R List. A violation would not directly impact the environment; however, it could result in an administrative action. AL&R standards are generally incorporated into site programs. There were no known non-compliance issues in 2002.

2.10 OTHER ENVIRONMENTAL ISSUES AND ACTIONS OF INTEREST

Listed here are some issues or actions identified in 2002 that are worth noting.

- Due to the increased need for cryomodules for CEBAF, the FEL, and SNS, more cryomodule fabrication resulted in increased hazardous waste generation.
- To help meet the Lab's waste minimization goal, a collaborative effort among Lab staff resulted in adding 11 new local recycling centers at some key buildings for office-related recyclables. As of the end of 2002, there were 16 recycling centers. For more information refer to Section 3.5.2.
- EH&S Reporting staff developed a new web page, *EarthWise*, as well as the *Earth Watcher* Newsletter, to inform and encourage staff about "earth-friendly" activities at work and at home. Activities specific to the Jefferson Lab community are included on the web page.
- Efforts by the Procurement Department improved the Lab's performance in implementing AP. A new web page specific to this program was introduced. Refer to Sections 2.8.3 and 3.2.1 for more information.

2.11 RELEASE REPORTING

There are no releases that require continuous release reporting. There were two small EHM spills that are noted in Section 3.5.1. There were no reportable spills or releases of any materials in 2002.

2.12 PERMIT SUMMARY

Information about permits held in 2002 is presented in Exhibit 2-5.

SECTION 3 ENVIRONMENTAL PROTECTION PROGRAM

Jefferson Lab's mission includes protection of the environment and public health. There are many facets to the site EP program, including an EMS strategy, which is integrated into facility operations under Jefferson Lab's ISM

System Plan. The site's EP program provides staff the requirements and guidance for

Exhibit 2-5
Jefferson Lab Permits

SER Section	Permit Number	Description	Permit Dates
3.6.1.2	VA0089320	VPDES Permit - Specifies allowable groundwater and surface water quality on-site during accelerator operations. Assures groundwater unaffected at and beyond site boundary.	7/16/1996 through 7/16/2006
3.6.1.2	VAG253002 (renewal package was submitted)	VPDES Permit - General Permit for Cooling Water Discharges - Authorizes cooling water discharges within identified discharge limitations.	9/1/1999 through 3/1/2003
3.6.2.1	HRSD No. 0117	Industrial Wastewater Discharge Permit - Limits wastes to be discharged to sewerage.	10/1/1987 through 3/1/2007
3.6.2.2	GW0030800	Permit to Withdraw Groundwater - Authorizes maximum quantities of water to be withdrawn by dewatering of area under experimental halls	11/1/1994 through 10/30/2004
2.2.2	4727-45-01	South Carolina Radioactive Waste Transport Permit - authorization to transport LLW within the State	Effective through 12/31/2003

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 2002 events and activities.

3.1 ENVIRONMENTAL MANAGEMENT SYSTEM

Jefferson Lab's EMS is 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 part of routine business at Jefferson Lab.

The Lab's 2001 commitment to review and improve the ISM System Plan, as well as the Lab's Quality Assurance Program Manual, to specifically incorporate EMS principles and core elements in FY 2002, was accomplished. The specific DOE/Jefferson Lab formats for these two documents do not provide a place to include specific EMS items. However, the Plan was modified to include references to the site EMS, and it was determined that the actual site commitment to EMS will be further incorporated into the Jefferson Lab EH&S Manual as it is updated.

Some specific items that make up an EMS, such as performance measures, are included in the DOE/SURA operating contract. Other items, such as the identification of environmental impacts, are documented in the EH&S Manual. EMS is applied on-site as described here.

Site EP Policy

Jefferson Lab has both a mission statement and an EH&S policy. The mission statement 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.

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 proper time for review and authorization as applicable. As well, some subcontracts are updated to require and encourage subcontractors to take EP into account.

Environmental Objectives and Targets

The Lab operates within contractual operating limits that include staying within permit criteria. Exhibit 2-3 lists the targets for many of the items identified in the Secretary of Energy's P2 and E2 Goals. Exhibit 2-4 shows the four EP-related contract performance measures.

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. The Manual is being augmented to include EMS items as EP chapters are revised. No separate EMS training has been provided.

Identification of Environmental Aspects and Impacts

No EMS-specific analysis has been performed; however, previous NEPA and other reviews have identified that the primary environmental aspects at Jefferson Lab are radiological implications to air, water, the public, and to local biota. As well, intensive use of resources, including electricity and water, would be considered aspects.

Performance Measurement

The Lab semi-annually reviews performance measure results for various topical areas that include EH&S. Specific energy efficiency performance measures were under consideration during FY 2002.

Corrective Action and Self-Assessment Procedures

The ISM System Plan is reviewed annually and updated (most recently in 2002) as necessary and shared with the DOE Site Office. Implementation of the ISM System was evaluated in 2002. This review identified a few areas where ISM program improvements should be made. The Lab Director has committed to making these changes. An implementation schedule has been generated and is being coordinated by the Office of Assessment.

Management Review Process

The Lab's 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.

3.2 MAJOR ENVIRONMENTAL PROGRAMS

3.2.1 Product and Service Life Cycles

A variety of products and materials are obtained and used on-site. When the materials have served their purpose, they are declared 'no longer needed' and disposal is managed appropriately. As there are EH&S risks involved, Jefferson Lab has programs and procedures in place which include EP and sustainability considerations to: guide product and service subcontractor procurement; minimize resource use in all stages of an activity; ensure materials are used safely and appropriately; and, manage their disposition either as 'for reuse', 'for recycling', or 'for waste'.

Purchasing and Planning

Environmentally Preferable Purchasing (EPP)

The Lab has committed to integrating EP and sustainability considerations into every aspect of the acquisition of products and services. This commitment is based on EPA requirements and DOE implementation goals. Jefferson Lab continues to make progress at meeting these requirements. To accomplish this, the Lab:

- uses an EPP focal point to train staff as well as to track and report the quantities of EPA-identified recycled content products purchased in comparison to those not having recycled content;
- has set a goal for improving the performance of procuring EPA-identified items;
- has identified the need to set goals to minimize (and eventually eliminate) all purchases of items containing ODSs and to purchase energy and water efficient products;
- keeps staff informed about important factors, such as opportunities to improve our purchase of EPA-identified materials, and in selecting non-toxic or bio-based materials rather than a product that could have a greater environmental impact;
- purchases and continues to use energy efficient products, such as certain computers, where possible. (During equipment repair and replacement, authorized repair parts are used and when equipment is beyond repair and must be replaced, an effort is made to utilize ENERGY STAR® replacements.);
- uses an office product supplier which highlights recycled content-containing products in both its paper and on-line catalogs; and,
- obtains lead shielding through the DOE Material Exchange network.

Two questions that staff and users are encouraged to ask themselves prior to making a purchase are: "Is this product safest for the environment and will it allow me to continue to do my job effectively?" and "Is this product composed of recycled post-consumer material?"

There was a small improvement over last year's performance at buying recycled-content materials, as reported in Section 2.8.3 and more opportunities to improve this level are being investigated. In 2002, for standard black/white printing on white or colored paper, where paper and services are provided by the central Copy Center, 30% recycled-content paper was utilized to the maximum extent possible. The exception is limited to the high-speed color copier that does not function properly when using recycled-content paper. The contract officer and the Copy Center will continue to search for recycled-content paper that will not inhibit operation of this copier.

Jefferson Lab's Procurement Group won an award at the 2002 DOE Contractor "Best Practices Competition - Procurement". The copy services subcontract combines an innovative incentive system with a state-of-the-art network infrastructure to promote both excellence and efficiency, which improves productivity and reduces cost.

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 to the extent possible. Subcontractors and staff involved with the design of new buildings or with changing and updating existing buildings or utility systems considered and implemented energy and water conserving strategies in 2002.

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 following projects or initiatives began and/or were completed in 2002.

- Energy Management Policy - a draft policy is being developed by Facilities Management.
- VARC - a capital improvement and energy conservation project with the complete refurbishment of the building's heating, ventilating, and air-conditioning system that included new boilers, air handlers, and an air-cooled chiller (instead of a water system), and a new control system.
- Test Lab - metering for process equipment was added and a new chilled water system was being designed to provide Test Lab and accelerator site cooling that will result in the replacement of two ODS-containing chillers.
- Accelerator Site - a new cooling tower with variable frequency drive motors was installed to facilitate cooling in the experimental halls.
- Various locations - lighting systems were upgraded in numerous buildings. Existing ballasts and lamps (T12) were changed to electronic, high frequency ballasts using T8 lamps. Light switches in many offices and conference rooms now have automatic occupancy sensor switches.
- Besides continuing to monitor energy activities for many site buildings, Facilities Management added more meters to buildings to better monitor energy usage.
- One Facilities Management manager received training in using Life Cycle analysis for all new buildings.
- One new construction subcontract required that the subcontractor provide an EP Plan in addition to the required Safety Plan. This first EP Plan, that included erosion and sediment control commitments, was approved in January 2003 and demonstrated the subcontractor's commitment to EP.

Water Conservation
With an increased emphasis on water conservation, especially due to the 2002 drought, water-using processes and site maintenance activities are getting extra attention. New projects that need water are being reviewed to minimize water use. Existing water-using activities are, or will be, evaluated to reduce water usage as much as possible. (Refer to the next section.)

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. Proper chemical handling and storage procedures are presented in *Chapter 6610* of the EH&S Manual. Lab staff and subcontractors have taken opportunities to

minimize energy and water use, such as shutting off lights when not in the room, and the Lab provides prompt response to address reported water leaks.

Available techniques are used to minimize water use, including a regular maintenance program. 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. The following actions to minimize water use were taken in 2002:

- Facilities Management modified one furnace that cooled with only one pass of water and created a closed loop cooling tower circuit to make it more water efficient.
- The wastewater from a new low conductivity water de-oxygenation system is now being captured and used as makeup cooling water.
- Water conservation has been built into the grounds maintenance subcontracts. Subcontractors are limited to irrigation at a rate of 1 inch per week, including rain. Water usage is monitored and usage is counted in the subcontractors' overall performance rating.

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 in some cases 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.

Jefferson Lab staff have a range of options for disposition of materials to include recycling, neutralizing, scrapping, providing spent chemicals or equipment to co-workers on-site or to other DOE facilities, 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. In accordance with these intentions, the Lab:

- Provided information to staff regarding reuse opportunities through the DOE Materials Exchange website;
- Further expanded its recycling efforts in 2002 by establishing 11 additional "local recycling centers". (Refer to Section 3.5.2 for more information on the Lab's recycling program); and,
- Initiated a program to standardize waste and recycling containers to facilitate proper disposal.

3.2.2 Waste Minimization and Pollution Prevention (WMin/P2)

The PPA established P2 as a national objective and the most important component of the environmental management hierarchy. Waste minimization, in combination with other P2 strategies, is recognized as the most cost-effective form of EP.

The purpose of Jefferson Lab's WMin/P2 Awareness Plan is to foster the philosophy that prevention is superior to either paying for special disposal or for remediation, and thus focuses on minimizing waste generation.

WMin/P2 reduces the quantity of EHMs and other pollutants or contaminants entering a waste stream or the environment prior to recycling or treatment. Various wastes, including air emissions and water discharges, can be significantly reduced or sometimes eliminated entirely by

reviewing processes during the planning phase or prior to altering current operations. These practices benefit the environment, protect employees and public health, and reduce site waste disposal costs. Specific objectives of this program include:

- making employees aware of WMin/P2 program requirements, goals, accomplishments, and general environmental activities and hazards at the site;
- informing employees, users, and visitors of specific environmental issues such as opportunities for recycling; and,
- encouraging staff and recognizing efforts to enhance the environment through WMin/P2.

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 business.

Site WMin/P2 highlights and significant accomplishments that are instrumental in meeting site waste reduction performance goals include:

- Eliminating cyanide use in electroplating operations.
- Expanding recycling efforts. (See Section 3.5.2)

The site performance status, as highlighted in Exhibit 2-3, shows progress in meeting site objectives based on the following DOE goals.

- Total number of DOE Goals: 16
- Total number of Applicable Goals: 10
- Goals Met in FY02: 4
- Goals currently 'Not Applicable' that are to be evaluated at a later date: 1

To reemphasize that AP minimizes disposed wastes, employees have recently been re-instructed that they may not purchase EPA-listed items, such as binders and traffic cones, if they do not contain recycled content. Guidance regarding available alternatives is obtainable through Business Services and EH&S Reporting staff.

Guidance stating that no items or equipment containing an ODS can be purchased without prior approval has also been provided. Staff were further re-informed in 2002 that all reclaimed ODS materials had to be provided to the DOE or DOD ODS banks.

3.2.3 Overview of the 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 Environmental Monitoring Program establishes guidelines for examining chemical, oil, and radioactive effluents generated from 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 effluents remain within the allowable range. Jefferson Lab also assesses the effects of Lab activities by measuring, monitoring, and calculating the effects of

past, current, and future Lab operations on the environment and public health.

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, the major focus of the site's program. The external exposure potential is from direct penetrating (10 CFR 834 (draft) and 10 CFR 835) and airborne radiation (40 CFR 61, Subpart H). 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 where applicable 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 (formerly the Office of Technical Performance).

Environmental monitoring data collected in 2002 included information about:

- operational measurements at site boundary monitor locations;
- groundwater quality for long-term facility operations;
- effluents to the sanitary sewer;
- groundwater dewatering discharges; and,
- other effluent streams, such as cooling water at the cooling towers.

On-site environmental surveillance continued in 2002. Environmental baseline data were obtained prior to the start of routine accelerator operations. Baseline data are compared with data obtained during ongoing facility operations to ensure that Lab operations are not adversely affecting public health or the environment.

Throughout 2002, the RadCon Group reviewed radiological and non-radiological environmental monitoring information stemming from accelerator operations for conformity with applicable standards.

Refer to Section 4 for the environmental radiological program discussion and to Section 5 for environmental non-radiological program information.

3.2.4 Site Permits

Environmental permits held by the DOE Site Office are listed in Exhibit 2-5, and compliance with each is discussed in Section 2.5 of this report. All permits citing limits and conditions involving water are discussed further in Sections 4.3 and 5.1.

There were two permit violations in 2002 as a result of the late submittal of pH information to HRSD in February (refer to Section 2.5.2.1). This was a minor administrative issue and had no effect on the environment.

3.3 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 2002, the Overlay Performance Evaluation Report yielded a rating of "Outstanding" in the EH&S category.

ISM (and EMS)

The ISM System Plan was reviewed and updated in 2002 and the Lab's ISM System program was assessed in 2002. Refer to Sections 2.8.5.2 and 3.1 for more information.

External Reviews

A Radiological Control Program Peer Review was conducted in August 2002 at Jefferson Lab, which is categorized as a low-hazard, non-nuclear accelerator facility. The review covered the many programmatic areas assigned to the RadCon Group. The current site program was noted as being carried out enthusiastically and in support of the Lab's mission. If radiological aspects, such as site boundary and waste management concerns, increase over time, additional support could be needed. The new radioactive material management program was noted as improved over the earlier system. The site's radiological control program was deemed to be "Outstanding" by the reviewers.

External Inspections

There were three external environmental inspections during 2002.

- HRSD staff performed the annual Jefferson Lab site inspection on March 7th. 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 2001 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.
- In May, the DEQ performed an inspection which resulted in two administrative deficiencies. First, a large city water leak on the site was not documented appropriately or reported promptly to the DEQ. The second resulted from a failure to follow standard information transfer procedures, which led to reporting incorrect information. Jefferson Lab assured the DEQ that prompt notifications and information transfer procedures would be followed with future events. (Refer to section 2.5.1.2).

- At the Lab's request, a DEQ hazardous waste representative inspected the site as well as the Lab's Hazardous Waste Management Program on September 5th. The inspector evaluated the Lab's program to determine whether any program changes would be necessary in the event that Jefferson Lab should occasionally exceed SQG generation limits as a result of a planned new chemical use activity beginning in early 2003. The DEQ-identified program changes included ensuring that the duties and requirements of all hazardous waste handlers are included in their job descriptions and that prompt notification be made to DEQ in the event of an SQG limit exceedance. If and when an exceedance does occur, the requirements for Large Quantity Generators, including shipping timeframes and biennial reporting, become applicable. The inspector visited the ARC and buildings 19 (Forestry), 33 (Chemical Storage), and 58 (Test Lab) - no concerns were identified. Information about the waste chlorine gas that had to be rerouted was provided to the inspector. See Section 3.5.1.

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 (IAs) of four or more of the Lab's organizational units each year, focusing on EH&S. Deficiencies identified through the IAs are tracked by SA/QA until the corrective actions are completed. Three recommendations stemming from an IA in 2001 and resolved in 2002 addressed the Lab's AP program. To ensure AP program requirements are properly applied in the acquisition and procurement processes, the Lab's EH&S Manual is being amended to include necessary AP program information.

3.4 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 2002 are as follows:

- DOE/EA-1384 and its associated FONSI documented DOE's EP commitments involving five future construction projects.
- Twelve Categorical Exclusion's (CXs) that pertain to regular activities, including the "Management of Radioactive Waste at TJNAF", were renewed.
- One project CX that covers the chiller upgrade project at the Test Lab, which involves the replacement of two old CFC-containing chillers, and other energy improvement activities was approved.
- The internal approval process for very small-scale construction projects and other minor activities that are covered under site EAs and CXs continued.
- The collection of background information to support a new EA was started in 2002. The new EA will address planned upgrades to the CEBAF and FEL accelerators and the expansion of the site's Central Helium Liquefier complex.

3.5 SUMMARY OF OTHER SIGNIFICANT SITE ENVIRONMENTAL ACTIVITIES

3.5.1 Issues and Actions

Safeguards and Security

The Lab issued an Integrated Security Management program in 2002. This program clearly identifies Jefferson Lab's role in meeting DOE and other Federal and local security-related requirements. The on-site presence of some EHS chemicals are addressed under this program.

Drought in the Mid-Atlantic United States

Low levels of snow cover and rainfall in 2002 led to a serious drought that affected the entire region. Jefferson Lab's grounds subcontractor complied with the mandated watering restrictions and implemented a plan to ensure sprinkling was not performed if there had been a recent rainfall.

Chlorine Gas Disposal

A hazardous waste shipment of chlorine gas containers, shipped on August 13th, had to be rerouted while in transit to a disposal facility in Texas after the New York facility burned down. Documentation concerning this event was provided to the DEQ.

Emergency Management Exercise

The year's exercise consisted of a table-top exercise that involved an employee who was injured within the fenced accelerator site. There were no environmental concerns; however, improvements to the emergency notification procedures were identified as a result of the exercise.

EHM Spills

There were two minor petroleum product releases involving a radiator coolant spill and a leaky diesel tank line. The instances were minor and quickly corrected by line management and EH&S staff.

SPCC Plan

New regulatory requirements became effective. The Lab began considering the implications involving the new annual briefing requirements for all 'oil workers'.

Other items of note include:

- The Lab began handling crushed fluorescent lamps and small used batteries as universal waste.
- The Lab's Business Services Department received a DOE Closing the Circle Award for implementing the idea of using a central copy center to manage many site photocopy needs.
- The first edition of the Lab's *Earth Watcher* newsletter was published in Winter 2002.
- The new *EarthWise* website was updated monthly and includes at least one Jefferson Lab specific article. www.jlab.org/intralab/earthwise/index.html
- A site storm water management study was completed in 2002. It is being used to highlight areas that need prompt attention and will also serve as a long-range planning tool.

3.5.2 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 during CY2001, office product recycling centers were established in two high-use buildings. During 2002, 11 additional recycling centers were set-up throughout the Lab, each coordinated by local volunteers. See Exhibit 3-1 for a list of locations and items collected. Eight of the centers collect all products noted.

Exhibit 3-1
Recycling Center Locations and Items Collected in 2002

ARC rooms **225**, **440**, **526**, & 706	Aluminum cans
Buildings 52, 52B, 85, 87, **89**	Small batteries
CEBAF Center	Cardboard
FEL	CD's/Diskettes
Test Lab	Copier/Fax/Inkjet/Laser Cartridges
Trailer City (3)	Greeting Cards
VARC	Paper Wastes
	Styrofoam Peanuts
	Telephone books
	Transparencies
	Tyvek Envelopes
	Plastic Bottles

The full service centers, noted in bold in Exhibit 3-1, have containers for twelve recyclable product types. Small batteries were added to the recycling program in 2002. The small sums received from recycling the toner cartridges and aluminum cans are 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.

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

The quantities of materials recycled in FY2002, as reported to the DOE, are shown in Exhibit 3-2.

3.5.3 Hazardous and Special Wastestreams

Variations 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.

In the category of special wastestreams, in FY02 Jefferson Lab generated about 5.1 tons (5100 kg) of hazardous waste and about 3.4 tons (11 cubic meters) of LLW. Except for the small amount of asbestos discussed in Section 2.2.7, no TSCA or mixed wastes (a combination of hazardous and radioactive) were generated during FY 2002.

The radioactive waste generated was less than CY 2001, but was still a large amount. This was primarily due to designating as waste some radioactive materials that were being stored in special holding areas to allow for decay and possible reuse. This material was designated waste and is being stored until it is prepared for shipment at a later date.

Exhibit 3-2
Quantities of Items Recycled or Reused in FY 2002

Description	Quantity (tons (kg))
Paper Products (office paper & cardboard)#	39.9 (36,233)
Aluminum Cans#	0.64 (580)
Plastic Bottles#	0.033 (30)
Scrap Metal (reclaimed through GSA)	85.2 (77,238)
Used Oil & Coolant	7.3 (6,622)
Large, car-type batteries	0.16 (145)
Fluorescent Lamps	0.5 (454)
Toner Cartridges#	0.53 (480)
Transparencies#	0.038 (34.7)
Computer Disks#	0.0068 (6.2)
Circuit Boards and Electronics	0.011 (10)
Small batteries#	0.2 (181)
New/Used All Occasion Cards*	0.042 (38)

*DOE initiative - provide to St. Jude's Ranch for Children to reuse.
#Items collected in office, kitchen, and recycling centers.

Recycling Centers Located at CEBAF Center (Building 12) and VARC (Building 28)

SECTION 4
ENVIRONMENTAL RADIOLOGICAL PROGRAM

Radioactive materials are used in many research activities at Jefferson Lab. The radiological impact of these materials and potential effective dose equivalents to members of the public from various pathways, such as inhalation, ingestion, and skin absorption, were evaluated to show compliance with EPA and DOE regulatory limits. During 2002, very low levels of radioactive gaseous and particulate emissions were released from facility ventilation exhausts.

Jefferson Lab operations had minimal radiological dose impact to the public and the environment. The ambient external dose measured was on the order of 1% of natural background levels or 3 mrem (30 μSv (microSieverts)). The effective dose equivalent to the maximally exposed individual from NESHAP air emissions for 2002 was calculated to be 0.007 mrem (0.07 μSv), as reported to the EPA. This dose is insignificant when compared to the EPA regulatory public air-dose limit of 10 mrem/yr (100 μSv/yr). The annual effective dose equivalent to an individual consuming contaminated water was so small it could not be measured. The maximum dose impact to the individual from both the air and direct pathways combined was 3 mrem (30 μSv). This is 3% of the DOE regulatory dose limit for members of the public from all pathways, which is 100 mrem (1000 μSv).

In 2002, the dose to terrestrial biota was also evaluated. No radiological doses, either to terrestrial animals or plants, above natural background were recorded from Jefferson Lab operations. There are no aquatic species in the Jefferson Lab vicinity that could be affected by Lab operations, so no such dose estimates are provided.

A summary of dose and release reporting for 2002 is provided in Exhibits 4-1, 4-2, and 4-3. More detailed information is provided later in the chapter. Note that information about all electron accelerator-related radionuclides, with the potential for release from the site, is documented in this chapter. All important discharges or releases of radioactive constituents are documented herein. There were no non-routine releases in 2002 so all values shown result from routine operations.

Exhibit 4-1
Jefferson Lab Radiological Dose Reporting Table for CY 2002

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	7 E-03 (7 E-05)	7 E-03	0.013 (1.3E-04)	-	N/A
Water	0	0	N/A	-	N/A
Other Pathways	3 (3 E-02)	3	Unknown/ Unknowable	-	N/A
All Pathways	3 (3 E-02)	3		214,000 est.	N/A

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

Values presented in Exhibits 4-1, 4-2, & 4-3 are presented in Scientific Notation (example, 2 E-05 is 0.00002)

Exhibit 4-2
Jefferson Lab Radiological Atmospheric Releases for 2002

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 2002	3.1 E-02 (1.1 E+09)	2.1 E-03 (7.8 E+07)	6.3 E-01 (2.3 E+10)	4.8 E+00 (1.8 E+11)	2.6 E+00 (9.6 E+10)	2.7 E-02 (1.0 E+09)	3.2 E-01 (1.2 E+10)	1.4 E-03 (5.2 E+07)

Notes: 1 pCi = 1 x 10E-12 Ci = 0.037 Bq

m: minutes

Exhibit 4-3
Jefferson Lab Liquid Effluent Releases of Radioactive Material for 2002

Radionuclide	Tritium	Be-7	Na-22
Ci (Bq) in CY 2002	1.06 E+00 (3.9 E+10)	2.4 E-04 (8.9 E+06)	1.5 E-05 (5.6 E+05)

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

4.1 SITE INFORMATION

Jefferson Lab protects the environment and the public from exposure to radiation. The radiological monitoring program is the primary means used at Jefferson Lab to verify accomplishment of this objective. Other 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 as low as reasonably achievable. The program also assures that Lab support activities and accelerator testing and operations, as described within the approved operational safety envelope, will result in minimum impacts to the environment and have minimal to no effect on public health.

4.2 ENVIRONMENTAL RADIATION MONITORING

Accelerator operations produce three types of radioactivity that can impact the general public: direct or prompt, airborne, and waterborne. Jefferson Lab performed extensive environmental monitoring in 2002 to measure these three forms of accelerator-produced radiation. Pathways to the general public are modeled and monitored when appropriate or as indicated 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; and,
- experience at other nuclear and high-energy physics laboratories.

4.3 AIRBORNE AND WATERBORNE RADIOACTIVITY

4.3.1 Direct Radiation and Airborne Radioactivity

In addition to 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. Though the direct radiation stops when the accelerator is turned off, this activated equipment, water, and air continue to emit radiation.

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 beam enclosure area is surrounded by radiation shielding.
- Direct radiation is monitored both on-site and at the site boundary.
- Interlocked access points provide a fail-safe barrier against entry to the beam enclosure during accelerator operations.
- The monitoring of airborne radioactivity is carried out locally to validate calculations and estimates of radiation dose.
- All material exposed to the beam is monitored for radioactivity prior to being removed from the beam enclosure.

Shielding Blocks at the Hall C Truck Ramp Entrance

While radiation dose rates offsite are expected to be well below limits set for the general public, monitoring ensures that the established controls are effective.

- Waterborne activity is discussed in Section 4.3.2.

- Monitoring for exposure of the public to direct radiation is discussed in Section 4.4.

The monitoring for public exposure to airborne emissions is addressed below.

Airborne emissions at the site boundary are addressed under the EPA requirements discussed in Section 2.4.2. 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. Calculated results based on an EPA-approved computer program, CAP-88 PC, are presented in Exhibit 4-4. Despite this very low calculated release rate, Jefferson Lab continued being proactive in 2002 by making continuous measurements to verify the calculations. A report covering CY 2002 was sent to the EPA as described in 40 CFR 61. This report documented that the dose to a maximally exposed individual of the public was 0.007 mrem/yr (0.07 μSv/yr) due to airborne releases. The dose from exposure through all applicable pathways is presented in Exhibit 4-1.

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. One entity is the Experimental Equipment Review Committee that reviews experiments for EH&S parameters, as well as for experimental and facility usage criteria. Another is a RadCon review of projected public exposures and airborne emissions from proposed experiments to help the Lab remain within established guidelines. Refer to Section 4.4 for specific information on the monitoring of direct radiation.

4.3.2 Waterborne Radioactivity

Groundwater

Radioactivity in groundwater, as a result of direct or secondary radiation, is possible in certain locations around the shielded accelerator and experimental hall structures. The VPDES Permit No. VA0089320 serves as the basis for evaluating accelerator-produced radioactivity in groundwater. Under the permit, Jefferson Lab is not allowed to exceed one-quarter of the EPA SDWA limits on-site, or change the quality of the groundwater offsite. Refer to Section 6 for more information on how the Lab incorporates monitoring to protect groundwater resources.

Exhibit 4-4
Nuclide Effective Dose Equivalent Summary

Nuclide	H-3	Be-7	C-11	N-13	O-15	Ar-41	Cl-38, 39	TOTAL
Calculation for Selected Individual Based on Conservative Calculations and Measurements (mrem/yr)	1.4 E-05	1.8 E-05	6.3 E-04	4.2 E-03	1.2 E-03	1.9 E-06	6.9 E-04	7 E-03 *

*value rounded up to nearest whole number

Conversion note: 1 mrem = 0.01 millisievert (mSv)
Values are presented in Scientific Notation (i.e., 1.2 E-3 = 0.0012)

This VPDES groundwater quality permit specifies EPA-approved sampling and analysis protocols, which were the basis of groundwater monitoring in 2002. 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 4-5 for monitoring well locations and to Exhibit 4-6 for parameters sampled. The groundwater dewatering effluent at the experimental halls was also monitored quarterly in 2002 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 2002 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.

Exhibit 4-7 lists the VPDES groundwater quality 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.

The radiological results from monitoring the wells in the accelerator vicinity during 2002 are presented in the first part of Exhibit 4-8. 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 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. There were no concerns at this discharge stream in 2002.

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 2002. 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. 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 2002 are provided in Exhibit 4-9. The concentrations varied based on the quantity of beam dump cooling water discharged during the reporting period.

On a periodic basis in 2002, 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

Exhibit 4-5
Monitoring Well Locations

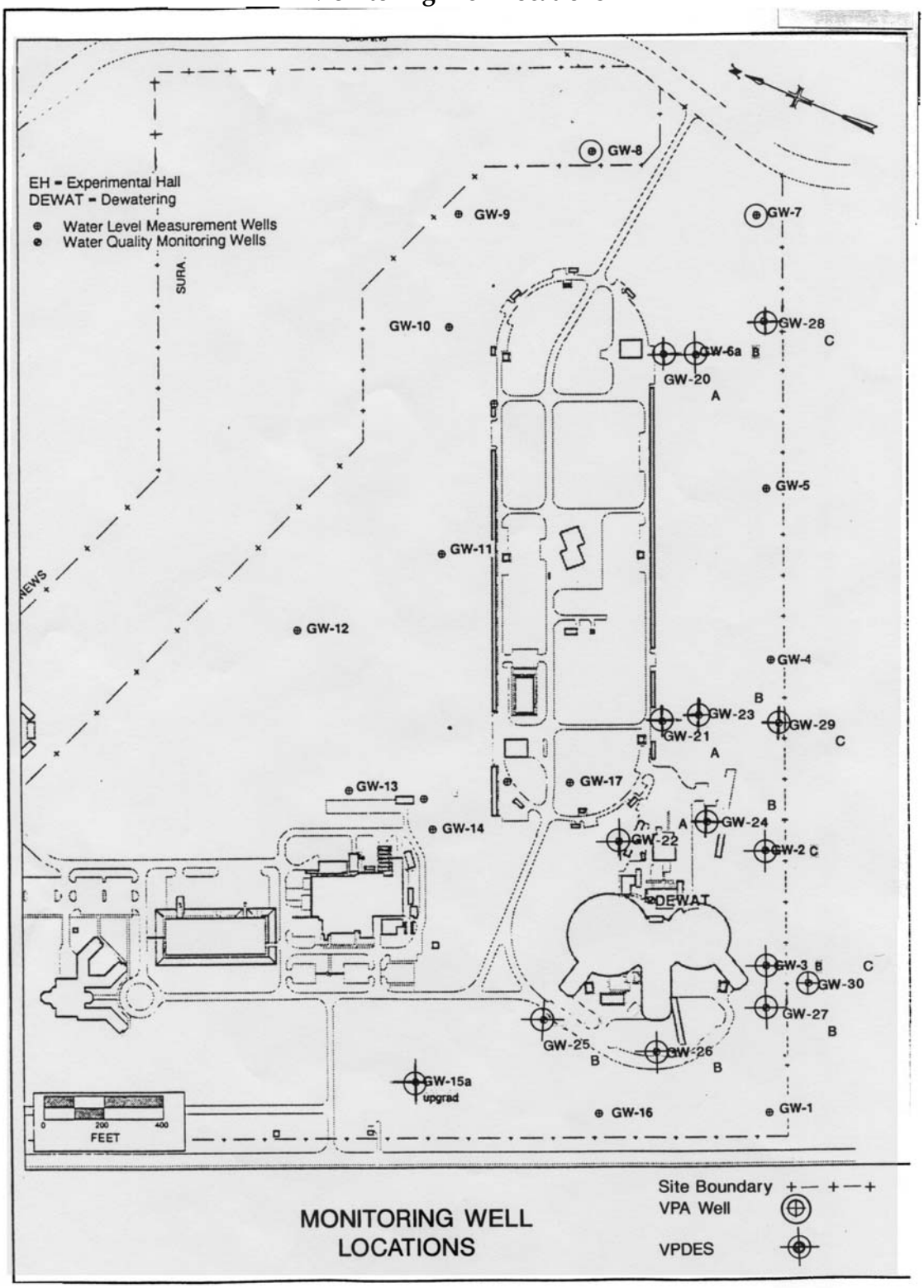


Exhibit 4-6
Groundwater Sampling Parameters

Wells	Sampling Frequency	Environmental Parameters
GW-15a	Annual	groundwater elevation, pH, conductivity, TSS, TDS, and radionuclides listed
A Ring Wells		
GW-20	Quarterly	groundwater elevation, pH, conductivity, TSS, TDS, manmade radioactivity, and radionuclides listed
GW-21		
GW-22		
B Ring Wells	Semi-annual	groundwater elevation, pH, conductivity, TSS, TDS, manmade radioactivity, and radionuclides listed
GW- 3		
GW-6a		
GW-23		
GW-24		
C Ring Wells	Annual	groundwater elevation, pH, conductivity, TSS, TDS, and radionuclides listed
GW- 2		
GW-28		
GW-29		
GW-30		
Other Sampling Point		
Outfall 001	Quarterly	flow, pH, and radionuclides listed

Radionuclides: Gross Beta, H-3 (Tritium), Be-7, Mn-54 and Na-22
TDS: Total Dissolved Solids
TSS: Total Suspended Solids

Exhibit 4-7
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 4-8
Maximum Groundwater Measurements for Radionuclides*
January 2002 through December 2002

Radionuclides at Associated Wells Relevant to Accelerator Operations

Analyte	A-Ring	B-Ring	C-Ring
Gross Beta	25.69	12.13	8.10
Manmade Radioactivity	< 0.255 mrem/yr.	< 0.165 mrem/yr.	not applicable
Tritium	ND at < 649	ND at < 592	ND at < 541
Sodium-22	ND at < 20	ND at < 12.2	ND at < 10.9
Beryllium-7	ND at < 160	ND at < 97.4	ND at < 91.4
Manganese-54	ND at < 19	ND at < 13.5	ND at < 9.49

Radionuclides At Other Permit Locations

Analyte	Upgradient Well	Discharge 001
Gross Beta	4.39	11.12
Tritium	ND at < 541	ND at < 649
Sodium-22	ND at < 5.74	ND at < 23
Beryllium-7	ND at < 48.5	ND at < 136
Manganese-54	ND at < 5.21	ND at < 21

Notes: *Those radionuclides determined to be relevant to Jefferson Lab operations.
Measurements are in pCi/l unless otherwise noted.
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 4-9
Analytical Results for Discharges to HRSD in 2002

Monthly Values

Reporting Period	Tritium Concentration (pCi/l)	Reporting Period	Tritium Concentration (pCi/l)
January	2,600	July	87,000
February	52,000	August	28,000
March	140	September	31,000
April	60,000	October	51,000
May	22,000	November	33,000
June	72,000	December	7,700

Quarterly Values

Reporting Period	Tritium Concentration (pCi/l)	Other Gamma-Emitting Radionuclides Concentration (pCi/l)	
First Quarter	6,800	Na-22 at 0.027	Be-7 at 0.38
Second Quarter	53,000	Na-22 at 1.5	None detected
Third Quarter	43,000	None detected	None detected
Fourth Quarter	31,000	Na-22 at 0.75	Be-7 at 24

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

concern was collected and discharged according to the terms of the HRSD permit.

Various accelerator-related water systems have the potential for becoming activated. Secondary containment and other physical controls are present around areas with the potential for spills of activated water. Additional administrative controls are in place where the water activation level is above an identified level.

There were a few minor water spills or leak events in 2002 involving these activated water systems. RadCon staff addressed and cleaned up the areas involved. There were no worker safety, environmental, or public health concerns. Collected water that did not meet immediate disposal criteria was transferred to a temporary storage area for later release to HRSD.

4.4 ACCELERATOR-PRODUCED DIRECT RADIATION

Direct radiation penetrates shielding with almost all this radiation stopped by the shielding - any exposure to this radiation is at a maximum on-site and decreases with distance. During 2002, Jefferson Lab continued regular accelerator operations in support of various 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 can automatically record the radiation levels for subsequent examination. When appropriate, Jefferson Lab employees, subcontractors, and visitors wear detection devices to monitor for on-site radiation exposure.

Six dual-channel microprocessor-based instruments for monitoring gamma and neutron radiation levels collected both direct and airborne radiation data at the site boundary in 2002. Radiation data collected prior to January 1995 serve as the statistical baseline for comparison to that collected since the accelerator became fully operational.

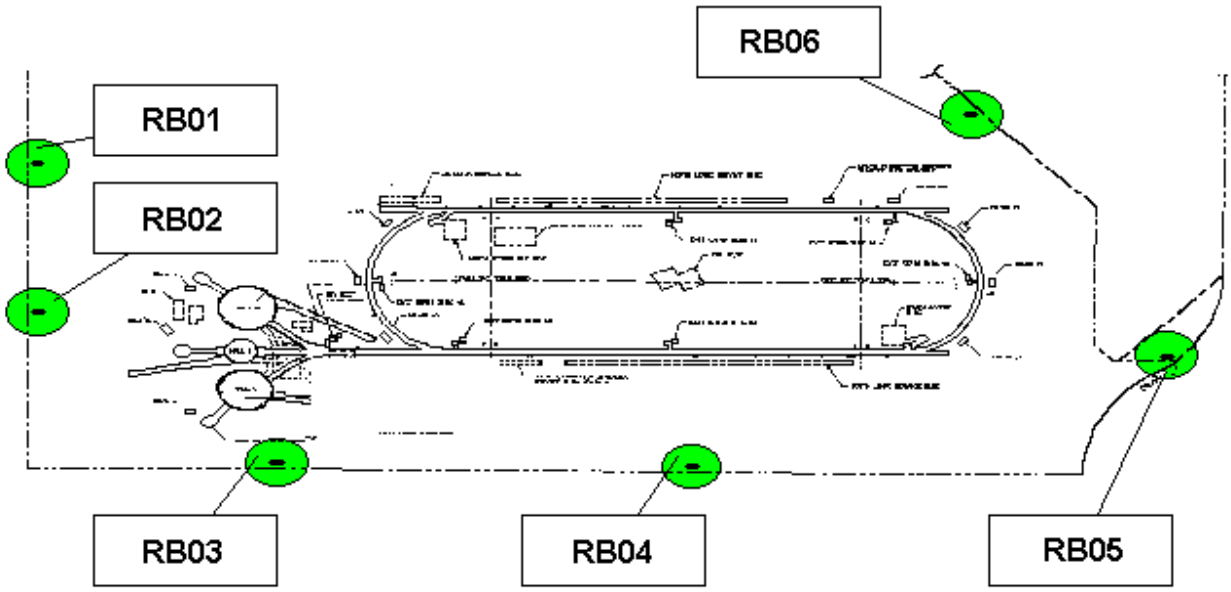
4.5 ASSESSMENTS OF POTENTIAL RADIATION DOSE TO THE PUBLIC AND TO BIOTA

The six electronic radiation measurement devices noted in Section 4.4, 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 at the locations shown in Exhibit 4-10. In addition, passive integrating detectors were used for a number of measurements. All measured dose values were within statutory and administrative limits. For 2002, the highest site boundary direct (prompt) radiation level was about 7.1% of the DOE annual dose limit of 100 mrem (1 mSv), or 71% of the site administrative dose limit of 10 mrem (0.1 mSv).

Exhibit 4-11 displays the radiation doses in mrem for 2002 at RBM-3. 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 radon, which

typically doubles natural radiation dose to the public.

Exhibit 4-10
Boundary Monitor Locations



Note: RB03 is the same as RBM-3.

Exhibit 4-11
Radiation Boundary Monitor RBM-3 Results for 2002

Period	Neutron (mrem)	Gamma (mrem)	Total (mrem)
Jan-Mar	0.62 ± 0.01	0.16 ± 0.01	0.78 ± 0.02
Apr-June	0.87 ± 0.01	0.22 ± 0.01	1.09 . ± 0.02
July-Sept	0.0	0.0	0.0
Oct-Dec	0.87 ± 0.02	0.22 ± 0.01	1.09 ± 0.02
TOTAL	2.36 ± 0.02	0.60 ± 0.02	2.96 ± 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

Jefferson Lab does not release any residual radioactive material, such as concrete or soil, so there are no resulting dose impacts to the public. Radioactive waste was turned over to a licensed subcontractor for reprocessing as appropriate to optimize the final disposition.
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 and/or groundwater pathways. The direct radiation exposure was again measurable in 2002, but was found to be about 71% of the Jefferson Lab design goal of one-tenth of the DOE limit.

4.6 OTHER SUPPORT ACTIVITIES

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

RadCon installs shielding blocks and devices as needed to minimize impacts both inside and outside the facility.

All areas where activated water could be present have controls in place. Locations with a high potential for activation have secondary containment measures installed and administrative lockout/tagout controls. Other areas with less or no 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.

SECTION 5 ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM

Jefferson Lab conducts a number of non-radiological activities to support protection of the environment and public health. These activities are performed in accordance with the WSS standards that include the site permits listed in Exhibit 2-5.

This section presents permit monitoring results and other actions that required attention in 2002. These other actions included: reviewing conventional air emissions; administering controls involving work with cooling water treatment additives; reviews for emergency planning; and, special waste management items. The respective programs are discussed in Section 3.

In general, controls to protect the environment are established through on-site programs and subcontractual agreements that address permit conditions and other Lab commitments or initiatives. There were only minor problems with respect to any of the aforementioned Jefferson Lab activities during 2002.

5.1 WATER PROGRAMS

Jefferson Lab reported DEQ information under three permits in 2002: quantities of groundwater discharged under the Permit to Withdraw Groundwater; radiological and general water quality parameters under VPDES Permit No. VA0089320; and, general water quality factors under VPDES Permit

No. VAG253002. Results were also reported to HRSD under Permit No. 0117. The general water quality results follow, with the radioanalytical results provided in Section 4.

5.1.1 Permit to Withdraw Groundwater

As noted in Section 2.5.2.2, Jefferson Lab's withdrawal of groundwater at the experimental halls is an unusual situation. The only factor of concern under the groundwater withdrawal permit is the quantity of water pumped. This permit allows the pumping of a maximum of 6,000,000 gallons per month and a restriction of 23,036,790 gallons annually. (Pumping is minimal in drought periods.) Quantities of water pumped from these tile fields are reported to the DEQ on a quarterly basis. There were no unusual issues regarding this discharge in 2002.

The maintenance of the structural integrity of the halls by pumping results in wide quantity variations. Exhibit 5-1 presents the quantity of water pumped monthly and the maximum daily flow for each month in 2002. Note that the quantity pumped each month is well under the 6,000,000 gallon permit limit.

This groundwater collection point, known as "Outfall 001", is monitored for water quality under VPDES Permit No. VA0089320. See section 5.1.2 for non-radiological results covered by this permit and Section 4.3.2 for information on the radiological parameters monitored at this outfall. Besides the VPDES permit noted, there are no other requirements for monitoring as no industrial or other use is made of the discharged groundwater.

5.1.2 VPDES Permit No. VA0089320

This permit covers monitoring for water quality at fifteen groundwater monitoring wells and at the Outfall 001 collection point noted above.

Monitoring wells were sampled for pH, conductivity, total suspended solids (TSS), and total dissolved solids (TDS) under the Permit terms. (See Exhibit 4-5 for the site map showing the wells monitored in 2002.) Sampling results for the wells are presented in Exhibit 5-2. Groundwater collected at Outfall 001 is sampled and reported quarterly for pH and results are shown in Exhibit 5-3. Also shown are the reported maximum daily discharge

Exhibit 5-1
2002 Flow Information at the Dewatering Discharge

Month	Monthly Flow (gal)	Maximum GPD During the Month*	Month	Monthly Flow (gal)	Maximum GPD During the Month*
January	427,644	16,533	July	455,666	13,981
February	402,942	16,623	August	383,790	13,763
March	346,675	16,644	September	415,205	15,083
April	406,437	13,782	October	388,656	13,460
May	419,443	13,981	November	415,081	13,927
June	384,166	13,984	December	426,857	14,884

Notes:

*Maximum GPD (gallons per day) per quarter is reported on VPDES Permit No. VA0089320. There is no daily permit limit. The monthly limit is 6,000,000 gallons and the yearly limit is about 23,000,000 gallons.

Exhibit 5-2
Range of 2002 Non-Radiological Monitoring Results at Wells

Parameter/Units	GW-15a	A Wells*	B Wells*	C Wells	Permit Limit
pH	4.3	6.1 to 7.2	5.3 to 7.3	5.8 to 6.7	None
Conductivity (µmho/cm)	151	705 to 2400	305 to 1215	342 to 854	None
TDS (mg/L)	105	451 to 1520	219 to 818	247 to 754	None
TSS (mg/L)	6	15 to 310	1 to 80	3 to 40	None
(frequency)	(annual)	(quarterly)	(semiannual)	(annual)	-

mg/L: milligrams/liter
mho: unit of conductance

* Minimum and maximum parameter results throughout the year for the A & B ring wells.

Exhibit 5-3
2002 Permit-Related Non-Radiological Monitoring Parameters at Outfall 001

Quarter	Maximum Flow (MGD)	pH
First	0.017	7.2
Second	0.014	7.0
Third	0.015	6.9
Fourth	0.015	7.2

MGD: million gallons/day
Notes: There is no limit on the reported flow.
The pH range is 6.0 to 9.0.

quantities for each quarter. Note that sampling data collected in 2002 was representative of groundwater quality during accelerator operations and is consistent with previous baseline measurements.

Variations in non-radiological information collected at the wells in 2002 may be due to seasonal, local ground conditions, earth-disturbing factors, and a regional drought. Even with a fully operating accelerator, various construction projects in the area, and a variety of physics experiments being performed, there were no facility-related effects on groundwater quality in 2002.

5.1.3 VPDES Permit No. VAG253002

Cooling water discharges from two cooling towers were covered by this permit in 2002. The materials used for cooling water treatment were Coastline Formula 2029 (scale and corrosion inhibitor), Formula 1909 (liquid biocide), and a small amount of a dispersant. There were no

environmental concerns with the use of these chemicals.

Quarterly sampling and reporting are performed at Discharge Numbers 001 and 002 under this 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. Exhibit 5-4 presents CY2002 results. Sampling for ammonia was started in 2003.

Exhibit 5-4
2002 Cooling Water Monitoring Parameters at Outfalls 001 and 002

Parameter/Units	First Quarter		Second Quarter		Permit Limit	Detection Limit
Outfall	**001**	**002**	**001****	**002****		
Flow (MGD)	0.012	0.00005	no discharge	no discharge	0.05 MGD	0.0001
pH	7.3	7.7	-	-	6 to 9	0.1
Temperature (°C)	13.2	13.0	-	-	Max. 32 °C. or as noted in the permit	0.1
Hardness (mg/L)	240	80	-	-	None	2
Copper (mg/L)	0.002	0.004	-	-	None	0.001
Zinc (mg/L)	0.727	0.113	-	-	None	0.03
Chlorine (mg/L)	< 0.1	< 0.1	-	-	Non-Detectable	0.1
	Third Quarter		**Fourth Quarter**			
Outfall	**001**	**002**	**001**	**002**		
Flow (MGD)	0.015	0.0001	0.019	0.0001	0.05 MGD	0.0001
pH	7.1	7.1	7.1	7.2	6 to 9	0.1
Temperature (°C)	23.5	22.0	10.5	10.7	Max. 32 °C. or as noted in the permit	0.1
Hardness (mg/L)	36	216	59	250	None	2
Copper (mg/L)	0.003	0.010	0.007	0.003	None	0.001
Zinc (mg/L)	0.079	0.047	0.122	0.115	None	0.03
Chlorine (mg/L)	< 0.1	< 0.1	< 0.1	< 0.1	Non-Detectable	0.1

NOTES:

**There was no flow at these sample points during this period. This is believed to be due to the regional drought.

MGD: million gallons/day

mg/L: milligrams/liter

Items of note for 2002 include:

- Fourth quarter 2001 sampling had a chlorine level at Discharge Number 001 above the non-detect level, as reported in the 2001 SER. It is believed that two separate piping failures in water supply lines contributed to the detectable level of chlorine. There were no detectable chlorine levels in 2002.
- The Lab received a notice of deficiency for not promptly reporting the leaks as well as another administrative deficiency as discussed in Section 2.5.1.2.

- Sampling could not be performed in the second quarter as there was no flow at either sampling point, a direct result of the area drought.

5.1.4 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 2002 was a combination of the output from dehumidification equipment in the experimental halls and small withdrawals from the beam dump cooling systems. Refer to Sections 2.5.2 and 4.3.2 for more information.

Jefferson Lab performs pH sampling at two sanitary sewer outflow streams to verify that pH levels are within permit criteria. Results for CY2002 are shown in Exhibit 5-5. Two elementary neutralization tanks continuously record pH levels and records are available for HRSD review.

As noted in Section 4, 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 2002. However, Jefferson Lab did receive two administrative violations for a late submittal of pH data for two sampling points.

5.1.5 Storm Water Management Program

Storm water runoff is a part of 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 the Chesapeake Bay.

Exhibit 5-5
pH Sampling Results for Wastewater Discharge

Monitoring Period	Manhole D	Manhole EF
First Quarter	6.5	7.0
Second Quarter	8.2	6.7
Third Quarter	8.0	7.5
Fourth Quarter	7.0	7.0

Permit Limits: Calendar Month Average and Calendar Day Maximum > 5.0
Detection Limit: 0.1

The Storm Water Pollution Prevention (SWPP) Program at Jefferson Lab addresses pollution prevention, control, and countermeasure issues. Jefferson Lab reduces contamination of storm water effluents by preventing open containers or unvegetated ground from being exposed to rainfall. If ground disturbance does take place, such as occurs during construction activities, Jefferson Lab manages runoff by implementing erosion and sediment control best management practices.

Jefferson Lab incorporates the relevant management practices described in the Virginia Erosion and Sediment Control Handbook in the course of the performance of construction activities and identified industrial activities. The purpose of the SWPP Program is to virtually eliminate soil erosion from storm water runoff and chemical pollution from runoff from sources that are not sufficiently weather-proofed. The EH&S Manual, Chapter 6733 *Storm Water Pollution Prevention*, covers Jefferson Lab's storm water program.

5.1.6 Other Water Quality Issues

As stated in Section 2.2.8, FIFRA applies to the storage and use of herbicides and pesticides at Jefferson Lab. 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. Exhibit 5-6 lists those products used at Jefferson Lab in 2002. All pesticides used were EPA-registered and applied according to the product instructions and Federal, State, and local guidelines. The Lab's Facilities Management Department subcontracts monthly preventive pest control.

Exhibit 5-6
Control Chemicals and Products Approved for Use in 2002

Pest Control	Herbicides/Landscape Maintenance
Borid	Damoil
Contrac	Diazinon 4E
Dursban T/C	Dicofol 4EC

Insect Guard ("No Pest Strip")	Dimension
Intruder HPX	Diometom
MaxForce Bait	Fore Tree & Ornamental Fungicide
Mosquito Dunks	Fusilade II
Precor 1%EC (fleas)	Merit
PT 565 plus	MSMA Target 6.6
Quintox Rat & Mouse Bait	Roundup
Wasp Freeze	Super Trimec
Termite Control	
Dursban T/C	

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 addressed included kitchens, laboratories, and other areas throughout the site.

Jefferson Lab requires that, when used outdoors, there is to be no application of these compounds when rain is expected in order to minimize the chances of them washing into local channels. 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.

5.2 CONVENTIONAL AIR EMISSIONS

The Hampton Roads area of southeastern Virginia remained in attainment of ozone ambient air quality standards in 2002, though it is still considered a CAA maintenance area. The Hampton Roads area also remained 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, as noted in the next paragraph. There are no applicable NAAQS emission sources present on the site.

Accelerator operations can 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. Refer to Exhibit 5-7 for information provided to the DEQ for 2002.

Exhibit 5-7
Jefferson Lab Air Emission Source for Calendar Year 2002

Ref. No.	Equipment	Annual Fuel Process Rate (Million Cu. Ft. Burned)	Process Volume * % Annual Throughput			
			J-M	A-J	J-S	O-D
HB-1	CLVR.BRKS.	1.5	58	35	7	0
HB-2	CLVR.BRKS. P-142-30	1.5	58	35	7	0
HB-3	CLVR.BRKS. CB-760-60	5.0	38	20	12	30
HB-4	CLVR.BRKS. CB-760-60	5.0	38	20	12	30
HB-5	BRYAN F-450 WG	1.7	25	25	25	25
HB-6	BRYAN F-90 WG	1.4	46	24	0	30
HB-7	BRYAN F-90 WG	1.4	46	24	0	30
HB-8	PSB Fin Tube Radiator	0.15	53	8	0	39

Process: Natural Gas (under 10MMBRU / Hr)
Heat Content: 1050 MMBTU / Cu. Ft.
Annual Schedule: 24 hrs / day, 7 days / wk, 52 wks/ yr
* Quarterly Values Shown

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 2002.

5.3 SAFETY

Jefferson Lab's performance, with respect to worker safety for the 2002 CY, was as follows:

- Recordable injury case rate: 1.7 per 100 employees;
- Lost Work Day case rate: 0.9 per 100 employees;
- Lost Work Day rate: 48.3 per 100 employees;
- Number of radioactive contaminations (external): 0; and,
- Number of Safety Occurrence Reports (OSHA confined space, chemical exposure, and lockout/tagout incidents): 5 – four electrical events and one mechanical malfunction.

SECTION 6
GROUNDWATER PROTECTION

6.1 INTRODUCTION

Groundwater is a vital natural resource, the contamination of which could present potential problems to the general population. Because of this, both the Federal government and the Commonwealth of Virginia regulate groundwater.

The Jefferson Lab Groundwater Protection Management Program is used as a management tool and provides a strategy to minimize impact to groundwater resources. 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 past, current, and future Jefferson Lab activities on groundwater quantity and quality.

6.2 HYDROGEOLOGY ISSUES

6.2.1 General Hydrogeology

Jefferson Lab is located in the Atlantic Coastal Plain Physiographic Province of

Virginia. This province is underlain by unconsolidated sediments ranging from early Cretaceous to Holocene Age. The sediments dipping and thickening eastward consist primarily of sand, clay, silt, and gravel, with variable amounts of shell material. The hydrogeologic framework for the lower Peninsula is a series of aquifers and intervening confining units defined on the basis of the lithologic and the hydrologic properties of the unconsolidated Coastal Plain sediments.

The site is located on the eastern tip of the lower James-York Peninsula. Sediments found within 50 feet of the surface belong to the Yorktown Formation (Chesapeake Group) and overlying Columbia Group, which is comprised of four formations. These formations are similar to many Quaternary formations that comprise the riverine, estuarine, and coastal terraces of the Virginia Coastal Plain.

Jefferson Lab is situated in the central section of Newport News, Virginia, at an average elevation of about 35 feet above MSL. 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. The reservoir served as a drinking water source for local military installations through mid-2002. The only long-lasting streams on the Jefferson Lab site are those due to discharges from cooling towers and groundwater dewatering operations. Small localized wet areas exist, a few are permanent, and the rest occur during periods of heavy precipitation and eventually drain by surface runoff and groundwater recharge.

6.2.2 Aquifer Information

The uppermost hydrostratigraphic unit encountered at the site is the water table aquifer, the Columbia, which is composed of sediments of the Columbia Group. The thickness of the aquifer ranges between 15 and 30 feet, with a seasonal variability of 8 feet or more. This water table aquifer, and up to nine confined aquifers, have been identified with the Atlantic Coastal Plain system. Groundwater flow within the water table aquifer is influenced by localized boundary conditions present as creeks and rivers. The first confined aquifer beneath the Columbia aquifer is the Yorktown-Eastover aquifer, composed of the coarser units of the Yorktown Formation. The upper 50 to 100 feet of the Yorktown-Eastover aquifer is usually fresh water and is one of the most important aquifers in the region.

Previous subsurface studies and groundwater elevation readings indicate that horizontal groundwater flow is generally across the site to the east-southeast. Modeling performed during 1995, with groundwater flow and velocity reevaluated in 2001 and early 2002, indicated that the groundwater flow pattern, including seasonal variations, had not changed from earlier studies with the exception of significant local effects in the vicinity of the experimental hall dewatering system. In this area, groundwater has the tendency to work slowly toward the halls and ultimately be cycled through the dewatering system and into a site surface water channel.

6.2.3 Potential Contamination Sources

Potential groundwater contamination sources in the vicinity of Jefferson Lab could include contaminants from offsite properties that could migrate across the site. No impacts from offsite sources have been noted on the DOE site. On-site sources had included three underground storage tanks, which were removed along with any identified contaminants.

Another potential contamination source is from EHMs that are used in daily operations by Jefferson Lab staff. Proper handling and storage practices, including the standard use of secondary containment, are implemented throughout the site. All hazardous waste is managed appropriately by EH&S staff under the applicable RCRA requirements.

Soil radioactivation is another potential source of groundwater contamination. As the facility has become fully operational, the monitoring of VPDES-permitted wells for particular groundwater quality parameters is performed at the frequencies shown in Exhibit 4-6. Jefferson Lab will maintain the capability to sample and analyze groundwater more frequently, as necessary, to ensure that effects on groundwater are minimal. From controls designed into the accelerator complex, 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.

6.2.4 Groundwater Uses

The groundwater resources of the York-James Peninsula are abundant; however, the generally poor water quality limits groundwater use. Some Peninsula groundwater is used in conjunction with area reservoirs to supply drinking water.

Jefferson Lab withdraws groundwater from below Halls A, B, and C under the site Permit to Withdraw Groundwater, as discussed in Section 2.5.2.2 There are no projected needs for the use of groundwater on the Jefferson Lab site. As the surrounding area continues to be developed, the use of this resource to serve the city remains under investigation.

6.3 GROUNDWATER PROTECTION PROGRAM SUMMARY

Jefferson Lab's EP programs have been established to allow the continued careful use of water resources and to ensure the desired maintenance of all water quality parameters to the maximum practicable extent. Existing water quality parameters are mandated under Federal and Commonwealth regulations, with the main guidance for this program being the CWA. The primary CWA objective is to "restore and maintain the chemical, physical, and biological integrity of the nation's waters." Jefferson Lab complies with the applicable standards discussed in Section 2.5.

Two significant operations that impact groundwater, described below, were addressed in the 1987 EA. Environmental impacts were minimized for both through design strategies.

- The continued withdrawal of groundwater for structural purposes and short-term dewatering for construction projects.
- The potential impact to the groundwater on the Jefferson Lab site or beyond the site limits because of construction and/or accelerator and physics program activities.

Both the 1987 and 2002 EAs found that "no significant environmental impacts are predicted." The 1987 EA had also concluded that proper design and careful operation of the accelerator would minimize any impacts, including those to groundwater. The Commonwealth's largest concern is the potential for radiological activation of the groundwater in the soil surrounding the accelerator. The 1997 EA addressed additional potential impacts based on changes in CEBAF operating parameters and the inclusion of FEL operations. (See Section 3.4 for additional information about NEPA.)

The prevention of hazardous material and oil spills is addressed through appropriate

training and awareness programs at Jefferson Lab. The prevention of oil spills is the main focus of the site SPCC Plan. The chemical assistance team assists by providing immediate containment in the event of oil or hazardous material spills, while the RadCon Group addresses any activated water spills, thus minimizing potential surface and groundwater impacts. An emergency management exercise that addressed an injury using a tabletop exercise in 2002 tested the Lab's response program effectiveness. A few minor opportunities for improvement in the site staff notification procedures were identified and addressed.

6.3.1 Groundwater Resource Protection Quantity

Groundwater withdrawn at Halls A, B, and C is pumped to a single discharge that empties into a stormwater drainage channel. The channel is graded to allow the water to flow east, then south and off the site, eventually flowing to the Big Bethel reservoir. This dewatering is allowed by the Permit to Withdraw Groundwater and is discussed further in Sections 2.5.2.2 and 5.1.1. The Permit allows an annual withdrawal of up to twenty-three million gallons of groundwater, with the actual amount pumped significantly less. No other withdrawals or projected uses are expected.

6.3.2 Groundwater Resource Protection Quality

The Commonwealth, through authorized discharge limits in VPDES Permit No. VA0089320, regulates accelerator-produced radionuclides that are potentially present in the groundwater. This Permit superseded a Virginia Pollution Abatement (VPA) Permit in 1996, which primarily established a groundwater quality baseline for comparison with measurements during long-term accelerator operations.

The current VPDES Permit specifies that the groundwater leaving the Jefferson Lab site shall not exceed the established baseline groundwater parameters. A groundwater monitoring program uses well sampling as the mechanism for making the determination that commitments are met. This Permit also requires keeping the DEQ informed about changes at Jefferson Lab that could affect surface or groundwater quality.

6.3.3 Surface Water Protection

Surface water quality is maintained by discharging only unpolluted waters, such as rainwater or groundwater, to the environment. Potential sources of contamination of surface waters and associated control measures identified for the site include:

- Using proper procedures, such as secondary containment, prevents releases of EHMs to surface water or the ground.
- The prevention of potential oil leaks from equipment or system malfunctions which are addressed in the SPCC Plan.
- The addition of sediments and other pollutants to surface waters from pumping at construction areas is addressed by including specific contractual requirements for any subcontractor performing earthwork to follow the practices identified in the *Virginia Erosion and Sediment Control Handbook*.
- Water within the tunnels and experimental halls may become activated from exposure to radiation. The RadCon Group 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.
- Groundwater surrounding the tunnel and experimental halls may become

activated during beam operations. The groundwater is shielded from exposure to radiation, so only minimal amounts of radiation are expected. The groundwater withdrawn at the halls is monitored under VPDES Permit No. VA0089320.

6.4 GROUNDWATER MONITORING REVIEW

Jefferson Lab's environmental monitoring program is designed to verify that any radiation exposures, as well as non-radioactive effluent releases, are below permissible limits, and that accelerator operations and physics experiments, as well as Laboratory support functions, have not affected the quality of the environment.

Radioactivation of groundwater 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 locations of the "A", "B", and "C" Ring wells, labeled as to proximity to the accelerator tunnel, are specified in VPDES Permit No. VA0089320. The permit-identified wells are used for sampling and analysis during regular accelerator operations and experimental physics activities. Exhibit 4-5 shows the locations of the background and active monitoring wells.

The "baseline" values obtained during the term of the VPA Permit helped define the operational groundwater quality limits that are listed in VPDES Permit No. VA0089320. The permit action or trigger levels, based on the statistical analysis provided to the DEQ, are shown in Exhibit 4-7. Note that the Commonwealth restricts water contamination to 1 mrem/yr., which is one-quarter of the regulated drinking water quality limit. Under this permit, Jefferson Lab has to take specific corrective action if any of the following values are detected at the "A" or "B" Ring wells: Gross Beta - 50 pCi/l; Tritium - 5000 pCi/l; and, Manmade Radioactivity - 1 mrem/yr. The "C" Ring wells are, at no time, to statistically exceed the background levels shown in the Permit.

Well locations are regularly reviewed, and local temporary test wells would be used to sample potential problem areas. Sampling point relocations would be considered based on study results.

SECTION 7
QUALITY ASSURANCE

Regular quality assurance (QA) efforts, which include quality control (QC) measures, are being made to ensure that Jefferson Lab's Environmental Monitoring Program is being performed in accordance with the principles of the Jefferson Lab Quality Assurance Program Manual. As well, EH&S Manual Chapter 6712, *Environmental QA,* provides methods and direction for critical and objective examination of Jefferson Lab's EP programs, practices, and performance.

7.1 QUALITY ASSURANCE 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 QC practices, recordkeeping, chain of custody, and the relevant portions of the QA program itself.

The RadCon Group 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 2002 regarding sampling protocols or results.

Line management responsible for any process documents all routine monitoring and surveillance sampling procedures. Some procedures have been incorporated into the EH&S Manual. Other specialized procedures have been developed in accordance with established standards, practices, and protocols. The procedures ensure that samples are representative of the media from which they are collected and will yield reliable results. Subcontractors are required to use approved documented procedures.
Universal Laboratories, Inc. (Universal Labs) collected most VPDES and HRSD permit-related water samples. Universal Labs performed all non-radiological analyses on these samples. Their subcontractor, BWX Technologies, Inc. (BWX), 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 the RadCon Group and analyzed in the RadCon radiological analysis lab (Building 52). In 2002, Jefferson Lab subcontracted with Marine Chemist, Inc. and American Medical Lab to provide general chemical analysis on samples that were not potentially radioactive. Qualified Jefferson Lab staff collect such non-permit related samples that require general chemical analysis.

7.2 QUALITY ASSURANCE 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. The RadCon Group, 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.

Jefferson Lab continues to maintain appropriate agency certifications and to incorporate certification requirements in subcontract specifications. Any equipment used for environmental monitoring is specified to have calibration certifications traceable to national standards.

Universal Labs and the RadCon radiological analysis lab participate in DOE's Quality Assessment Program (QAP) run by Environmental Measurements Laboratory (EML). BWX participates in two DOE crosscheck evaluation programs: one from the EML, and one from the Mixed Analyte Performance Evaluation Program (MAPEP). In addition, the National Environmental Laboratory Accreditation Conference (NELAC) certifies BWX. NELAC's purpose is to establish and promote mutually acceptable performance standards for the operation of environmental laboratories. BWX is also EPA sample certified by the State of Utah, as well as with the Commonwealth of Virginia for environmental monitoring. Universal Labs, Marine Chemist, and American Medical Lab participate in state programs to maintain their state certification.

7.2.1 Radiological

Independent QA under the DOE

The EML 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 2002, BWX and Jefferson Lab's RadCon lab participated in the EML's QAP for radionuclides. Two sets of results for BWX and one for Jefferson Lab under the QAP were available. The results, for the parameters analyzed by BWX and Jefferson Lab, that are applicable at Jefferson Lab, are provided as Exhibits 7-1 and 7-2. Note that only selected results are presented in these exhibits. Results indicated as warnings mean they are near the limits of acceptability. BWX's overall results for QAP 56 were 91% acceptable and 9% acceptable with warning. It also shows that 100% of the results for the water program, which is of greatest importance for Jefferson Lab, were all acceptable or acceptable with warning. Selected results for both BWX and Jefferson Lab under QAP 57 were 100% acceptable for the water programs. For the air results, Jefferson Lab had 100% acceptable and BWX had 80% acceptable or acceptable with warning and 20% not acceptable. No 2002 results under the MAPEP were provided. [Note: acceptable with warning shows good results, just not in the smaller margin of error to be called 'acceptable'.]

BWX participated in a QA program for analysis of samples under the Environmental Resource Associates. Performance results for RAD49 and RAD50 were received. Results for radionuclides of interest to Jefferson Lab are shown in Exhibit 7-3. The selected results for both were 100% acceptable.

Other QA Activities

BWX also participates in a RadCon Group directed crosscheck program for selected radionuclides that includes duplicates and spiked samples provided at various times in the year. In all circumstances, the results were satisfactory in all appropriate testing categories.

In conjunction with VPDES and HRSD permit-related sampling activities, the RadCon lab runs parallel analyses on selected groundwater monitoring samples

and HRSD quarterly composite samples as a QA verification.

7.2.2 Other Programs

Universal Labs, as part of its credentialing program, participates in two QA programs to ensure a high level of testing accuracy. During CY 2002, they received blind samples and conducted analyses on them. WP-075 results, under the protocol of a NSI Laboratory Proficiency Testing Program, for the parameters of interest to Jefferson Lab are shown in Exhibit 7-4. Results were 88% acceptable or acceptable with warning and 12% not acceptable for the selected parameters. No other results from other QA programs were provided.

All testing protocols were done in accordance with EPA guidelines. Test results that were outside of acceptable standards were addressed by Universal Labs to determine what went wrong and how to make improvements for the future. RadCon staff review the test results to ensure Universal Labs is maintaining its ability to provide quality services.

Exhibit 7-1
Quality Assurance Program (QAP 56)
Selected Results for 2002

		Reported		EML Known			
Matrix	Analyte	Value (Bq/l)	Error	Value (Bq/l)	Error	Ratio Rep/EML	Result
Water	Gross Alpha	468.000	27.000	375.000	37.500	1.248	W
(BWX)	Gross Beta	899.000	30.000	1030.000	103.000	0.873	A
	H-3	335.000	21.000	283.700	3.380	1.181	A
	Co-60	368.000	15.000	347.330	12.400	1.060	A
	Cs-134	3.160	1.210	3.357	0.200	0.941	A
	Cs-137	55.900	2.300	56.067	2.929	0.997	A
Air	Gross Alpha	0.539	0.034	0.534	0.053	1.009	A
(BWX)	Gross Beta	1.180	0.040	1.300	0.130	0.908	A
	Co-60	30.000	1.600	30.520	0.652	0.983	A
	Cs-137	27.300	1.200	28.230	0.701	0.967	A
	Mn-54	38.100	3.000	38.530	0.867	0.989	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 7-2
Quality Assurance Program (QAP 57)
Selected Results for 2002

		Reported		EML Known			
Matrix	Analyte	Value (Bq/l)	Error	Value (Bq/l)	Error	Ratio Rep/EML	Result
Water (BWX)	Gross Alpha	226.000	19.000	210.000	21.000	1.076	A
	Gross Beta	826.000	31.000	900.000	90.000	0.918	A
	H-3	276.000	21.000	227.300	5.615	1.214	A
	Co-60	283.000	12.000	268.670	9.710	1.053	A
	Cs-134	55.100	2.600	60.200	1.860	0.915	A
	Cs-137	83.200	3.100	81.430	4.280	1.022	A
Water (JLab)	Co-60	266.400	9.400	268.670	9.710	0.992	A
	Co-60	279.000	7.100	268.670	9.710	1.038	A
	Co-60	272.200	6.200	268.670	9.710	1.013	A
	Cs-134	58.000	1.700	60.200	1.860	0.963	A
	Cs-134	56.900	2.400	60.200	1.860	0.945	A
	Cs-134	54.300	3.700	60.200	1.860	0.902	A
	Cs-137	80.700	3.300	81.430	4.280	0.991	A
	Cs-137	81.500	6.000	81.430	4.280	1.001	A
	Cs-137	85.500	4.400	81.430	4.280	1.050	A
Air (BWX)	Gross Alpha	0.283	0.031	0.287	0.029	0.986	A
	Gross Beta	0.769	0.064	0.871	0.087	0.883	A
	Co-60	19.900	1.100	23.000	0.059	0.865	W
	Cs-137	27.400	1.200	32.500	0.777	0.843	W
	Mn-54	40.000	6.700	52.200	1.170	0.766	N
Air (JLab)	Co-60	23.300	0.800	23.000	0.059	1.013	A
	Co-60	23.300	0.700	23.000	0.059	1.013	A
	Co-60	24.100	1.000	23.000	0.059	1.048	A
	Cs-137	33.500	1.500	32.500	0.777	1.031	A
	Cs-137	35.100	1.400	32.500	0.777	1.080	A
	Cs-137	37.800	1.800	32.500	0.777	1.163	A
	Mn-54	54.000	2.300	52.200	1.170	1.034	A
	Mn-54	54.500	2.200	52.200	1.170	1.044	A
	Mn-54	56.900	2.000	52.200	1.170	1.090	A

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

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

Exhibit 7-3
ERA QA Program
Average Parameter Results for 2002

Matrix	Analyte	Reported Value (pCi/L)	Experimental Deviation (pCi/L)	Assigned Value (pCi/l)	Control Limits (pCi/L)	Performance Evaluation
RAD49						
Water	Co-60	44.2	5.84	39.1	30.4 - 47.8	A
(BWX)	Cs-134	13.3	0.404	17.1	8.44 - 25.8	A
	Cs-137	53.7	0.551	52.1	43.4 - 60.8	A
RAD50						
Water	Gross Alpha	42.5	2.21	58.8	33.5 - 84.1	A
(BWX)	Gross Beta	18.7	1.15	21.9	13.2 - 30.6	A
RAD51						
Water (BWX)	H-3	10,500	265	10,200	8,440 – 12,000	A

BWX: BWX Technologies, Inc.

Exhibit 7-4
Selected Results from Universal Laboratories Performance Evaluation Reports
NSI Laboratory Proficiency Testing Program Study WP-075

Sample Category	Parameter	Units	Reported Value	True Value	Acceptance Limits	Results
Trace Metals	Aluminum	µg/L	1460.0	1570	1345 - 1784	A
	Cadmium	µg/L	646.0	623	532 - 707	A
	Chromium	µg/L	223.0	225	194 - 256	A
	Copper	µg/L	418.0	425	385 - 468	A
Trace Metals	Lead	µg/L	2999.0	2880	2539 - 3206	A
	Manganese	µg/L	1904.0	1870	1682 - 2078	A
	Nickel	µg/L	2244.0	2490	2265 - 2774	N
	Zinc	µg/L	904.0	874	774 - 982	A
pH	pH	-	9.1	9.00	8.73 - 9.27	A
Mercury	Mercury	µg/L	17.5	12.7	9.50 - 15.9	N
Ammonia as N	Ammonia as N	mg/L	14.2	16.1	12.5 - 19.5	A
Residual Chlorine	Total Residual Chlorine	mg/L	0.575	0.671	0.494 - 0.847	A
Residue	Non-filterable Residue TSS	mg/L	62.0	67.0	51.4 - 72.2	A
Oil and Grease	Oil and Grease	mg/L	32.4	32.3	20.7 - 37.7	A
Demand	COD	mg/L	63.0	78.8	57.0 - 94.0	W
	TOC	mg/L	31.8	31.1	25.9 - 36.0	A

Notes: Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.
Ug/L: micrograms per liter; mg/L: milligrams per liter
COD: Chemical Oxygen Demand
TOC: Total Organic Carbon
TSS: Total Suspended Solids

SECTION 8
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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.

A C M	Asbestos-containing material	**E H M**	Environmentally Harmful Material
A E A	Atomic Energy Act	**E H S**	Extremely hazardous substance
A L & R	Administrative Laws and Regulations	**E H & S**	Environment, Health, and Safety
A P	Affirmative Procurement	**E M L**	Environmental Measurements Laboratory
A R C	Applied Research Center	**E M S**	Environmental Management System
BMP	Best Management Practice	**E O**	Executive Order of the President of the United States
B q	Becquerel	**E P**	Environmental Protection
B W X	BWX Technologies, Inc.	**E P A**	Environmental Protection Agency
C A A	Clean Air Act	**E P C R A**	Emergency Planning and Community Right-to-Know Act
C A A A	Clean Air Act Amendments	**E P Gs**	Emergency Planning and Response Groups
C A S A	Center for Advanced Studies of Accelerators	**E P P**	Environmentally Preferable Purchasing
C B P A	Chesapeake Bay Preservation Act	**E S A**	Endangered Species Act
CBPADMR	Chesapeake Bay Preservation Area Designation and Management Regulations	**E S & H**	Environment, Safety, and Health
C E B A F	Continuous Electron Beam Accelerator Facility	**F D S**	Floor Drain Sump
C E R C L A	Comprehensive Environmental Response, Compensation, and Liability Act	**F E L**	Free Electron Laser
C F C	Chlorofluorocarbon	**F I F R A**	Federal Insecticide, Fungicide, and Rodenticide Act
C F R	Code of Federal Regulations	**F O N S I**	Finding of No Significant Impact
C i	Curie	**F Y**	Fiscal Year
C L A S	CEBAF Large Acceptance Spectrometer	**G e V**	Billion (Giga-) electron volts
C O D	Chemical Oxygen Demand	**G P D**	Gallons per day
C W A	Clean Water Act	**G S A**	General Services Administration
C X	Categorical Exclusion	**H R S D**	Hampton Roads Sanitation District
C Y	Calendar Year	**H S**	Hazardous Substance
C Z M A	Coastal Zone Management Act	**H W C**	Hazardous Waste Coordinator
D E Q	(Virginia) Department of Environmental Quality	**I A**	Independent Assessment
D O D	U.S. Department of Defense	**I R**	Infrared
D O E	U.S. Department of Energy	**I S M**	Integrated Safety Management
D O T	U.S. Department of Transportation	**I W D R**	Industrial Wastewater Discharge Regulations
E 2	Energy Efficiency	**k g**	Kilogram

E A	Environmental Assessment	**LLW**	Low Level Radioactive Waste

ACRONYMS and ABBREVIATIONS (continued)

L S A	Line Self-Assessment	**RCRA**	Resource Conservation and Recovery Act
µ g/L	Micrograms per Liter	**RMA**	Resource Management Area
µ S v	MicroSievert	**R Q**	Reportable Quantity
M 3	Cubic Meters	**R & D**	Research and Development
M A P E P	Mixed Analyte Performance Evaluation Program	**S A/Q A**	Self-Assessment/Quality Assurance
M B T A	Migratory Bird Treaty Act	**S A R A**	Superfund Amendments and Reauthorization Act
m g/L	Milligrams per liter	**S D W A**	Safe Drinking Water Act
M G D	Million gallons per day	**S E R**	Site Environmental Report
m r e m	Millirem	**S N S**	Spallation Neutron Source
M S D S	Material Safety Data Sheet	**S P C C**	Spill Prevention, Control, and Countermeasure (Plan)
M S L	Mean Sea Level	**S Q G**	Small Quantity Generator
m S v	MilliSievert	**S R F**	Superconducting Radiofrequency
MT	Metric Ton	**S U R A**	Southeastern Universities Research Association, Inc.
N A A Q S	National Ambient Air Quality Standards	**S v**	Sievert
N A S A	National Aeronautics and Space Administration	**S W D A**	Solid Waste Disposal Act
N C P	National Oil and Hazardous Substances Pollution Contingency Plan	**S W P P**	Storm Water Pollution Prevention
N E L A C	National Environmental Laboratory Accreditation Conference	**T D S**	Total Dissolved Solids
N E P A	National Environmental Policy Act	**T J N A F or Jefferson Lab**	Thomas Jefferson National Accelerator Facility
N E S H A P s	National Emission Standards for Hazardous Air Pollutants	**T O C**	Total Organic Carbon
N H P A	National Historic Preservation Act	**T P Q**	Threshold Planning Quantity
O D S	Ozone-Depleting Substance	**T R I**	Toxic Release Inventory
O R O	Oak Ridge Operations – (DOE)	**T S**	Total Solids
O S H A	Occupational Safety and Health Act	**T S C A**	Toxic Substances Control Act
P 2	Pollution Prevention	**T S S**	Total Suspended Solids
P A A A	Price-Anderson Amendments Act	**Universal Labs**	Universal Laboratories, Inc.
P C B	Polychlorinated biphenyl	**U V**	Ultraviolet
p C i/l	Picocuries per liter	**V A C**	Virginia Administrative Code
P P A	Pollution Prevention Act	**V D H R**	Virginia's Department of Historic Resources
Q A	Quality Assurance	**V P A**	Virginia Pollutant Abatement (Permit)
Q A P	Quality Assessment Program	**V P D E S**	Virginia Pollutant Discharge Elimination System (Permit)
Q C	Quality Control	**W M i n/P 2**	Waste Minimization/Pollution

			Prevention
Rad Con	Radiation Control Group	**W S S**	Work Smart Standards

APPENDIX B

TECHNICAL TERMS

A

accuracy - The degree of agreement of a measurement with an accepted reference or true value. It is expressed as the difference between two values, as a percentage of the reference or true value, or as a ratio of the measured value and the reference or true value.

activated water - Water that becomes radioactive due to interaction with high energy neutrons or other high energy particles. Groundwater that comes into close proximity to locations at Jefferson Lab such as the accelerator tunnel, experimental halls, and beam dump earth shielding may become activated.

activation - The process of making a material radioactive by bombardment with electrons, neutrons, or other high energy particles.

activation products - A material that has become radioactive through the process of activation.

activity - Synonym for radioactivity.

affirmative procurement (AP) - A Federal program that obligates the Federal government to participate in the final link in the closed loop recycling process; procurement of products made from recycled materials.

airborne radioactivity - Radioactive material in any chemical or physical form that is present in ambient air, above natural background. This radioactivity can be generated by interaction with direct radiation.

ALARA - As Low As Reasonably Achievable; a phrase that describes an approach to minimize exposure to individuals and minimize releases of radioactive or other harmful materials to the environment to levels as low as social, technical, economic, practical, and public policy considerations will permit. ALARA is not a dose limit, but a process with a goal to keep dose levels as far below applicable limits as is practicable.

alpha radiation - The emission of alpha particles during radioactive decay. Alpha particles are identical in makeup to the nucleus of a helium atom and have a positive charge. Alpha radiation is easily stopped by materials as thin as a sheet of paper and has a range in air of only an inch or so. Despite its low penetration ability, alpha radiation is densely ionizing and therefore very damaging when ingested or inhaled. Naturally occurring radioactive elements such as radon emit alpha radiation.

ambient air - The surrounding atmosphere, usually the outside air, as it exists around people, animals, plants, and structures. It does not include the air immediately adjacent to emission sources.

analyte - A constituent that is being analyzed.

aquifer - A water saturated layer of rock or soil below the ground surface that can supply usable quantities of groundwater to wells and springs. Aquifers can be a source of water for domestic, agricultural, and industrial uses.

asbestos - A mineral fiber that can pollute air or water and cause cancer or asbestosis when inhaled. EPA has banned or restricted its use in manufacturing and construction.

B

background - A sample or location used as reference or control to compare Jefferson Lab analytical results to those in areas that could not have been impacted by Lab operations.

background radiation - Radiation present in the environment as a result of naturally occurring radioactive materials, cosmic radiation, or human-made radiation sources, including fallout.

becquerel (Bq) - A quantitative measure of radioactivity. This is an alternate measure of activity used internationally and with increasing frequency in the United States. One Bq of activity is equal to one nuclear decay per second.

beta radiation - Beta radiation is composed of charged particles emitted from a nucleus during radioactive decay, with a mass equal to 1/1837 that of a proton. A negatively charged beta particle is identical to an electron. A positively charged beta particle is called a positron. Beta radiation is slightly more penetrating than alpha, but may be stopped by materials such as aluminum or Lucite

panels. Naturally occurring radioactive elements such as potassium-40 emit beta radiation.

blank - A sample (usually reagent grade water) in the same type of container used for quality control of field sampling methods, to demonstrate that cross contamination has not occurred.

C

chain-of-custody - A method for documenting the history and possession of a sample from the time of collection, through analysis and data reporting, to its final disposition.

chlorofluorocarbon (CFC) – An inert, nontoxic, and easily liquefied chemical used in air conditioning, refrigeration, solvents, packaging, and aerosol propellants that is being phased out because of the damage it causes to the air's upper ozone level.

Code of Federal Regulations (CFR) - A codification of all regulations developed and finalized by Federal agencies in the Federal Register.

composite sample - A sample of an environmental medium that contains a certain number of sample portions collected over a period of time. The samples may be collected from the same location or different locations. They may or may not be collected at equal time intervals over a predefined period of time, *e.g.*, 24 hours.

contamination - Unwanted radioactive and/or hazardous material that is dispersed on or in equipment, structures, objects, air, soil, or water.

control - See background.

cooling water - Water that is used to cool machinery and equipment. Contact cooling water is any wastewater that contacts machinery or equipment to remove heat from the metal. Non-contact cooling water is water used for cooling purposes but has no direct contact with any process material or final product. Process wastewater cooling water is water used for cooling purposes that may have become contaminated through contact with the process raw materials or final products.

curie (Ci) - A quantitative measure of radioactivity. One Ci of activity is equal to 3.7×10^{10} decays per second. (1 picoCi = 0.037 Bq).

D

Department of Energy (DOE) - The federal agency that sponsors energy research and regulates nuclear materials used for weapons production. DOE has responsibility for the national laboratories and facilities and the science and research conducted at these institutions, including Jefferson Lab.

direct radiation - Radiation resulting from the interaction of the accelerator beam with matter is called direct (or prompt) radiation. This direct radiation is produced within the beam enclosure and stops being generated as soon as the accelerator is turned off.

disposal - Final placement or destruction of waste.

dose - The amount of energy imparted to matter, measured in units of rad or millirad (mrad); 1 rad = 1000 mrad.

dosimeter - A portable detection device for measuring the total accumulated exposure to ionizing radiation.

downgradient - In the direction of groundwater flow from a designated area; analogous to "downstream."

E

effective dose equivalent - A value used to express the health risk from radiation exposure to a tissue or tissues in terms of an equivalent whole body exposure. It is a normalized value that allows the risk from radiation exposure received by a specific organ or part of the body to be compared with the risk due to whole body exposure. It is equal to the sum of the dose to different organs of the body multiplied by their respective weighting factors. It includes the sum of the effective dose equivalent due to radiation from sources external to the body and the committed effective dose equivalent due to the internal deposition of radionuclides. EDE is expressed in units of rem or sieverts.

effluent - Any liquid discharged to the environment including stormwater runoff at a site or facility.

emission - Any gaseous or particulate matter discharged to the atmosphere.

Energy Star ® - a government-backed program that requires appliance energy efficiencies to be shown to guide purchasing decisions towards the more efficient product.

environment - Surroundings in which an organization operates (including air, water, land, natural resources, flora, fauna, and humans) and their interrelation.

environmental aspect - Elements of an organization's activities, products, or services that can interact with the environment.

environmental assessment (EA) - A report that identifies potentially significant environmental impacts from any federally approved or funded project that may change the physical environment. If an EA identifies a "significant" impact (as defined by NEPA) an Environmental Impact Statement is required.

environmental impact - Any change to the environment, whether adverse or beneficial, wholly or partially resulting from an organization's activities, products, or services.

environmental monitoring or surveillance - Sampling for contaminants in air, water, sediments, soils, food stuffs, plants, and animals, either by directly measuring or by collecting and analyzing samples.

Environmental Protection Agency (EPA) - The Federal agency responsible for developing and enforcing environmental laws. Although state regulatory agencies may be authorized to administer environmental regulatory programs, EPA generally retains oversight authority.

environmentally harmful material (EHM) - Any material that, if released into the environment in sufficient quantity, can have a negative impact on the environment or public health.

environmentally preferable purchasing - The act of purchasing products or services that have a lesser or reduced effect on human health and the environment when compared with competing products or services that serve the same purpose.

The comparison may consider raw materials acquisition, production, manufacturing, packaging, distribution, reuse, operation, maintenance, or disposal. (EO 13101, Section 201)

exposure - A measure of the amount of ionization produced by x-rays or gamma rays as they travel through air. The unit of radiation exposure is the roentgen (R).

extremely hazardous substance - Any of the chemicals identified by EPA based on toxicity, and listed under SARA Title III. The list of nearly 300 chemicals is periodically revised and published in the Federal Register.

G

grab sample - A single sample collected at one time and place.

groundwater - Water found beneath the surface of the ground (surface water). Groundwater usually refers to a zone of complete water saturation containing no air.

H

half-life ($t_{1/2}$) - The time required for one half of the atoms of any given amount of radioactive substance to disintegrate; the time required for the activity of a radioactive sample to be reduced by one half.

hazardous substance - A material that poses a threat to human health and/or the environment. Any substance designated by EPA to be reported if a designated quantity of the substance is spilled in the waters of the United States, or if it is otherwise emitted into the environment.

hazardous waste - Toxic, corrosive, reactive, or ignitable materials that can negatively affect human health or damage the environment. It can be liquid, solid, or sludge, and include heavy metals, organic solvents, reactive compounds, and corrosive materials. It is defined and regulated by the Resource Conservation and Recovery Act (RCRA), Subtitle C.

hydrogeology - the branch of geology that deals with the occurrence and distribution of groundwater. Effects on groundwater are also evaluated.

I

ionizing radiation - Any radiation capable of displacing electrons from atoms or molecules, thereby producing ions. Some examples are alpha, beta, gamma, x-rays, and neutrons. High doses of ionizing radiation may produce severe skin or tissue damage.

L

large quantity generator (LQG) - A facility generating more than 1,000 kg of hazardous waste per month.

lithologic - The gross physical character of a rock or rock formation; the description of a rock, especially sedimentary rock.

low-level radioactive waste (LLW) - Wastes containing radioactive material that is neither high level or transuranic. According to 10 CFR Part 61, this category includes, but is not limited to, slightly radioactive solidified liquids, resins, filters, and lab trash.

M

material safety data sheet (MSDS) - Information required under the OSHA Hazard Communication Standard on the identity of hazardous chemicals, health and physical hazards, exposure limits, and precautions.

maximally exposed individual - The hypothetical individual whose location and habits tend to maximize his/her radiation dose, resulting in a dose higher than that received by other individuals in the general population.

mean sea level (MSL) - The average height of the sea for all stages of the tide. Used as a benchmark for establishing groundwater and other elevations.

mho – A unit of conductance equal to the reciprocal of the ohm.

mixed waste - Waste that contains both a hazardous waste component regulated under Subtitle C of the Resource Conservation and

Recovery Act (RCRA) and a radioactive component.

monitoring - The collection and analysis of samples or measurements of effluents and emissions for the purpose of characterizing and qualifying contaminants, and demonstrating compliance with applicable standards.

monitoring well - A well where groundwater collects and is used to: evaluate water quality; establish groundwater flow and elevation; determine the effectiveness of treatment systems; and, determine whether administrative or engineering controls designed to protect groundwater are working as intended.

N

nuclide - A species of atom characterized by the number of protons and neutrons in the nucleus.

neutron radiation - Radiation consisting of energetic neutrons. At Jefferson Lab, neutron radiation can give rise to very low levels of radiation exposure at the site boundary.

O

on-site - The area within the boundaries of a site that is controlled with respect to access by the general public.

outfall - The place where any water is discharged.

ozone (O_3) - A very reactive form of oxygen formed naturally in the upper atmosphere and providing a shield for the earth from the sun's ultraviolet rays. At ground level or in the lower atmosphere, it is pollution that forms when oxides of nitrogen and hydrocarbons react with oxygen in the presence of strong sunlight. Ozone at ground level can lead to health effects and cause damage to trees and crops.

P

permit - An authorization issued by a Federal, State or local regulatory agency. Permits are issued under a number of environmental regulatory programs, including RCRA, CAA, CWA, and TSCA. They grant permission to operate, to discharge, to construct, etc. Permit provisions may include emission/effluent limits and other requirements such as the use of pollution control devices, monitoring, record keeping and reporting. Also called a "license" or "certificate" under some regulatory programs.

pH - A measure of hydrogen ion concentration in an aqueous solution. Acidic solutions have a pH less than 7, neutral solutions have a pH of 7, and basic solutions have a pH greater than 7 and up to 14.

point source - Any confined and discrete conveyance (*e.g.*, pipe, channel, well, or stack) of a discharge.

pollutant - Any hazardous or radioactive material naturally occurring or added to an environmental medium such as air, soil, water, or vegetation.

pollution prevention (P2) - Preventing or reducing the generation of pollutants, contaminants, hazardous substances or wastes at the source, or reducing the amount for treatment, storage, and disposal through recycling. P2 can be achieved through reduction of waste at the source, segregation, recycle/reuse, and the efficient use of resources and material substitution. The potential benefits of P2 include the reduction of adverse environmental impacts, improved efficiency, and reduced costs.

polychlorinated biphenyls (PCBs) - A family of organic compounds used from 1926 to 1979 (when they were banned by EPA) in electrical transformers, lubricants, carbonless copy paper, adhesives, and caulking compounds. PCBs are extremely persistent in the environment because they do not break down into different and less harmful chemicals. PCBs are stored in the fatty tissues of humans and animals through the bioaccumulation process.

precision - The dispersion around a central value, usually represented as a variance, standard deviation, standard error, or confidence interval.

Q

quality assurance (QA) - In environmental monitoring, any action to ensure the reliability of

monitoring and measurement data. Aspects of QA include procedures, interlaboratory comparison studies, evaluations, and documentation.

quality control (QC) - In environmental monitoring, the routine application of procedures to obtain the required standards of performance in monitoring and measurement processes. QC procedures include calibration of instruments, control charts, and analysis of replicate and duplicate samples.

R

radiation boundary monitor - Devices placed strategically around the perimeter of the accelerator site that monitor dose information.

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.

radionuclide - A radioactive element characterized by the number of protons and neutrons in the nucleus. There are several hundred known radionuclides, both artificially produced and naturally occurring.

regulated medical wastes - Includes human body tissues or body fluids, and nonreusable medical utensils that held or came in contact with body tissues or fluids. To prevent the passing of contagious diseases, the handling and disposal of these wastes are covered under the Medical Waste Tracking Act of 1988.

release - Spilling, leaking, pumping, pouring, emitting, discharging, injecting, escaping, leaching, dumping, or disposing of a hazardous substance, pollutant, or contaminant into the environment. The National Contingency Plan also defines the term to include a threat of release.

rem - Stands for "roentgen equivalent man," a unit by which human radiation dose is assessed. This is a risk-based value used to estimate the potential health effects to an exposed individual or population.

reportable quantity (RQ) - The quantity of a hazardous substance that triggers reports under CERCLA. If a substance is released in amounts exceeding its RQ, the release must be reported to the National Response Center, the State response center, and community emergency coordinators for areas likely to be affected.

runoff - The movement of water over land. Runoff can carry pollutants from the land into surface waters or uncontaminated land.

S

sampling - The extraction of a prescribed portion of an effluent stream or environmental medium for purposes of inspection or analysis.

sediment - The layer of soil and minerals at the bottom of surface waters, such as streams, lakes, and rivers.

sensitivity - The minimum amount of an analyte that can be repeatedly detected by an instrument.

sievert (Sv) - A unit for assessing the risk of human radiation dose, used internationally and with increasing frequency in the United States. One sievert is equal to 100 rem.

skyshine - Radiation emitted over a shielded enclosure and reflected by air so as to radiate people on the outside.

small quantity generator (SQG) - A facility generating between 100 and 1,000 kg of hazardous waste, or less than 1 kg of acutely hazardous waste, per month. Requirements are less stringent than for an LQG.

spallation - The process by which a high energy particle striking a nucleus causes fragments to be ejected from the nucleus. The resulting atom is usually radioactive.

sump - A pit or tank that catches liquid runoff for drainage or disposal.

T

threshold planning quantity (TPQ) - A quantity designated for each chemical on the list of EHSs that triggers notification by facilities to the state emergency response commission that such facilities are subject to EPCRA.

total dissolved solids (TDS) - A measure of the total amount of minerals, organic matter, and nutrients that are dissolved (not merely suspended) in water.

total suspended solids (TSS) - A measure of the suspended solids in wastewater, effluent, or water bodies, determined by using tests for total suspended nonfilterable solids.

tritium - The heaviest and only radioactive nuclide of hydrogen, with a half-life of 12.3 years and a very low energy radioactive decay (beta emitter).

U

upgradient/upslope - A location of higher groundwater elevation; analogous to "upstream."

V

Virginia Pollutant Discharge Elimination System (VPDES) - A program under which permits are issued by the state to regulate water discharges. The permit specifies the maximum discharge limits for the parameters present in the particular discharge.

W

waste minimization (WMin) - An action that avoids or reduces the generation of waste by source reduction, reduces the toxicity of hazardous waste, improves energy usage, or recycling. This action is consistent with the general goal of minimizing present and future threats to human health, safety, and the environment. Associated with P2, but more likely to occur after the waste has already been generated.

water table - The water-level surface below the ground at which the unsaturated zone ends and the saturated zone begins. It is the level to which a well that is screened in the unconfined aquifer would fill with water.

watershed - The region draining into a river, a river system, or a body of water.

APPENDIX C

APPLICABLE SITE STANDARDS

APPLICABLE SITE STANDARDS

Standards in the Work Smart Standards (WSS) Set

The DOE uses the WSS Process to identify EP (environmental protection), health and safety hazards, and the standards describing mitigation measures. Through this process, the particular hazards associated with the Lab were identified, along with the corresponding laws, regulations, and other standards necessary and sufficient to protect the worker, the public, and the environment against the identified hazards. This summary of applicable environment, health, and safety requirements for Jefferson Lab is the WSS Set. The WSS Set was amended again in August 2002.

The applicable EP and public health-related standards, including the site operating permits, are listed in Exhibits C1, C2, and C3. Various Occupational Safety and Health Act (OSHA)-related standards are included in the WSS Set, but since these contain minimal EP controls, compliance with OSHA was not singled out in this report. Compliance with each of the listed standards, by category, is presented in the parts of Section 2 referenced in the exhibits.

Administrative Laws and Regulations (AL&R) List

The AL&R List was developed along with the WSS Set and identifies EH&S implementation standards and requirements that are of an administrative nature and not directly related to hazards. The EP and public health-related AL&R documents include some U.S. Department of Transportation (DOT) hazardous material regulations and a section of the U.S. Code dealing with generators of hazardous waste. AL&R items are not specifically listed below but refer to the appropriate topical discussions in the SER.

Together, the WSS Set and the AL&R List contain almost all of Jefferson Lab's EH&S requirements.

Other Contractual Commitments

These EH&S commitments, such as radioactive waste management requirements and the obligation to maintain the EH&S Manual, are identified specifically in the DOE/SURA contract. These items are not listed here but are referenced in the SER if appropriate.

Exhibit C1
Federal Laws and Regulations Included in the WSS Set

SER References		Citations	Titles
LAWS (by subject)			
2.2.7	Asbestos	15 U.S.C. § 2641 et seq.	Asbestos Hazard Emergency Response Act of 1986 (training)
2.5	Water	33 U.S.C. § 1251 et seq.	Federal Water Pollution Control Act (Clean Water Act)
2.3.1	Radiation	42 U.S.C. § 2282a	Price-Anderson Amendments Act of 1988 (referenced in 10 CFR 835)
2.6	Public Health	42 U.S.C. § 300f et seq.	Safe Drinking Water Act, as amended
2.4	Air	42 U.S.C. § 7401 et seq.	Clean Air Act and Amendments

Exhibit C1 (continued)
Federal Laws and Regulations Included in the WSS Set

SER References		Citations	Titles
LAWS			
2.8.5	Emergency Response	42 U.S.C. § 9601 et seq.	CERCLA
2.8.5	Emergency Planning	42 U.S.C. § 11001-11050	SARA Title III EPCRA
2.8.5	Pollution Prevention and Waste Minimization	42 U.S.C. § 13101 et seq.	Pollution Prevention Act of 1990
REGULATIONS			
2.3.1		**Title 10 - Energy**	Part 71, Radiation Protection
2.3.1			Parts 834 & 835
		Title 29 - OSHA	
2.2.7			Part 1910.1001, Asbestos
		Title 40 - Protection of Environment	
2.4		Subchapter C	Various Air Programs
2.5		Subchapter D	Various Water Programs
2.2		Subchapter I	Various Waste Programs including RCRA
2.2		Subchapter J	Various Superfund, EPCRA Programs
2.5.2		Subchapter N	Part 403
2.2.7		Subchapter R	Part 763
		Title 49 - Transportation	
2.7.5	Transportation	Subchapter C	Various Hazardous Materials Regulations
DOE GUIDANCE			
2.9.3		O 5400.5	Radiation Protection of the Environment, Chapter II and IV
EXECUTIVE ORDERS (EOs)			
2.8.3		13101	*Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*
2.8.4		13123*	*Greening the Government Through Efficient Energy Management*
2.8.5		13148	*Greening the Government Through Leadership in Environmental Management*

Notes: See referenced sections for full titles of noted laws or permits.

* In the AL&R List

Exhibit C2
Permits, State Laws, and Regulations Included in the WSS Set

SER References	Citations	Standard	Issued	Effective
LAWS				
2.2.1	Title 10.1 - Conservation	Chapter 14, Virginia Waste Management Act		
2.5	Title 62.1 - Waters of the State, Ports & Harbors	Chapter 3.1, State Water Control Law		
PERMITS			**Issued**	**Effective**
2.5.1.2	DEQ No. VA0089320	VPDES Permit - Specifies allowable groundwater and surface water quality on-site during accelerator operations. Assures groundwater unaffected at and beyond site boundary.	7/16/96	Through 7/16/2006
2.5.1.2	DEQ No. VAG253002 (replaced by VAG250018 in 3/2003)	General Permit for Cooling Water Discharges - Authorizes cooling water discharges within identified discharge limitations.	[applicable 9/99]	Through 3/1/2003
PERMITS				
2.5.2.1	HRSD No. 0117	Industrial Wastewater Discharge Permit - Limits wastes to be discharged to sewerage.	10/87	3/1/2002 3/1/2007
2.5.2.2	DEQ No. GW0030800	Permit to Withdraw Groundwater - Authorizes maximum quantities of water to be withdrawn by dewatering of area under experimental halls.	11/1/94	Through 10/30/2004
2.2.2	4727-45-01	South Carolina Radioactive Waste Transport Permit – Authorization to transport LLW within the State	9/14/2001	Through 12/31/2003
REGULATIONS				
2.4	9 - VAC (Environment)	Chapter 5, Air Quality		
2.2	9 - VAC (Environment)	Chapter 20, Waste Regulations		
2.5	9 - VAC (Environment)	Chapter 25, Water Quality		
2.5.2	*none*	HRSD Industrial Wastewater Discharge Regulations		

Note: See referenced SER sections for full titles of noted laws or permits.

Exhibit C3
Other Standards Identified in the WSS Set

Category/SER References	Citations	Standard
REGULATIONS		
2.7.5	49 CFR 177	Hazardous Materials Regulations
DOE GUIDANCE		
2.9.3	O 5400.5	Radiation Protection of the Environment, Sections 1a and 1b
Transportation-Related Information		
2.8.5.1	Emergency Response: response actions in the event of a transportation emergency that include reporting and notification requirements	CERCLA/SARA VA Emergency Management Operations Plan
2.8	Emergency Response: response actions in the event of a transportation emergency	EH&S Manual Standards: Appendix 3510-T3 and Chapter 6732
2.2.1	Hazardous Waste: on-site movement and preparation for offsite shipment	EH&S Manual Standard: Chapter 6761
EH&S MANUAL		
2.2, 2.3, 2.4, 2.5, 2.7, 2.8, 3.2, 5.1, & 7.0	Assorted Chapters and Appendices referenced within.	Manual sections include topics on: ionizing radiation protection, asbestos, emergency planning, air and water quality, oil spill prevention, waste minimization, recycling and waste management practices.