Thomas Jefferson National Accelerator Facility
U.S. Department of Energy
12000 Jefferson Avenue
Newport News, VA 23606

JEFFERSON LAB
SITE ENVIRONMENTAL REPORT
For Calendar Year 2000

Prepared by:
SURA/Jefferson Lab
Office of Technical Performance
EH&S Reporting
September 2001

TABLE OF CONTENTS

(Continued)

(Continued)

EXHIBITS

ACRONYMS	ACRONYM LIST
ACM	Asbestos-containing material
AL&R	Administrative Laws and Regulations
AP	Affirmative Procurement
ARC	Applied Research Center
CAA	Clean Air Act
CAAA	Clean Air Act Amendments of 1990
CEBAF	Continuous Electron Beam Accelerator Facility
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFC	Chlorofluorocarbon
CFR	Code of Federal Regulations
Ci	Curie
CWA	Clean Water Act
CX	Categorical Exclusion
CY	Calendar Year
DEQ	(Virginia) Department of Environmental Quality
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EA	Environmental Assessment
EHM	Environmentally Harmful Material
EHS	Extremely Hazardous Substance
EH&S	Environment, Health, and Safety
EML	Environmental Measurements Laboratory
EO	Executive Order of the President of the United States
EPA	Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act of 1986
EPGs	Emergency planning and response groups
ESA	Endangered Species Act
ES&H	Environment, Safety, and Health
FDS	Floor drain sump
FEL	Free Electron Laser
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FY	Fiscal Year
GeV	Giga-electron Volts
GSA	General Services Administration
HRSD	Hampton Roads Sanitation District
HS	Hazardous Substance
HWC	Hazardous Waste Coordinator
IA	Independent Assessment
IR	Infrared
ISM	Integrated Safety Management
IWDR	Industrial Wastewater Discharge Regulations
kg	Kilogram
LSA	Line Self-Assessment
MAPEP	Mixed Analyte Performance Evaluation Program
McDermott	McDermott Technologies
mg/l	Milligrams per liter
MGD	Million gallons/day
mrem	Millirem

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ACRONYMS	ACRONYM LIST
MSDS	Material Safety Data Sheet
MSL	Mean Sea Level
mSv	Millisievert
NAAQS	National Ambient Air Quality Standards
NASA	National Aeronautics and Space Administration
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NELAC	National Environmental Laboratory Accreditation Conference
NEPA	National Environmental Policy Act
NESHAPs	National Emission Standards for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
ODS	Ozone-Depleting Substance
ORO	Oak Ridge Operations – (DOE)
OSHA	Occupational Safety and Health Act
P2	Pollution Prevention
PAAA	Price-Anderson Amendments Act
PCB	Polychlorinated biphenyl
pCi/l	Picocuries per liter
PPA	Pollution Prevention Act
QA	Quality Assurance
QAP	Quality Assessment Program
QC	Quality Control
RADCON	Radiological Control
RBM	Radiation boundary monitor
RCG	Radiation Control Group
RCRA	Resource Conservation and Recovery Act
RQ	Reportable Quantity
SA/QA	Self-Assessment/Quality Assurance
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SER	Site Environmental Report
SNS	Spallation Neutron Source
SPCC	Spill Prevention, Control, and Countermeasure (Plan)
SQG	Small Quantity Generator
SRF	Superconducting Radiofrequency
SURA	Southeastern Universities Research Association, Inc.
SWDA	Solid Waste Disposal Act
TDS	Total Dissolved Solids
TOC	Total Organic Carbon
TPQ	Threshold Planning Quantity
TRI	Toxic Release Inventory
TSCA	Toxic Substances Control Act
TSS	Total Suspended Solids
UV	Ultraviolet
Universal Labs	Universal Laboratories, Inc.
VAC	Virginia Administrative Code
VPA	Virginia Pollution Abatement (Permit)
VPDES	Virginia Pollutant Discharge Elimination System (Permit)
WMin/P2	Waste Minimization/Pollution Prevention
WSS	Work Smart Standards

JEFFERSON LAB SITE ENVIRONMENTAL REPORT FOR CALENDAR YEAR 2000

SECTION 1

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 (CY) 2000. 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 Jefferson Lab operations. The report also summarizes environmental programs, initiatives, and assessments that were undertaken in 2000. The objective of the Site Environmental Report (SER) is to document Jefferson Lab's active environmental protection program that protects the environment and public health.

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) provides an electron beam to three experimental halls where a variety of physics experiments are conducted. Correlative programs where environmental protection is considered are: the Free Electron Laser (FEL); Superconducting Radio-Frequency research and development; and cryomodule development for the Spallation Neutron Source (SNS) project.

Major Site Programs

CEBAF: During 2000, progress was made to upgrade CEBAF to 6 GeV (Giga-electron Volts). The accelerator continued to deliver electron beams at energies close to 6 GeV to meet the variety of needs of the experimenters in Halls A, B, and C. The CEBAF accelerator, originally designed to provide 4 GeV continuous wave electron beams, reached 6.07 GeV at 109 microamperes during test runs in August**.**

Jefferson Lab has completed 32 experiments and partially completed another 47 between facility commissioning and the end of CY 2000. One of the major experiments in Hall C, known as Gen (that means the charge form factor of the neutron), is using a new kind of detector called a "neutron polarimeter". A large Hall A collaboration, involving researchers from all over the world, investigated electro-disintegration at high momentum transfer using the electron beam to interact with the atomic nucleus of a gaseous isotope of helium known as helium-3.

Superconducting Radio-Frequency (SRF) Technology: SRF research and development were enhanced in 2000 to better support the existing accelerators. Improvements were made to the original CEBAF cryomodule design to support current 6 GeV and future 8 GeV and 12 GeV operations. Also, SRF improvements and applications to meet SNS needs were underway.

FEL: The Lab's FEL is in its fourth year of activity. It is a kilowatt level light source with output in both the infrared (IR) and ultraviolet (UV) wavelength domains. It supports basic science research and serves universities, private industry, the U.S. Navy, and the U.S. Air Force.

During 2000, the FEL experiments included: energy flow within proteins, production of coatings and thin films for electronics and microcomponents, and production of carbon nanotubes. CY 2000 also marked the beginning of a two-year FEL 10 kilowatt upgrade project to add two new cryomodules to the FEL accelerator, a new injector to double the quantity of beam produced, and a new "wiggler" magnet to help improve operational capabilities.

SNS: The SNS project is a partnership involving six DOE national research centers, Jefferson Lab, Argonne, Brookhaven, Lawrence Berkeley, Los Alamos, and Oak Ridge, to design and construct what will be the most powerful spallation source in the world in Oak Ridge, Tennessee. The SNS will provide intense pulsed-neutron beams for scientific research and industrial development. Jefferson Lab's contribution is to develop and build the cryomodules and to design the cryogenic support facilities for the project. Many SNS milestones were reached in 2000.

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

Organization and Management: Ultimate responsibility for protection of the environment and the 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 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. More information is provided in Section 3.

EH&S Performance Measures: These 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 3.

Inspections and Appraisals: The Virginia Department of Environmental Quality (DEQ) and the Hampton Roads Sanitation District (HRSD) performed inspections in 2000. There were no concerns or violations identified. The remaining deficiencies from three previous DOE external appraisals were closed in 2000. The DOE Site Office's Overlay Report included an "outstanding" rating for SURA in the EH&S category. These are discussed further in Section 4.

Implementation of 10 CFR 835: This DOE Code of Federal Regulations 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. This is addressed in Section 3.

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). Routine activities are covered under site-specific Categorical Exclusions (CXs). New activities in 2000 received NEPA CX authorizations, including two that covered radioactive

waste management and an addition to the Test Lab to support SNS activities. NEPA is discussed further in Section 3.

Environmental Management System Implementation: This 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.

Summary of Environmental Results in 2000

Compliance

Jefferson Lab complied with applicable Federal, State, and local environmental laws, regulations, and DOE guidance during 2000. 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 and improved to ensure that new compliance initiatives were incorporated in 2000.

Radiological Monitoring

Water: Radiation measurements are made at the groundwater dewatering sump and groundwater monitoring wells located near the accelerator and the experimental halls. Sampling intervals vary from quarterly to annually. There were no readings above background in 2000. No analyte, except gross beta, was detected above the permit-required sensitivity levels. The gross beta was detected at normal background levels. Therefore, there were no accelerator-produced radionuclides detected in our groundwater.

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

Airborne: Radiological airborne emissions at the site boundary are addressed under the Environmental Protection Agency's (EPA's) 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, CY 2000 values were reported to the EPA. One result reported to the EPA for 2000 was that the total maximum offsite dose from radiological airborne releases was less than 0.048 mrem / year.

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 2000 were within Jefferson Lab's allowable limits. The highest direct radiation level measured was only 3.8% 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 5.

Non-radiological Monitoring

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

Items of Interest in 2000

Highlights in Jefferson Lab's 2000 environmental protection and pollution prevention program included:

- Modified the cavity production process to achieve a 50% reduction in acid use;
- Sent 7.4 tons of various outdated computer equipment for recycling;
- Maintained a top rating in the Lab's performance measure that addresses recycling compared to landfilled waste;
- Appointed a Green Acquisition Advocate in the Business Services Department to spearhead a program to purchase EPA-designated recycled-content products;
- Received a "Gold Pretreatment Excellence Award" from the local sanitation district; and
- Instituted a new radioactive waste management program.

SECTION 2
INTRODUCTION

2.1 GENERAL

This report provides the public with a summary of CY 2000 environmental protection and public health items that characterize the environmental management performance at Jefferson Lab. This report addresses the Lab's compliance status with applicable requirements, standards, and contractual commitments. Information on related assessments, initiatives, and site programs is also included.

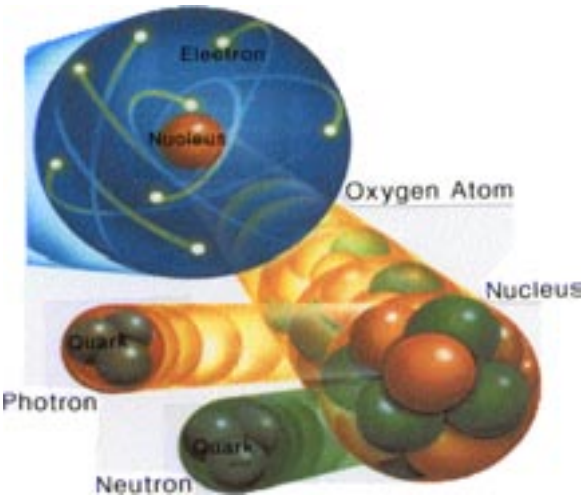
The term "safety" in the ISM program includes environmental protection and public health, as well as worker safety and health (all are generally termed EH&S). EH&S responsibilities are incorporated in each employee's position description as described in the Jefferson Lab ISM Plan. The DOE validated the ISM Plan in 1999. Refer to Section 4.2 for more information.

2.2 LABORATORY MISSION

Jefferson Lab, formerly known as CEBAF, is a national accelerator facility managed by SURA for the DOE. The accelerator complex portion of the Lab still retains the name CEBAF and includes three underground halls that house the physics program experiments. Jefferson Lab's mission statement addresses quality and excellence in research, community partnership, and environment, health, and safety.

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. The accelerator is used to study quark structures and behaviors and the forces governing the clustering of individual nucleons in the nuclear medium.

There were improvements in CEBAF operations in support of the physics program experiments in 2000, including further progress in upgrading CEBAF to 6 GeV. Since the Lab began operations, through the end of 2000, researchers had completed 32 major physics program experiments. In 2000 alone, 12 experiments were successfully completed, 5 in Hall A, 4 in Hall B, and 3 in Hall C. Jefferson Lab's expertise in SRF technology is being used to design and build the cryomodules and refrigeration system for the DOE's SNS that is being built in Oak Ridge, Tennessee. Use of the FEL by Jefferson Lab, industrial, Department of Defense (DOD), and university partners also continued in 2000.



Atomic Structure

2.3 ENVIRONMENTAL REVIEW

An environmental assessment, termed EA, performed under NEPA, was conducted prior to construction of CEBAF (February 1987), resulting in a Finding of No Significant Impact (FONSI). The EA and other NEPA-related documentation have been reviewed periodically with no significant changes noted. A 1997 EA, that yielded a FONSI, addressed CEBAF upgrades and FEL-related activities. Refer to Section 3.15.1 for additional NEPA information.

2.4 SITE 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 2-1. 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 2-2 shows the Jefferson Lab site proper.

Jefferson Lab is sited in the northern section of Newport News at an average elevation of 34 feet above mean sea level (MSL). The site elevation ranges from 29 to 35 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. The site is a part of the Brick Kiln Creek watershed, which discharges into the Big Bethel Reservoir. Big Bethel Reservoir is operated by the U.S. Army and provides drinking water to Fort Monroe, Langley Air Force Base, and the National Aeronautics and Space Administration (NASA)-Langley Research Center.

2.5 SITE HISTORY AND DESCRIPTION

Prior to Jefferson Lab, there were several users of this general area. In 1942 and 1943, the 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 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, NASA (110 acres), 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. Therefore, the total DOE-owned parcel, upon which Jefferson Lab is built, is 162 acres.

An adjacent 44 acres, owned by the city of Newport News, were conveyed to SURA in December 1986. A SURA dormitory is located on a portion of this land, and is used by guests and visiting experimenters, who are referred to as users.

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), located on this property, was completed in 1998. The ARC is used by Jefferson Lab, industry, and universities and is the cornerstone of the newly designated Jefferson Center for Research and Technology. Other adjacent land owned by the Commonwealth of Virginia is leased to SURA and the DOE for its use in support of Jefferson Lab.

Sign at Main Entrance to Site

EXHIBIT 2-1

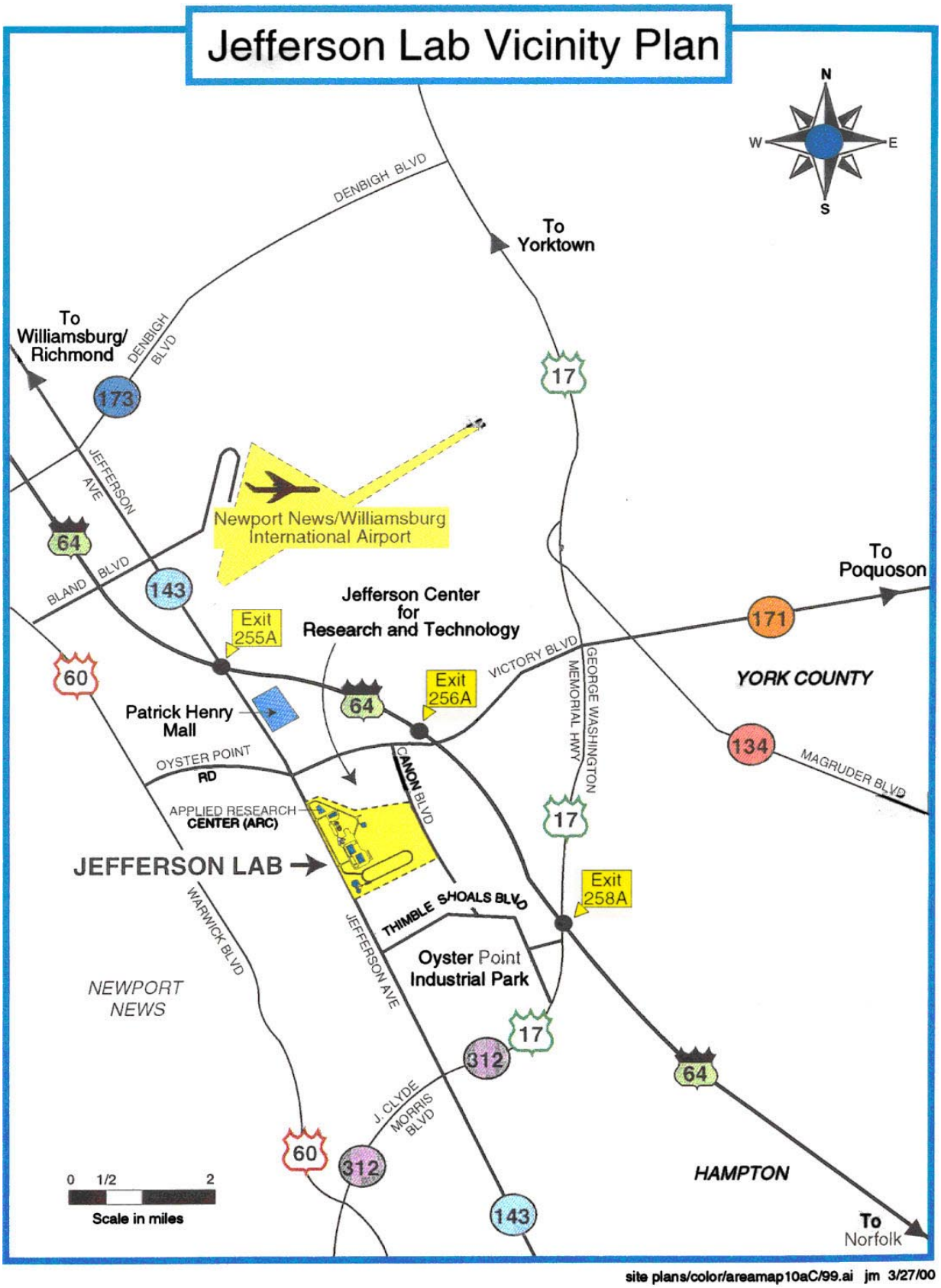
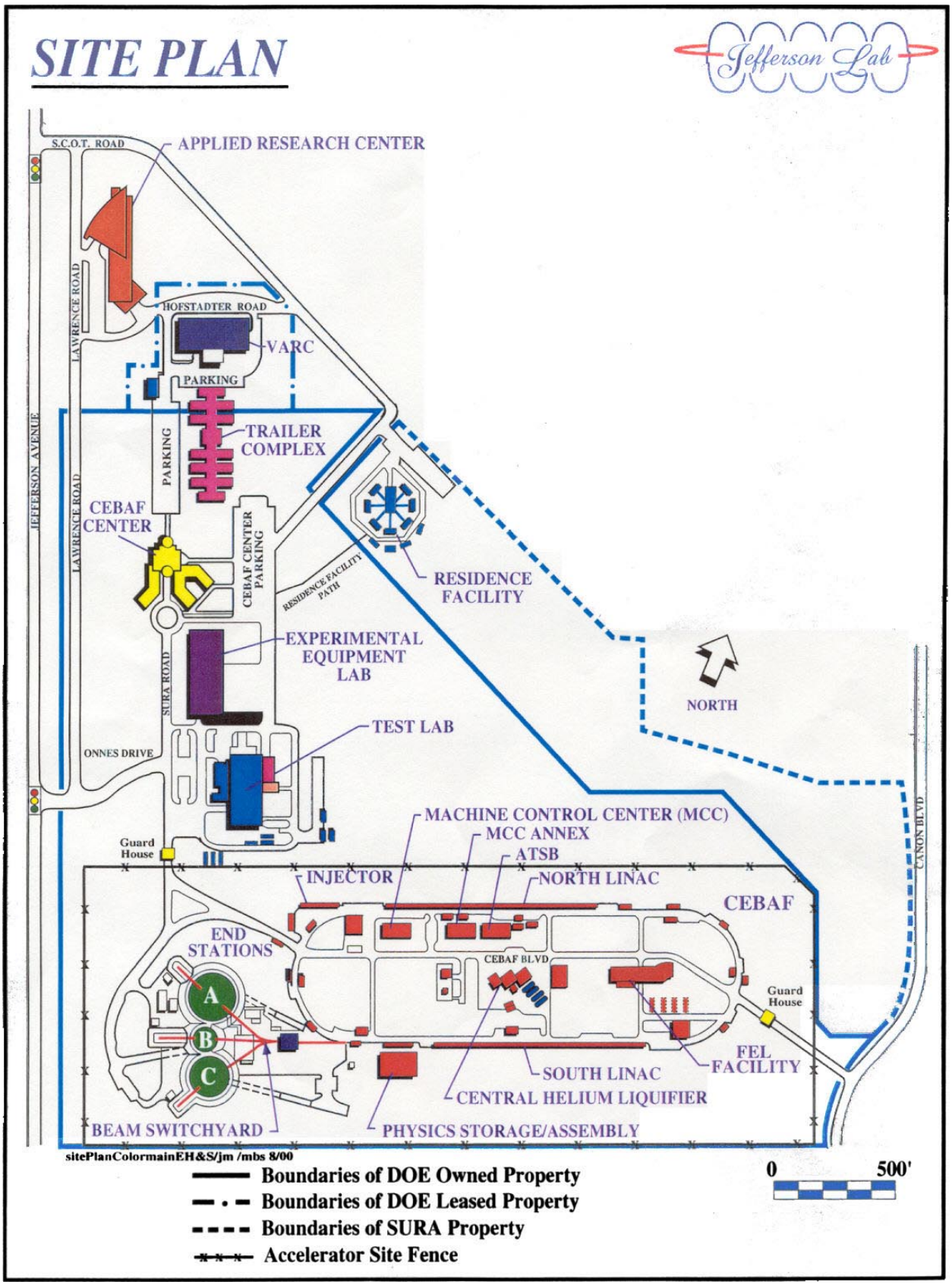

Jefferson Lab Vicinity Plan
N
W
E
S
To Yorktown
DENBIGH BLVD
To Williamsburg/ Richmond
DENBIGH BLVD
173
JEFFERSON AVE
17
Newport News/Williamsburg International Airport
64
BLAND BLVD
143
Jefferson Center for Research and Technology
Exit 255A
To Poquoson
171
60
Exit 256A
VICTORY BLVD
GEORGE WASHINGTON MEMORIAL HWY
YORK COUNTY
Patrick Henry Mall
64
134
MAGRUDER BLVD
OYSTER POINT RD
CANON BLVD
APPLIED RESEARCH CENTER (ARC)
17
JEFFERSON LAB
Exit 258A
THIMBLE SHOALS BLVD
WARWICK BLVD
JEFFERSON AVE
Oyster Point Industrial Park
NEWPORT NEWS
17
312
64
J. CLYDE MORRIS BLVD
60
312
HAMPTON
0 1/2 2
Scale in miles
143
To Norfolk
site plans/color/areamap10aC/99.ai jm 3/27/00

EXHIBIT 2-2


SITE PLAN
Jefferson Lab
S.C.O.T. ROAD
APPLIED RESEARCH CENTER
LAWRENCE ROAD
HOFSTADTER ROAD
VARC
PARKING
TRAILER COMPLEX
JEFFERSON AVENUE
PARKING
LAWRENCE ROAD
CEBAF CENTER
CEBAF CENTER PARKING
RESIDENCE FACILITY PATH
RESIDENCE FACILITY
EXPERIMENTAL EQUIPMENT LAB
SURA ROAD
NORTH
TEST LAB
ONNES DRIVE
MACHINE CONTROL CENTER (MCC)
MCC ANNEX
ATSB
Guard House
INJECTOR
NORTH LINAC
CEBAF
END STATIONS
CEBAF BLVD
A
B
C
Guard House
FEL FACILITY
SOUTH LINAC
CENTRAL HELIUM LIQUIFIER
BEAM SWITCHYARD
PHYSICS STORAGE/ASSEMBLY
CANON BLVD
sitePlanColormainEH&S/jm /mbs 8/00
Boundaries of DOE Owned Property
Boundaries of DOE Leased Property
Boundaries of SURA Property
Accelerator Site Fence
0
500'

2.6 SITE ENVIRONMENT, HEALTH, & SAFETY RESOURCES

The facility makes available a variety of EH&S resources to serve the Jefferson Lab community. The Lab community includes staff, Commonwealth employees, subcontractors, visiting experimenters, and students of all ages that participate under various programs.

Local EH&S resources 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 implementing procedures for EH&S. The EH&S Manual is accessible via paper copy at designated locations or at 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 and the Oak Ridge Operations (ORO) Office; 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 2000 to support the continued development and implementation of environmental protection and public health-related programs at Jefferson Lab.

SECTION 3
2000 COMPLIANCE SUMMARY

3.1 INTRODUCTION

Compliance with applicable environmental protection 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 by Jefferson Lab's self-assessments, routine inspections, and through oversight by the DOE Site Office and outside regulators, including staff from the DEQ and HRSD. Assurance is also obtained through guidance from the DOE ORO Office, with additional program support by the DOE Office of Science.

3.2 LIST OF ENVIRONMENTAL PROTECTION AND PUBLIC HEALTH STANDARDS

Environmental protection and public health-related standards and commitments have been identified in DOE/SURA contractual documents. They are divided into three groupings:

- the Work Smart Standards Set;
- the Administrative Laws and Regulations (AL&R) List; and
- other Contractual Commitments.

3.2.1 Standards in the WSS Set

The DOE designated the Necessary and Sufficient Process, now called the WSS Process, to identify environmental protection, health, and safety hazards and the standards describing mitigation measures. During this process, the particular hazards associated with the Lab were identified, 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 most recently amended in February 2001.

The applicable environmental protection and public health-related standards, including the four site operating permits, are listed in Exhibits 3-1, 3-2, and 3-3. Various Occupational Safety and Health Act (OSHA)-related standards are included in the WSS Set, but since these contain minimal environmental protection controls, compliance with OSHA is not singled out in this report. Compliance with each of the listed standards, by category, is presented in parts of Section 3 as referenced in the exhibits.

EXHIBIT 3-1

FEDERAL LAWS AND REGULATIONS INCLUDED IN THE WSS SET

SER References		Citations	Titles
LAWS (by subject)			
3.3	Asbestos	15 U.S.C. § 2641 et seq.	Asbestos Hazard Emergency Response Act of 1986 (training)
3.4	Water	33 U.S.C. § 1251 et seq.	Federal Water Pollution Control Act (Clean Water Act)
3.5	Radiation	42 U.S.C. § 2282a	Price-Anderson Amendments Act of 1988 (referenced in 10 CFR 835)
3.6	Public Health	42 U.S.C. § 300f et seq.	Safe Drinking Water Act, as amended
3.7	Air	42 U.S.C. § 7401 et seq.	Clean Air Act and Amendments
3.8	Emergency Response	42 U.S.C. § 9601 et seq.	CERCLA
3.9	Emergency Planning	42 U.S.C. § 11001-11050	SARA Title III EPCRA
3.10	Pollution Prevention and **3.11** Waste	42 U.S.C. § 13101 et seq.	Pollution Prevention Act of 1990
REGULATIONS		**Title 10 - Energy**	
(3.5.1)			Parts 71, 834, and 835
(3.15.6)			Part 10
		Title 40 - Protection of Environment	
(3.7)		Subchapter C	Various Air Programs
(3.4)		Subchapter D	Various Water Programs
(3.11)		Subchapter I	Various Waste Programs including RCRA
(3.8 & 3.9)		Subchapter J	Various Superfund, EPCRA Programs
(3.4.3)		Subchapter N	Part 403
(3.3)		Subchapter R	Part 763
		Title 49 - Transportation	
3.12	**Transportation**	Subchapter C	Various Hazardous Materials Regulations
DOE GUIDANCE			
(3.5.4)		O 5400.5	Radiation Protection of the Environment, Chapter II and IV

(Continued)

EXHIBIT 3-1 (Continued)

EXECUTIVE ORDERS (EOs)		
(3.10 and 3.11)	13101	*Greening the Government Through Waste Prevention, Recycling, and Federal Acquisition*
(3.10)	*13123*	*Greening the Government Through Efficient Energy Management*
(3.7.3, 3.9, 3.10, and 3.11)	*13148*	*Greening the Government Through Leadership in Environmental Management*

Notes:
SER: Site Environmental Report
Italics indicate it is in the process of being incorporated into WSS Set.
See referenced sections for full titles of noted laws or permits.

EXHIBIT 3-2

PERMITS, STATE LAWS AND REGULATIONS INCLUDED IN THE WSS SET

SER References	Citations	Standard	Issued	Effective
LAWS				
(3.11)	Title 10.1 - Conservation	Chapter 14, Virginia Waste Management Act		
(3.4)	Title 62.1 - Waters of the State, Ports and Harbors	Chapter 3.1, State Water Control Law		
PERMITS			**Issued**	**Effective**
(3.4.2)	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 7/16/2001
(3.4.2)	DEQ No. VAG253002	General Permit for Cooling Water Discharges - Authorizes cooling water discharges within identified discharge limitations.	[applicable 9/99]	Through 3/1/2003
(3.4.4)	HRSD No. 0117	Industrial Wastewater Discharge Permit - Limits wastes to be discharged to sewerage.	10/87	3/1/99-3/1/2002
(3.4.5)	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
REGULATIONS				
(3.7)	9 - VAC (Environment)	Chapter 5, Air Quality		
(3.11)	9 - VAC (Environment)	Chapter 20, Waste Regulations		
(3.4)	9 - VAC (Environment)	Chapter 25, Water Quality		
(3.4.4)	*none*	HRSD Industrial Wastewater Discharge Regulations		

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

EXHIBIT 3-3

OTHER STANDARDS IDENTIFIED IN THE WSS SET

Category/SER References	Citations	Standard
REGULATIONS		
(3.12)	49 CFR 177	Hazardous Materials Regulations
DOE GUIDANCE		
(3.5.4 3.15.8)	O 5400.5	Radiation Protection of the Environment, Sections 1a and 1b
VIRGINIA PLAN		
(3.8)		Virginia Emergency Management Operations Plan
EH&S MANUAL		
(3.3, 3.4, 3.5, 3.7, 3.8, 3.9, 3.11, & 3.13)	Assorted Chapters and Appendices referenced below.	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.

3.2.2 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. Together, the WSS Set and the AL&R List contain almost all of Jefferson Lab's EH&S requirements. The environmental protection and public health-related AL&R documents are not specifically listed here, but include some U.S. Department of Transportation (DOT) hazardous material regulations and a section of U.S. Code dealing with generators of hazardous waste. Refer to Section 3.14 for the compliance status.

3.2.3 Other Related Contractual Commitments

Compliance with other environmental protection or public health-related contractual requirements, e.g., the Endangered Species Act, is discussed in Section 3.15.

3.3 COMPLIANCE STATUS-ASBESTOS AND PCB STANDARDS

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.

3.3.1 PCBs

Since 1987, SURA has been removing PCBs and PCB-contaminated items from the site. Technically, the site is PCB-free. There were no compliance issues in 2000.

3.3.2 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 NESHAPs. EH&S Manual Chapter 6681, *Asbestos Management*, implements the ACM requirements at Jefferson Lab. There were no compliance issues in 2000.

3.4 COMPLIANCE STATUS - WATER QUALITY STANDARDS

Groundwater and surface water protection are a high priority 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. Each of these standards is referenced under the respective topic below.

Facilities in Virginia that directly discharge to waters of the United States must obtain a Virginia Pollutant Discharge Elimination System (VPDES) permit to do so. 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 are addressed in Section 3.4.1. VPDES concerns relating to industrial activities, including the quality of cooling water discharges and the potential for radiological contamination of groundwater, are covered under Section 3.4.2.

The concrete halls, which house the experimental apparatus that accepts accelerator beam, are partially buried. As the floors of the halls are situated 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. This process is termed dewatering. Compliance with the related permits is described in Sections 3.4.2 and 3.4.5.

Jefferson Lab has a variety of on-site activities that result in water discharges to the sanitary sewer system. The associated wastewater standards included in the WSS Set are discussed in Sections 3.4.3 and 3.4.4.

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 presented in Section 3.4.6.

3.4.1 VPDES - Construction Activity

Jefferson Lab strives to keep pollutants, such as sediments, out of surface waters. No permits have been required through 2000. The Lab's Plant Engineering 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 some of the site-specific procedures to address erosion control.

3.4.2 VPDES - 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 (see Section 3.4.5). The purpose of the original Virginia Pollution Abatement (VPA) Permit, which was superseded by a VPDES permit, was to quantify water quality "baseline" values for certain parameters and to 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 the groundwater dewatering do not degrade the quality of either on-site or offsite groundwater. Refer to Section 7 and EH&S Manual Chapter 6731, *Groundwater Protection,* for background and site-specific information.

Throughout 2000, 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 groundwater compliance issues in 2000.

Cooling Water Discharges - General Permit for Cooling Water Discharges

This permit covers the surface discharges from the cooling towers adjacent to the Central Helium Liquifier, Building 8. A small tower adjacent to the Test Lab, Building 58, was added to the Permit in early 2001. The permit contains water quality limits.

Sampling is performed under a subcontract with an accredited laboratory and is submitted to the Commonwealth at the end of each quarter. The sampling during 2000 revealed one unusual result each for pH and chlorine. One involved sampling that occurred during a no flow situation and the other was due to taking the sample too close to the source. The two values were reported to the DEQ, and Jefferson Lab satisfactorily resolved any concerns.

3.4.3 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. No compliance issues occurred in 2000.

3.4.4 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,* describes specific implementation practices at Jefferson Lab.

Monthly pH values are taken by a subcontractor at permitted 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. There were no violations or disparities in 2000.

Permitted discharges of activated water at one HRSD sampling point continued in 2000. 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 the analytical reports are provided to the HRSD. All radiological permit and regulatory criteria were met in 2000 and are discussed further in Section 5.2.2.

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 2000 was 0.26 Ci of tritium (*or about 5.2% of the total allowed*) and 0.0000004 Ci of Beryllium-7 (*or 0.00004% of the total allowed*).

Laboratory staff participated in the February 15, 2000 annual inspection by the HRSD. No compliance issues were identified at that time or in the course of the year.

3.4.5 Permit to Withdraw Groundwater

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. 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 2000, and all monthly values were within permit requirements. The total quantity of water withdrawn in 2000 was 4.5 million gallons, 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 2000. Water quality sampling is performed under the terms of the VPDES Permit No. VA0089320, as described in Section 3.4.2.

3.4.6 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. The Lab has an approved SPCC Plan under 40 CFR 112, which is due for review in 2001. The SPCC Plan covers handling, storage, and transportation activities and is implemented by division-specific procedures and 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. A number of gas-powered emergency generators containing small amounts of oil were added to the site inventory in 2000, but are not subject to this threshold.

3.5 COMPLIANCE STATUS-RADIOLOGICAL PROTECTION STANDARDS

This section addresses the status of Jefferson Lab's compliance with radiological environmental protection and public health laws and regulations.

3.5.1 Title 10 - Energy

10 CFR 71, Packaging & Transportation of Radioactive Material

There were no offsite shipments or compliance issues in 2000. Refer to further transportation compliance information under Section 3.12.

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 EH&S Manual Chapters 6310, *Ionizing Radiation Protection* and 6315, *Environmental Monitoring of Ionizing Radiation*. Refer to Section 3.5.3 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 radiological-related activities and requires reporting of non-compliances. DOE PAAA radiation protection regulations are codified in 10 CFR 835 and address: radioactive contamination, storage of radioactive materials, and radiological emergency response. Jefferson Lab complied with 10 CFR 835 requirements in 2000. Refer to Section 3.8 for additional information.

3.5.2 Title 40, Part 61, Subpart H

The Lab complied with 40 CFR 61 Subpart H requirements in 2000. Refer to discussion in Section 3.7.2.

3.5.3 EH&S Manual Chapters 6310 and 6315

Chapters 6310, *Ionizing Radiation Protection,* and 6315, *Environmental Monitoring of Ionizing Radiation,* contain site-specific programs used to manage identified radiological 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 radioactive contamination of other water-containing systems and groundwater. There were no compliance issues in 2000.

3.5.4 DOE Order 5400.5

Portions of chapters II and IV of Order 5400.5, *Radiation Protection of the Public and the Environment,* apply and are addressed as described in the Jefferson Lab Radiological Control (RADCON) Manual. There were no compliance issues in 2000.

3.6 COMPLIANCE STATUS - PUBLIC HEALTH STANDARDS

The Safe Drinking Water Act of 1974 (SDWA) was enacted to ensure 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 provides drinking water to its staff and visitors through three public water supply lines provided by the city of Newport News Waterworks.

The SDWA applies to two areas at Jefferson Lab: the Backflow Prevention Program and the surface discharges under the two VPDES permits. Jefferson Lab had no SDWA compliance issues during 2000.

3.6.1 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. The purpose is to ensure that untreated industrial wastewater is mechanically prevented from contaminating the drinking water supply. Jefferson Lab subcontracts with locally approved plumbing firms to certify that all backflow prevention devices function as designed. Annual inspection reports are sent to the city's Public Utilities Department. All inspections to date, the last one in May 2000, have had no identified issues.

3.6.2 Surface Water Quality

The site drainage system flows to the Big Bethel Reservoir, a drinking water source for local military installations. The groundwater dewatering discharge and the cooling water effluent are discharged into surface water channels that lead offsite. Both streams are monitored for quality pursuant to the applicable VPDES permit. There were no compliance issues in 2000. Refer to Section 4 for further discussion on the permit monitoring programs.

3.7 COMPLIANCE STATUS - AIR QUALITY STANDARDS

The Clean Air Act (CAA), that includes the Clean Air Act Amendments of 1990 (CAAA), regulates 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. Jefferson Lab has no processes that require air permitting at this time.

Applicable regulations are contained in 40 CFR Subchapter C, and the Virginia Regulation 9 VAC 5 series, *Air Quality*. Standards include EO 13148 and EH&S Manual Chapter 6720, *Air Quality Management*. Air quality regulatory information is presented below.

3.7.1 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 2000, 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). The vehicle maintenance is performed offsite by shops approved by the GSA. There is no gasoline dispensing facility on-site. 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 compliance actions under Title I of the CAA in 2000.

3.7.2 National Emission Standards for Hazardous Air Pollutants (NESHAPs)

The NESHAPs is a CAA-implementing regulation that sets quality standards for air emissions

that contain hazardous components (e.g., 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.

Radionuclide Emissions

Radionuclide emissions generated during accelerator and FEL testing and operations, including emissions resulting from interactions of the accelerator beam 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 5.3 for discussion of direct radiation, the primary form of radiation generated on-site.)

Jefferson Lab used sampling results to demonstrate that the Lab remained under the EPA-defined 10% of the 10 mrem/yr. potential effective dose equivalent to any member of the public during 2000. 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 at representative site boundary locations 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 criteria 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 commenced annual reporting for 1999. This is discussed further in Section 5. No notifications for construction or modifications were necessary in 2000.

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 with asbestos. There were no asbestos-related NESHAP issues in 2000. Compliance with other asbestos standards is described in Section 3.3.

3.7.3 Other Air Emission Concerns

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 ensures that by utilizing preventive maintenance measures and scrubbers, it minimizes releases of polluted air. The Lab's emissions remain below reporting thresholds.

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. The usage values for CY 2000 are presented in Exhibit 3-4. In 2000, a new paint spray booth and several natural gas-powered emergency generators were installed. No requirements for permits are anticipated.

EXHIBIT 3-4

SOURCE REGISTRATION UPDATE FOR CALENDAR YEAR 2000

Ref. No.	Equipment	Annual Fuel Process Rate (Million Cu. Ft. Burned)	Process Volume % Annual Thruput J-M	A-J	J-S	O-D
HB-1	CLVR.BRKS.	2.7	40	26	10	24
HB-2	CLVR.BRKS. P-142-30	2.7	40	26	10	24
HB-3	CLVR.BRKS. CB-760-60	5.6	35	24	15	26
HB-4	CLVR.BRKS. CB-760-60	5.6	35	24	15	26
HB-5	BRYAN F-450 WG	3.5	25	25	25	25
HB-6	BRYAN F-90 WG	1.08	48	20	0	32
HB-7	BRYAN F-90 WG	1.08	48	20	0	32
HB-8	PSB Fin Tube Radiator	0.4	85	7	0	8

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

A DEQ inspection occurred on September 7, 2000, with no concerns identified. There were no air emission violations at Jefferson Lab in 2000.

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 R12, 22, 502, and 134a) on-site. Also, the subcontractor, who performed all service, repair, and maintenance on Jefferson Lab refrigeration / air conditioning equipment during 2000, was required to be certified in compliance and has demonstrated effectiveness in capturing and recycling these compounds. Four Jefferson Lab Plant Engineering employees have received certification training, ensuring that laboratory staff understand the EPA requirements and that

subcontractors are appropriately certified.

Jefferson Lab has three chlorofluorocarbon (CFC)-based (one R-11 and two R-113) chillers onsite. They are effectively maintained by mechanical staff to ensure optimal performance and minimize CFC losses. Opportunities to modify or replace them were considered in 2000, but the existing units presently meet Jefferson Lab needs.

The site is preparing to phase 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 and hall staff are 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 understands its responsibility to minimize or eliminate the purchase and use of ODSs. The Lab's CFC and Halon Use Policy is included in the EH&S Manual Appendix 6720-T2, *Air Quality Program Regulatory Requirements.*

3.8 COMPLIANCE STATUS - EMERGENCY RESPONSE STANDARDS

Two environmental emergency response-related hazards exist at Jefferson Lab. One hazard involves releases resulting from the storage or transport of environmentally harmful materials (EHMs). The applicable legislation is the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA). Other applicable regulations are noted in the WSS Set. The second hazard is a radiological release, as addressed in 10 CFR 835.

Emergency response standards that apply to EHMs are noted in the WSS Set and referenced in Exhibits 3-1 and 3-3. There were three minor oil spills in 2000 that were mitigated promptly, none of which impacted the environment. These small spills are discussed in Section 4.5.1.

There were no releases subject to CERCLA or other emergency response regulations in 2000.

3.9 COMPLIANCE STATUS - EMERGENCY PLANNING STANDARDS

The Emergency Planning and Community Right-to-Know Act of 1986 (EPCRA), also known as SARA Title III, addresses accidental chemical releases in communities. EPCRA 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 EPA and local response agencies. The EPA posts some information on their website.

EPCRA-related planning and prevention standards that apply to Jefferson Lab include: 40 CFR 300, 355, 370, and 372, under Subchapter J (see specifics below) provide regulatory compliance guidance; EO 13148, *Greening the Government through Leadership in Environmental Management*; and Appendix 6710-T2, *Emergency Planning and Community Right-to-Know* of the EH&S Manual provides site-specific compliance information.

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 city of Newport News Fire Department. Transportation-related standards pertaining to emergency planning are discussed in Section 3.12.

Jefferson Lab maintained compliance with applicable emergency planning standards in 2000.

3.9.1 40 CFR 300

This regulation is titled *the National Oil and Hazardous Substances Pollution Contingency Plan* (NCP) and 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.*

3.9.2 40 CFR 355, Emergency Planning and Release Reporting

Under EPCRA Section 302, 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 the Threshold Planning Quantity (TPQ). Jefferson Lab's EPCRA Section 302 notifications to date include hydrofluoric acid, nitric acid, and bromine. There were no new EHSs identified in 2000.

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 (RQ) 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 3.4.4.

3.9.3 40 CFR 370, Hazardous Chemical Inventories

Under EPCRA Sections 311 and 312 Material Safety Data Sheets (MSDSs), or a list of those chemicals, must be submitted to EPGs for each hazardous chemical present when the quantity exceeds the TPQ identified in the regulations. Jefferson Lab's submittal of the annual Tier II Report, a hazardous chemical inventory form, to the EPGs satisfies this requirement. In addition, upon request, the Lab's Emergency Management Manager provides MSDSs to the local Fire Chief for their records. See Section 6.6 for more information.

3.9.4 40 CFR 372, Toxic Release Reporting

These regulations require 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. No listed toxic chemicals were "otherwise used" in quantities exceeding 10,000 pounds in 1999; therefore, no reporting was required in 2000.

3.10 COMPLIANCE STATUS - POLLUTION PREVENTION STANDARDS

Jefferson Lab has identified four applicable pollution prevention (P2) standards: the Pollution Prevention Act (PPA) of 1990; Executive Order (EO) 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.* Jefferson Lab EH&S staff continued to stress the importance of source reduction to prevent pollution. This education process informs process owners of the financial advantages of avoiding unnecessary waste disposal fees. Specific Lab P2 and energy efficiency initiatives are discussed in Section 4.5. There were no outstanding compliance issues regarding P2 or energy efficiency standards in 2000.

3.10.1 Pollution Prevention Act (PPA)

The PPA established the policy that pollution should be reduced at the source by prevention, recycling, treatment, or disposal, in that order. Disposal should be used only as a last resort. All alternatives should be performed in an environmentally safe manner. Jefferson Lab complies with this pollution reduction policy to the extent possible.

3.10.2 EO 13148

EO 13148 revoked and replaced various EOs in April 2000. Its primary purpose is to integrate environmental accountability into federal agency policies, operations, planning, and management. The DOE established agency-wide goals based on those established in the EO. The primary P2 goal was that, where possible, pollution should be prevented or reduced at the source.

Jefferson Lab uses very few listed toxic chemicals and complies with the P2 goals by minimizing use, reusing to the maximum extent, and disposing of these wastes in the most effective environmentally safe manner. The Lab is in the process of establishing P2 goals regarding reductions in standard sanitary waste, hazardous waste, and low-level radioactive waste generation, and for improving our recycling performance.

There were no P2 compliance concerns in 2000.

3.10.3 EO 13101

EO 13101 strengthens and expands the previous EO 12873 by encouraging more efficient use of natural resources and waste prevention measures. EO 13101 includes implementing waste recycling by encouraging federal agencies to procure products made with recycled materials. The purchase of these materials helps "close-the-loop" in the recycling process. To comply with this EO, the DOE has set goals and performance standards on a variety of product classes.

This policy of procuring products made with recycled materials is termed Affirmative Procurement (AP). The DOE's complex-wide Fiscal Year (FY) 2000 procurement

target for purchasing EPA-listed products was 100%. The FY 2000 AP Annual Reporting System report reveals that Jefferson Lab's compliance level was 58.2%, revealing room for improvement. The majority of applicable year 2000 purchases involved uncoated copy paper, binders, and toner cartridges. The Procurement Department reported that centralized copy paper purchases met the 100% goal, but individual purchasers fell far short of the goal. To meet DOE and Jefferson Lab goals, the Procurement Department has named an AP champion and is continuing to educate individual purchasers to buy materials that meet EPA-recommended criteria. Jefferson Lab is trying other means to maximize the use of AP.

Review of the Lab's AP program continued in 2000, primarily in conjunction with DOE-sponsored teleconferences on EO 13101.

3.10.4 EO 13123

This initiative focuses on energy efficiency as a means of pollution prevention. It became effective on November 4, 1999. The Plant Engineering Department provides an annual energy report and additional opportunities were reviewed for saving energy in 2000. Though there are only a few buildings that are identified for the site goals, the FY report showed that a 7% reduction from the baseline energy use was achieved.

3.11 COMPLIANCE STATUS - WASTE MANAGEMENT STANDARDS

The Resource Conservation and Recovery Act of 1976 (RCRA), also called the Solid Waste Disposal Act (SWDA), 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. 40 CFR Subchapter I, *Waste Programs*, implements the Act and has application at Jefferson Lab.

RCRA provides EPA's authority to regulate solid waste, from minimization and recovery to collection and disposal. The Virginia DEQ has been delegated the authority to regulate solid wastes by the EPA. The Virginia Waste Management Act and Commonwealth regulations under the Virginia Administrative Code sections 9 VAC 20-80 (et seq., *Waste Regulations)* apply. The EH&S Manual implements this program at Jefferson Lab.

Full compliance was maintained through 2000. Each of the major wastestreams is addressed below.

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

These references set 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. The DEQ regulates hazardous waste management in Virginia. Jefferson Lab's Hazardous Waste Coordinator (HWC) manages the site-specific program in compliance with the referenced Manual chapter.

Jefferson Lab registered as a RCRA Small Quantity Generator (SQG) in 1987. To maintain SQG status, a facility cannot generate more than 1 kilogram (kg) of acutely hazardous waste and 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 4600 kgs of hazardous waste in 2000. Some recent hazardous waste minimization initiatives are described in Section 4.5. The DEQ performed an inspection in 2000 and no compliance issues were identified.

Jefferson Lab maintains hazardous waste storage units. No permitting is required because hazardous waste is not stored on-site beyond the regulatory time frame. Jefferson Lab neither transports hazardous wastes nor operates any regulated treatment or disposal units. There are two elementary neutralization units, but they are not regulated as treatment devices. Some EHMs are recycled and/or reused prior to final disposal.

The PPA and EO 13148

A common goal of the PPA and EO 13148 is preventing and reducing pollution, including that from toxic materials, to the maximum extent practicable. A contractual Performance Measure addresses this goal. Refer to Section 3.15.7.

3.11.2 Radioactive and Mixed Waste

The new DOE Order 435.1, *Radioactive Waste Management*, was reviewed with the DOE Site Office for applicable requirements in 2000. Radiation Control Group staff then began implementation of the applicable sections of the Order, which included establishing a program for more efficient separation and categorization of the Lab's low-level radioactive wastes.

Approximately 5.0 cubic meters of low-level radioactive waste were generated in 2000. No radioactive waste has been disposed of to date, but plans are underway to dispose of any identified wastes by the date set in the Order, July 9, 2001. There has been no mixed waste, which exhibits both hazardous and radioactive characteristics, generated to date. Jefferson Lab was in compliance with all applicable standards in 2000.

3.11.3 Non-Hazardous Waste VA Standards and EH&S Manual Chapter 6760, *Waste Management*

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 waste programs in Virginia. Jefferson Lab assigns oversight responsibility to staff members for the different wastestreams covered under this category according to EH&S Manual Chapter 6760.

EO 13101 and 13148

These EOs encourage waste prevention and the procurement of products made with recycled materials, thereby keeping materials out of landfills. Waste disposal cost-saving opportunities were reviewed in 2000 and improvement opportunities with scrap metal recycling were identified.

Other Non-Hazardous Waste-Related Compliance Items

There are other forms of liquid and solid non-hazardous wastes, including domestic wastewater. Two water collection pits are in the Counting House (Building 97); one discharges to surface water and the

other to the HRSD system. The permits for these water discharges are discussed in Sections 3.4.2 and 3.4.4. Other non-hazardous wastes are disposed in a landfill, reused on-site, recycled, or used for other purposes offsite. Approved waste management plans and procedures prevent or minimize impacts to the environment, both at the generating facility and the final disposal or usage point. Jefferson Lab minimizes the generation of waste (reduction at the source) as the primary way of reducing environmental impacts, thereby lowering purchase and disposal costs.

Jefferson Lab utilizes licensed subcontractors for collection, separation, and permanent disposal. Aluminum cans and paper goods are recycled separately. Refer to Section 4.5 for more information on lab recycling efforts. Section 3.15.7 refers to Performance Measure results for tracking recyclables.

3.11.4 Regulated Medical Waste

The Lab's EH&S Manual Chapter 6850, *Regulated Medical Waste Management* and Appendix 6850-T1, *Regulated Medical Wastes Handling Procedures* apply, and include RCRA and Virginia requirements. There were no compliance issues with this program in 2000.

3.11.5 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 2000.

3.12 COMPLIANCE STATUS - 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.

Requirements include the DOT regulations identified in 49 CFR Subchapter C, *Hazardous Materials Regulations*, the Jefferson Lab RADCON Manual, and EH&S Manual Chapters 6150, *Compressed Gases*, 6310, *Ionizing Radiation Protection*, Appendix 6750-T4, *Packaging EHMs for Transport*, and identified industry standards.

Many of the regulations applicable to transportation also apply to other environmental or public health topics.

Compliance with these regulations is addressed under the appropriate topical areas elsewhere in this Report, as shown on Exhibit 3-5, unless noted below.

3.12.1 49 CFR Regulations

49 CFR 171 through 178 apply to hazardous and radioactive material transportation. These regulations cover the DOT packaging and transport requirements that minimize risk to the environment or public health in case of accidents.

The delivery of hazardous or radiological materials to the site is contingent upon compliance with appropriate DOT and other requirements. Hazardous and radioactive materials must be properly packaged for offsite transport according to DOT regulations. The Radiation Control Group (RCG) manages the radiological portion of this program

EXHIBIT 3-5

TRANSPORTATION-RELATED STANDARDS DISCUSSED ELSEWHERE IN SER

SER Section	Transportation-related Information	Applicable Standards
3.4.6	SPCC Plan: oil and oil-product issues	40 CFR 112
3.5.1	Radiation Protection: packaging and transport of radiological materials	10 CFR 71
3.8	Emergency Response: response actions in the event of a transportation emergency that include reporting and notification requirements	CERCLA/SARA VA Emergency Management Operations Plan
3.9.1	Emergency Response: response actions in the event of a transportation emergency	EH&S Manual Standards: Appendix 3510-T3 and Chapter 6732
3.11.1	Hazardous Waste: on-site movement and preparation for offsite shipment	EH&S Manual Standard: Chapter 6761

and the HWC manages non-radiological DOT requirements. There were no compliance issues in 2000.

3.12.2 Radiological Control Manual, EH&S Manual Chapters 6150, 6310 and 6750, and Handbook of Compressed Gases

These industry and site-specific standards primarily provide for the safe packaging and transport of both hazardous and radioactive materials on Jefferson Lab property.

Properly trained staff perform the on-site transport of hazardous materials. This is done in accordance with specific procedures, including those in EH&S Manual Chapter 6750, *Environmentally Harmful Materials.* Radioactive materials are managed by the RCG in accordance with the Jefferson Lab RADCON Manual, internal procedures, and work permits. All medical wastes are handled by specially trained staff and managed by Medical Services.

Involved staff have received the appropriate training. There were no compliance issues regarding these transportation standards in 2000.

3.13 COMPLIANCE STATUS - 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. Accidental release protection measures include the provision of secondary containment and the location of EHM storage areas away from floor drains.

Though there were three minor oil spills, there were no uncontrolled EHM releases affecting the environment or public health in 2000.

3.14 COMPLIANCE STATUS - AL&R LIST

Administrative environmental protection and public health requirements are in the AL&R Set. Though a violation would not directly impact the environment, it could result in an administrative action. AL&R standards are generally incorporated into site programs. There were no known non-compliance issues in 2000.

3.15 COMPLIANCE STATUS - OTHER OBLIGATIONS IDENTIFIED IN THE CONTRACT

Jefferson Lab has other environmental protection and public health-related obligations not specifically included in the standards lists. These obligations are incorporated into site programs, including subcontractual agreements, exclusive of direct legal requirements. Jefferson Lab's participation in DOE's NEPA process and implementing EO 13123 are examples of these obligations.

3.15.1 NEPA

NEPA requires that projects with potentially significant impacts to the environment be carefully evaluated and alternative actions explored. These evaluations are to be performed and reported as EAs or Environmental Impact Statements. Jefferson Lab is required to assist the DOE in implementing the NEPA process on the site, including preparing NEPA documents.

An EA for the proposed Newport News site for CEBAF (now Jefferson Lab), 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 and resulted in a FONSI. Refer to Section 4.4 for discussion of 2000 NEPA items.

Jefferson Lab will respond to any requirements identified by the DOE with respect to NEPA compliance issues. There were no NEPA compliance issues in 2000.

3.15.2 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

This Act 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. The Jefferson Lab Plant Engineering Department subcontracts regular monthly preventive pest control. There were no FIFRA compliance issues at Jefferson Lab in 2000. See discussion in Section 6.3.

3.15.3 Endangered Species Act (ESA)

The ESA designates and protects endangered wildlife, fish, plants, and their ecosystems. A 1986 environmental survey of Jefferson Lab's 162-acre site uncovered no endangered species in the area. Plans are underway for a new technical research park adjacent to the site. No ESA compliance issues were identified in 2000, but are being revisited in early 2001 with the preparation of a new EA that primarily involves construction activities.

3.15.4 National Historic Preservation Act (NHPA)

The NHPA of 1966, Section 106, governs the protection of archaeological and historical resources. Area surveys in 1987 uncovered no historic sites. On October 16, 1992, the Commonwealth of Virginia's Department of Historical Resources determined that all Section 106 conditions had been met and no further assessments were required. No new compliance issues were identified during 2000.

3.15.5 EO 11988, "Floodplain Management"

This EO relates to the occupancy and modification of floodplains, and

as Jefferson Lab is not in a floodplain, the specific EO 11988 requirements do not apply; however, localized flooding during significant rain events, including hurricanes, does occur. Plant Engineering coordinates any modifications to site drainage patterns in local flood zones to ensure appropriate drainage is maintained.

3.15.6 EO 11990, "Protection of Wetlands"

This EO was issued to ensure that adverse impacts to wetlands are avoided or responsibly mitigated prior to disturbance from construction activities. 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 EA and FONSI. Evaluation of Jefferson Lab activities involving potential wetlands is accomplished through the NEPA review process. No concerns involving wetlands were identified in 2000.

3.15.7 Compliance Status - Performance Measures

Performance Measures are incorporated into the DOE/SURA Contract. Four of them reflect environmental protection issues. The FY 2000 scores follow in Exhibit 3-6.

3.15.8 Compliance Status - DOE Guidance

The current performance-based DOE/SURA Contract incorporated applicable DOE requirements, previously addressed in DOE Orders and guidance, in either a Performance Measure or in the Environment, Safety and Health (ES&H) Responsibilities portion of the Contract under Appendix E.

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 5400.1 and 5400.5, and DOE Standards N441.1 and 1023-95. 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 was implemented in 1999 and 2000.

In 2000, Jefferson Lab complied with applicable DOE documents, guidance, and related contractual commitments.

EXHIBIT 3-6

RELATED PERFORMANCE MEASURE RESULTS

I.D.	Performance Measure Description	Score for FY 2000
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.	81%

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

SECTION 4

ENVIRONMENTAL PROTECTION PROGRAM INFORMATION

Jefferson Lab's mission includes protection of the environment and public health. There are many facets to the site environmental protection program, including the primary activity of radiological and non-radiological monitoring, and other actions such as program and lab-wide assessments and inspections. This section provides information on these and other environmental protection or public health-related 2000 events and activities.

4.1 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 or public health, identify potential environmental problems, provide data to support management decisions, and evaluate the need for remedial actions or mitigative measures.

The Jefferson Lab Environmental Monitoring Program establishes guidelines for examining chemical, oil, and radioactive effluents 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 have emphasized 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 in potential drinking water sources. These exposure potentials are discussed in Section 5 and are not 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 Technical Performance.

Jefferson Lab environmental data collected in 2000 included:

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

On-site environmental surveillance continued in 2000. The 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 Jefferson Lab operations are not adversely affecting public health or the environment.

Throughout 2000, the RCG reviewed radiological and non-radiological environmental monitoring information stemming from accelerator operations for conformity with applicable standards. Refer to Section 5 for the environmental radiological program discussion and to Section 6 for environmental non-radiological program information.

4.2 APPRAISALS, ASSESSMENTS, AND INSPECTIONS

The DOE Site Office, the ORO Office, and various Commonwealth and local authorities provide external oversight of the Jefferson Lab Environmental Protection Program.

External Appraisals

The last of the environmentally related deficiencies identified during three previous DOE external appraisals were closed in 2000. This closure followed review and approval of the Lab's corrective actions by the DOE Site Office. None of these deficiencies represented a threat to public health or the environment.

DOE Review of Jefferson Lab Self-Assessment

The DOE Site Office's Overlay Report, produced in conjunction with SURA's annual laboratory-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 2000, the Overlay Performance Evaluation Report yielded a rating of "Outstanding" in the EH&S category.

Integrated Safety Management (ISM)

ISM is a process that ensures that safety (EH&S collectively) is incorporated into all work processes. This was Jefferson Lab's philosophy even before ISM was incorporated into the Laboratory's contract with DOE.

Subsequent to a November 1999 DOE Site Office validation of the effectiveness of ISM at the Laboratory, the few areas identified for improvement have been the subject of Laboratory corrective action plans, most of which have been completed.

External Reviews

A Radiation Control Group Peer Review was conducted in August 2000 at Jefferson Lab, which is categorized as a low-hazard, non-nuclear accelerator facility. The review covered many topics including radiation work controls, workplace and environmental monitoring, activated water management, and source accountability. Jefferson Lab earned 92.5% of the available points, an "Outstanding" rating.

External Inspections

There were two external environmental inspections during 2000:

- The HRSD staff performed the annual Jefferson Lab site inspection on February 15. The HRSD chose to review the Test Lab equipment and laboratory areas in 2000. No problems were identified. The inspector commended the staff for its professionalism and the good secondary containment practices evident in all areas.
- An unannounced DEQ inspection of the Lab's air emission sources took place on September 7. The inspection encompassed the natural gas-fired boilers, the new natural gas emergency generators, and a new paint booth. No concerns were identified, and information on the new equipment was provided to the inspector.

Line Self-Assessments

Line managers perform line self-assessments (LSAs) of their organizational elements annually. 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 of the Lab's organizational units each year, with a focus on EH&S.

Deficiencies identified through the IAs are tracked by SA/QA until the corrective actions are completed.

4.3 ENVIRONMENTAL PERMITS

Environmental permits held by the DOE Site Office are listed in Exhibit 3-2, and compliance with each is discussed in Section 3 of this report. All permits citing limits and conditions involving water are discussed in Sections 5.2.2 and 6.1.

4.4 2000 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 follow the related EPA regulations. Jefferson Lab assists the DOE by preparing documents and performing assessments of existing Jefferson Lab documentation. NEPA actions performed in 2000 follow.

- The existing eight site-specific CXs were renewed during 2000. These CXs pertain to regular activities that meet NEPA criteria, such as "Improvements to Cooling Water Systems" and "Routine On-site Storage of Activated Material".
- One new project CX covering the Test Lab addition to house SNS activities was approved.
- New site-specific CXs approved covered: radioactive waste management, the siting of particle accelerators with beam energies under approximately 100 MeV, and access road improvements.
- The internal approval process for very small-scale construction projects that are covered under existing CXs continued in 2000.

4.5 SUMMARY OF SIGNIFICANT ENVIRONMENTAL ACTIVITIES AT JEFFERSON LAB

4.5.1 Issues and Actions

An emergency management exercise simulated an oil spill within the accelerator fence. Issues, such as interfaces with various response agencies and between lab departments, were identified. Line management is resolving these issues.

There were three minor oil releases in 2000. Two involved hydraulic line leaks, one from a delivery truck where a loose line caused a localized spray, and another from a forklift line break inside a building. The third spill was due to a small hole in a drum that had just arrived on site. All instances were minor and quickly corrected by line management and EH&S staff.

Other items of note include:

- The HRSD awarded Jefferson Lab a Gold Pretreatment Excellence Award for its excellent performance record in 2000.
- A second cooling tower discharge was added to the DEQ General Permit at the end of the year.
- The Lab continued to procure low-mercury fluorescent lamps that should result in the eventual elimination of the fluorescent lamp hazardous waste stream.
- Due to a new DOE initiative, the RCG instituted a new program for radioactive waste management in 2000.

4.5.2 WMin/P2 Awareness

Waste Minimization/Pollution Prevention (WMin/P2) reduces the quantity of environmentally harmful materials and other pollutants or contaminants entering a waste

stream or the environment prior to recycling or treatment. These practices benefit the environment, protect employees and public health, and reduce site waste disposal costs. Specific objectives of the WMin/P2 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;
- encouraging staff and recognizing efforts to enhance the environment through WMin/P2; and
- publicizing WMin/P2 success stories.

Jefferson Lab's WMin/P2 Awareness program addresses most forms of site-generated waste. Staff are aware of the following methods and techniques:

- preventive maintenance programs;
- substitution, to encourage use of more environmentally-friendly materials;
- source reduction such as process changes to minimize use;
- materials exchange, both on-site and through the DOE Website;
- reclamation, e.g., scrap metal for GSA contractor collection;
- maximizing the use of products before declaring them waste;
- utilization, as possible, of recyclers for the acid mixture, waste paper, and other refuse; and
- procurement and storage procedures that ensure materials are used up in a timely manner.

Refuse/Recycling

Staff education on waste reduction initiatives and waste disposal options continued in 2000. Communication channels, such as the Lab newsletter and EH&S wall-mounted and electronic bulletin boards, display recycling information. Actual quantities recycled in FY 2000, as reported to the DOE, are shown in Exhibit 4-1.

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, Jefferson Lab generated about 4.6 tons of hazardous waste, 5.0 cubic meters of low-level radioactive waste, and no TSCA or mixed wastes (a combination of hazardous and radioactive) during FY 2000. Some radioactive materials are stored in special holding areas to allow for decay and possible reuse. No radioactive waste was contracted for disposal in FY 2000.

EXHIBIT 4-1

QUANTITIES OF ITEMS RECYCLED OR REUSED IN FY 2000

Description	Quantity (tons unless noted)
Paper Products (office paper & cardboard)	38.5
Aluminum Cans	0.25
Scrap Metal (reclaimed through GSA)	62.4
Used Oil	1.65
Used Coolant	0.68
Toner Cartridges	0.13
Transparencies	1.5 pounds
Lead-acid Batteries	0.08
Fluorescent Lamps	0.59
Computer Disks	1 pound
Data Processing Equipment	7.4
Circuit Boards and Electronics	0.03
*Used All Occasion Cards	0.07

** A DOE initiative to provide to St. Jude's Ranch for Children for reuse.*

4.5.3 Other Measures to Minimize Environmental Consequences

Affirmative Procurement

- The Lab's Business Services Department and EH&S Reporting staff continued to encourage the purchase of EPA-listed materials with recycled-material content.
- The main office product supplier used by staff highlights recycled-content-containing products in both its paper and on-line catalogs.
- The Lab and DOE goal of Lab-wide use of 30% recycled-content copy paper through the central Copy Center was achieved throughout 2000.

Energy Efficiency

- At least fifteen lighting systems were modified to include sensors that turn the ceiling lights off when the room is unoccupied for a designated period of time.
- Plant Engineering proposed other initiatives in response to EO 13123, *Greening the Government through Efficient Energy Management*.

4.5.4 Environmental Quality Enhancements

The following projects enhanced environmental quality in 2000.

- The Test Lab's use of solvents has been virtually eliminated and the acid usage in the cavity production process has been reduced by 50%. These improvements are due to the combined efforts of the lab users, the process designers, and the Accelerator Division EH&S staff.
- Oil-spill prevention controls were added and/or improved in a number of work areas.

SECTION 5

ENVIRONMENTAL RADIOLOGICAL PROGRAM 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.

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.

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 effects on public health.

5.1 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 2000 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;
- the radionuclides released;
- the potential hazard;
- the experience from previous monitoring results at Jefferson Lab; and
- the experience at other nuclear and high-energy physics laboratories.

5.2 DIRECT, AIRBORNE, AND WATERBORNE RADIOACTIVITY

Radiation resulting from the accelerator beam or the interaction of the 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.

5.2.1 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 in this matter, through activation. 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.

- 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.

- Radiation shielding surrounds the beam enclosure area.
- All material exposed to the beam is monitored for radioactivity prior to being removed from the beam enclosure.

Shielding Blocks Located in Hall A

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 issues are discussed in Section 5.2.2.
- Monitoring for exposure of the public to direct radiation is discussed in Section 5.3.
- The monitoring for public exposure to airborne emissions is addressed below.

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.

Airborne emissions at the site boundary are addressed under EPA requirements discussed in Section 3.7.2. Airborne radionuclide concentrations at the site boundary have been too low to accurately measure. Preoperational calculations, using EPA-approved computer modeling codes, indicated that Jefferson Lab operational emissions were 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 5-1. Despite this very low calculated release rate, Jefferson Lab continued being proactive in 2000 by making continuous measurements to verify the calculations. A report for 2000 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 is less than 0.048 mrem/yr. due to airborne releases.

EXHIBIT 5-1

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.)	1.2 E-3	3.0 E-2	1.9 E-3	6.3 E-3	6.7 E-5	3.4 E-3	5.6 E-3	4.8 E-2

Conversion note: 1 mrem = 0.01 millisievert (mSv)

In conclusion, there are entities in place to 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 RCG review of projected public exposures and airborne emissions from proposed experiments to help the Lab remain within established guidelines. Refer to Section 5.3 for specific information on the monitoring of direct radiation.

5.2.2 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 groundwater quality permit 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 Safe Drinking Water Act limits on-site or change the quality of the groundwater offsite. Refer to Section 7 for more information on how the Lab incorporates monitoring to protect groundwater resources.

This VPDES groundwater quality permit specifies EPA-approved sampling and analysis protocols, which were the basis of groundwater monitoring in 2000. 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 5-2 for monitoring well locations. Refer to Section 7.2 for more information on sampling requirements. The groundwater dewatering effluent at the experimental halls was also monitored quarterly in 2000 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 2000 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 is also analyzed.

Exhibit 5-3 lists the VPDES groundwater quality permit levels for radiological parameters with values in picocuries per liter (pCi/l). The values in Exhibit 5-3 represent normal background radionuclides, which are also generated through Jefferson Lab activities.

The radiological results from monitoring the wells in the accelerator vicinity during 2000 are presented in the first part of Exhibit 5-4. The results from the other locations described in the permit are shown in the second half of the exhibit. All measurements were within the permit levels. No accelerator-produced activity has been detected. All values represent natural background and variations are normal.

EXHIBIT 5-2

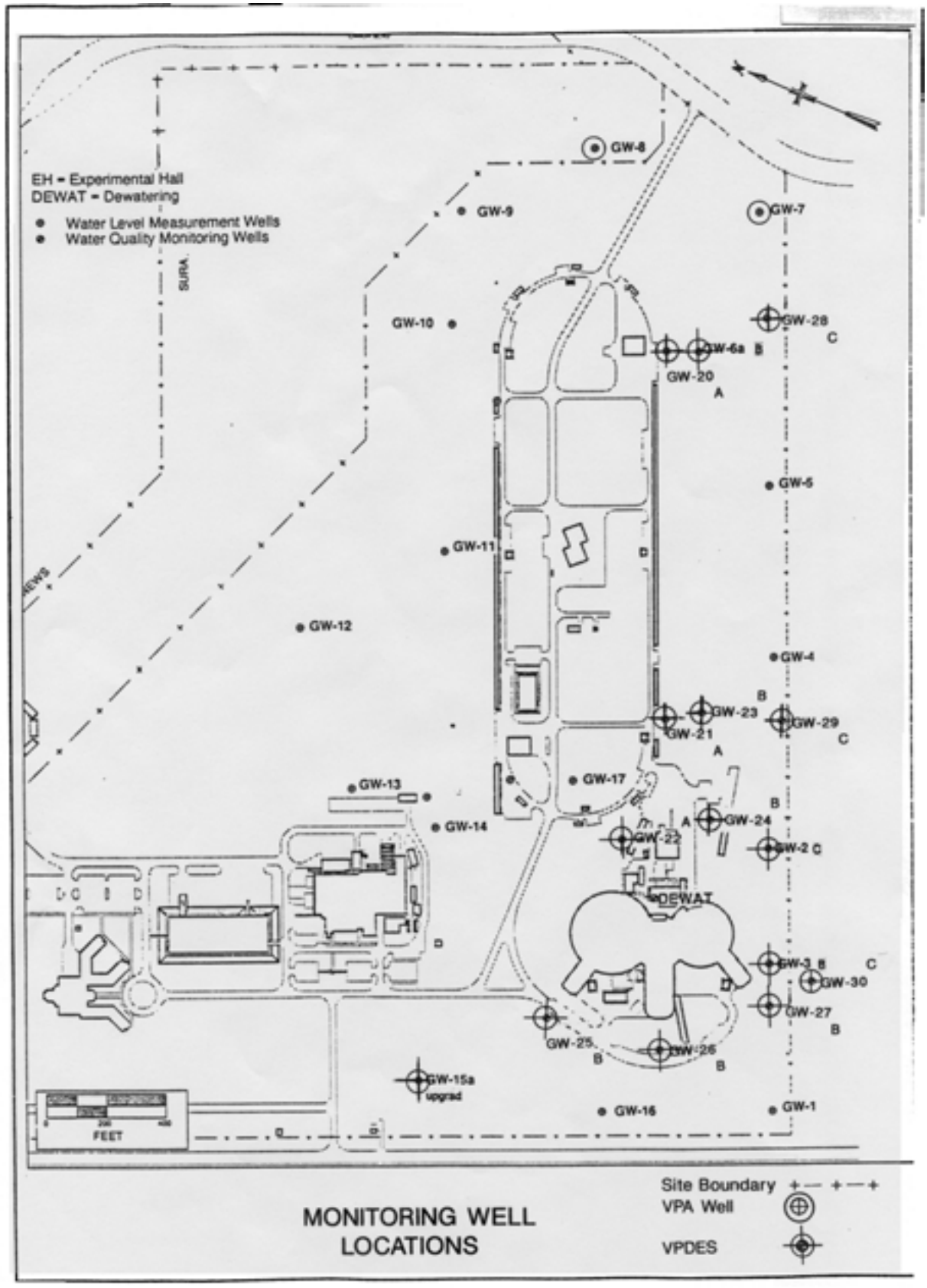

EH = Experimental Hall
DEWAT = Dewatering
Water Level Measurement Wells
Water Quality Monitoring Wells
SURA
NEWS
GW-8
GW-9
GW-7
GW-10
GW-28
GW-6a
GW-20
GW-5
GW-11
GW-12
GW-4
GW-23
GW-29
GW-21
GW-17
GW-13
GW-14
GW-24
GW-22
GW-2
DEWAT
GW-3
GW-30
GW-27
GW-25
GW-26
GW-15a
upgrad
GW-16
GW-1
FEET
MONITORING WELL LOCATIONS
Site Boundary
VPA Well
VPDES

EXHIBIT 5-3

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

EXHIBIT 5-4

MAXIMUM GROUNDWATER MEASUREMENTS FOR RADIONUCLIDES*
January 2000 through December 2000

Radionuclides at Associated Wells Relevant to Accelerator Operations

Analyte	A-Ring	B-Ring	C-Ring
Gross Beta	16.1 pCi/l	6.9 pCi/l	4.43 pCi/l
Manmade Radioactivity	ND at < 0.307 mrem/yr.	ND at < 0.296 mrem/yr.	not applicable
Tritium	ND at < 595 pCi/l	ND at < 595 pCi/l	ND at < 595 pCi/l
Sodium-22	ND at < 27.8 pCi/l	ND at < 25 pCi/l	ND at < 28 pCi/l
Beryllium-7	ND at < 169 pCi/l	ND at < 217 pCi/l	ND at < 186 pCi/l
Manganese-54	ND at < 23 pCi/l	ND at < 28 pCi/l	ND at < 21 pCi/l

Radionuclides At Other Permit Locations

Analyte	Upgradient Well	Discharge 001
Gross Beta	1.67 pCi/l	16.3 pCi/l
Sodium-22	ND at < 18 pCi/l	ND at < 20 pCi/l

(Continued)

EXHIBIT 5-4 (Continued)

Tritium	ND at < 595 pCi/l	ND at < 595 pCi/l
Beryllium-7	ND at < 125 pCi/l	ND at < 126 pCi/l
Manganese-54	ND at < 16 pCi/l	ND at < 17 pCi/l

Notes:
*Those radionuclides determined to be relevant to Jefferson Lab operations.
ND: Not detectable above permit-required sensitivity limits
No accelerator-produced activity has been detected.

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

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 2000. 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 2000.

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, that 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 2000. Sampling and analysis for tritium is 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 the RCG staff, such as the total amount of activity discharged to the sanitary sewer system. Monthly and composite quarterly results for 2000 are provided in Exhibit 5-5. The concentrations varied based on the quantity of beam dump cooling water discharged during the reporting period.

On a periodic basis in 2000, other water sampling and analysis for tritium and gross beta activity were performed on various discharges from potential radiological areas, such as from sump pumps. Any water identified as a potential concern was collected and was discharged according to the terms of the HRSD permit.

Various accelerator-related water systems have the potential of 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 2000 involving these activated water systems. The RCG staff addressed and cleaned up the areas involved. There were no worker safety, environmental, or

EXHIBIT 5-5

ANALYTICAL RESULTS FOR DISCHARGES TO HRSD IN 2000

Monthly Values

Reporting Period	Average Tritium Concentration	Reporting Period	Average Tritium Concentration
January	6,900 pCi/l	July	2,700 pCi/l
February	330 pCi/l	August	8,000 pCi/l
March	26,000 pCi/l	September	3,300 pCi/l
April	490 pCi/l	October	38,000 pCi/l
May	290 pCi/l	November	4,000 pCi/l
June	540 pCi/l	December	31,000 pCi/l

Quarterly Values

Reporting Period	Average Tritium Concentration	Other Gamma-Emitting Radionuclides Concentration
First Quarter	11,000 pCi/l	Na-22 at 0.072 pCi/l
Second Quarter	420 pCi/l	None detected
Third Quarter	4,500 pCi/l	None detected
Fourth Quarter	21,000 pCi/l	None detected

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

public health concerns. Collected water that did not meet immediate disposal criteria was transferred to a temporary storage area for later release to HRSD.

5.3 MONITORING FOR EXPOSURE TO 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 2000, 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 the RCG and were performed within an approved safety envelope.

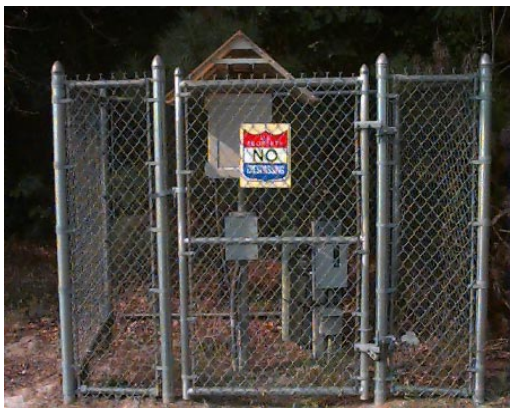
The Jefferson Lab areas, where direct radiation can be produced, are not accessible during accelerator operations. There are approximately 50 electronic radiation detectors and a series of associated passive integrating detectors deployed around the accelerator site with the primary purpose of measuring 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, contractors, 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 2000. Radiation data collected prior to January 1995 serve as the statistical baseline for comparison to that collected since the accelerator became fully operational.

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

The six electronic radiation measurement devices noted in 5.3, 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 on Exhibit 5-6. In addition, passive integrating detectors were used for a number of measurements. All measured dose values were within statutory and administrative limits. For 2000, the highest site boundary direct (prompt) radiation level was about 3.8% of the DOE annual dose limit of 100 mrem (1 mSv), or 38% of the site administrative dose limit.



Radiation Boundary Monitor

Exhibit 5-7 displays the radiation doses for 2000 in mrem at RBM-3 at the site boundary. 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

Jefferson Lab does not release any residual radioactive material, such as concrete or soil, so there are no resulting dose impacts to the public.

The absorbed dose to any local aquatic animals, or terrestrial plants or animals, from Jefferson Lab operations will not exceed the internationally recommended dose limits for terrestrial biota. As there are no potential releases of a magnitude that could result in doses exceeding 0.1 rad/day to terrestrial animals, the lowest limit for any biota, no dose limits will be exceeded.

In conclusion, 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 2000, but was found to be about 38% of the Jefferson Lab design goal of one-tenth of the DOE limit.

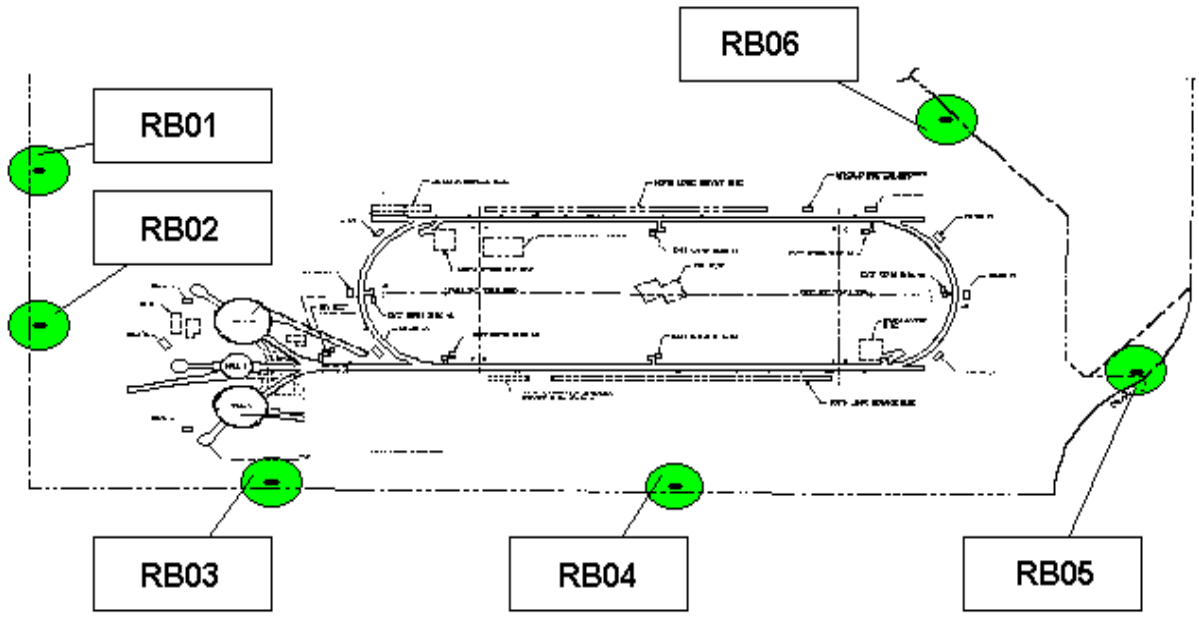
5.5 OTHER SUPPORT ACTIVITIES

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. The RCG 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.

EXHIBIT 5-6

BOUNDARY MONITOR LOCATIONS



Note: RB03 is the same as RBM-3.

EXHIBIT 5-7

RADIATION BOUNDARY MONITOR RBM-3 RESULTS FOR 2000

Period	Neutron (mrem)	Gamma (mrem)	Total (mrem)
Jan-Mar	0.45 ± 0.02	0.11 ± 0.01	0.56 ± 0.03
Apr-June	0.41 ± 0.02	0.10 ± 0.01	0.51. ± 0.03
July-Sept	0.23 ± 0.02	0.06 ± 0.01	0.29 ± 0.03
Oct-Dec	1.96± 0.03	0.49 ± 0.02	2.45 ± 0.03
TOTAL	3.05 ± 0.04	0.76 ± 0.02	3.81 ± 0.04
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 note: 1 mrem = 0.01 mSv

The RCG 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 6

ENVIRONMENTAL NON-RADIOLOGICAL PROGRAM INFORMATION

There are a number of non-radiological activities that Jefferson Lab performs in supporting protection of the environment and public health. The major activity is non-radiological pollutant monitoring, performed under the site permits listed in Exhibit 3-2. Other activities include reviewing conventional air emissions; administering appropriate controls involving work with chemicals such as herbicides and cooling water treatment additives; reviews for emergency planning regarding on-site chemicals; and special waste management.

In general, controls to protect the environment are established through on-site programs and subcontractual agreements that address permit condition requirements and other identified Lab commitments or initiatives. There were no problems with respect to any of the aforementioned Jefferson Lab activities during 2000.

6.1 WATER PROGRAMS

6.1.1 VPDES Permits

Jefferson Lab monitored the dewatering discharge and the monitoring wells identified in Section 5 for general water quality parameters under Permit No. VA0089320. The cooling water discharge was monitored under Permit No. VAG253002.

Dewatering Discharge

A sample of the groundwater collected from the dewatering process is taken quarterly at the collection pit located in the Counting House basement. This collection point, termed "Outfall 001", is monitored for pH along with the radiological parameters mentioned previously. Results are shown on Exhibit 6-1. The maximum daily discharge quantity for each quarter is also reported.

EXHIBIT 6-1

2000 PERMIT-RELATED NON-RADIOLOGICAL MONITORING RESULTS

Parameter/Units	Outfall 001	GW-15a	A Wells	B Wells	C Wells
Maximum Flow (MGD)	0.016 to 0.019	n/a	n/a	n/a	n/a
pH	6.7 to 7.2	4.4	5.1 to 6.6	5.5 to 7.2	6.6 to 6.9
Conductivity (µmhos/cm)	n/a	100	500 to 2100	210 to 800	410 to 600
TDS (mg/l)	n/a	53	395 to1834	222 to 832	335 to 548
TSS (mg/l)	n/a	2	18 to 165	2 to 43	2 to 31

MGD: million gallons/day
mg/l: milligrams/liter

Monitoring Wells

Monitoring wells were sampled for pH, conductivity, total suspended solids (TSS), and total dissolved solids (TDS) under the terms of Permit No. VA0089320. See Exhibit 5-2 for the site map showing the well locations monitored in 2000. Data collected in 2000 was representative of groundwater quality during accelerator operations and consistent with previous baseline measurements.

Non-radiological information collected at the wells in 2000 is also noted in the results due to seasonal, local ground conditions, and earth-disturbing factors. 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 2000.

Cooling Water Discharges

The materials used for cooling water treatment in 2000 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 under a VPDES General Permit. Values for flow, pH, temperature, total phosphorus, hardness, total dissolved copper, and total dissolved zinc were provided to the DEQ. The values reported for 2000 are provided on Exhibit 6-2. Monitoring for chlorine was initiated in 2000 and phosphorus was dropped. In the 3rd quarter, a sample was taken from a stagnant source, which resulted in a 5.8 pH reading, which is just slightly below the lower permit limit of 6.0. A second sample was taken, when conditions were suitable, with a reading of 6.8, which is within the acceptable range. The first quarter chlorine sample was taken too close to the tower that uses chlorinated city water. A better sampling point was selected.

EXHIBIT 6-2

2000 COOLING WATER DISCHARGE RESULTS

Parameter	First Quarter	Second Quarter	Third Quarter	Fourth Quarter
Flow	.011 MGD	.011 MGD	.009 MGD	.008 MGD
pH	8.0	6.9	*5.8 to 6.8	7.3
Temperature	15.6 °C	25.1 °C	29.5 °C	25.2 °C
Hardness	388 mg/l	407 mg/l	388mg/l	338 mg/l
Copper	0.057mg/l	0.010 mg/l	0.020mg/l	0.010 mg/l
Zinc	.0317mg/l	0.049 mg/l	0.037 mg/l	0.050 mg/l
Chlorine	*0.9 mg/l	< 0.1 mg/l	< 0.1 mg/l	< 0.1 mg/l

* Out of range results are discussed in text.
MGD: million gallons/day
mg/l: milligrams/liter

6.1.2 Permit to Withdraw Groundwater

Jefferson Lab's withdrawal of groundwater at the experimental halls is an unusual situation, as presented in Exhibit 6-1, and is shown as a range. Wide variations in pumping are required to maintain the structural integrity of the halls. Dewatering pumpage is minimal in drought periods. There are no special requirements for monitoring as no industrial or other use is made of the discharged groundwater. Radiological parameters are monitored due to proximity to the accelerator. Refer to Section 5.2.2 that covers other sampling requirements.

The only factor of concern under the groundwater withdrawal permit is the quantity of water pumped. Quantities of water pumped from these tile fields are reported to the Commonwealth on a quarterly basis. The groundwater withdrawal permit allows the pumping of a maximum of 6,000,000 gallons per month; Jefferson Lab is normally pumping about 500,000 gallons. The other pumpage restriction is a yearly limit of 23,036,790 gallons. There were no unusual issues regarding this discharge in 2000.

6.1.3 Industrial Wastewater Discharge Permit

Industrial wastewater, that includes a small quantity of activated water, is generated by Jefferson Lab and discharged to the HRSD. The activated water that was collected and discharged in 2000 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 3.4.4 and 5.2.2 for more information.

Jefferson Lab and the HRSD perform sampling of discharges. A subcontractor monitors two sanitary sewer outflow streams to assure that pH levels are within permit criteria. As noted in Section 5, the RCG staff manages the HRSD radiological sampling and analysis requirements. The HRSD samples all discharge streams regularly for a full complement of metals. 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. Monitoring results assured that Jefferson Lab remained within the limits of the HRSD-issued permit in 2000. Jefferson Lab received a Gold Pretreatment Excellence Award for its performance in 2000 by the HRSD.

6.1.4 Drinking Water

Jefferson Lab receives its drinking water from the city of Newport News Waterworks, an approved potable water supplier. No monitoring by Jefferson Lab is required. Backflow preventive device inspections are regularly performed; refer to Section 3.6.1.

The site surface water flow is directed to Big Bethel reservoir, a drinking water source. Fort Monroe environmental staff are provided annual information on the quantity of groundwater discharged. There were no drinking water issues in 2000.

6.1.5 SPCC Plan

Jefferson Lab maintains an SPCC Plan, which was revised in 1998. Refer to Section 3.4.6 for compliance information.

6.2 CONVENTIONAL AIR EMISSIONS

The Hampton Roads area of southeastern Virginia remained in attainment of ozone ambient air quality standards in 2000, 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 as there are no applicable emission sources present on the site.

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. Reports of annual air emissions are provided to the DEQ upon request; refer to Exhibit 3-4.

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. The DEQ air emission inspection, mentioned in Section 3.7.3 noted the new natural gas-fired generators and spray booth, but no new requirements have become applicable.

Accelerator operations result in the generation of small quantities of ozone. There are some minor on-site worker health issues, but there are no environmental or public health effects from this generation. Ozone is monitored as a worker health issue and is appropriately controlled.

6.3 HERBICIDES AND PESTICIDES

Certified subcontractors who meet the requirements of the FIFRA through Virginia licensing do all applications of herbicides and pesticides. All pesticides used in 2000 were EPA-registered and applied according to the product instructions and Federal, State, and local guidelines. The Jefferson Lab's Plant Engineering Department coordinates these subcontracts under the Lab's pest control guidelines.

Herbicides were used on annual and perennial weeds and grasses, stumps of trees, and brush. Pesticides were applied on-site for control of insects. Miscellaneous pest control was handled in 2000 by a licensed subcontracted exterminator. 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-site. Small containers of household pesticides are stored on-site and applied per manufacturer's recommendations. Pesticides and herbicides that were approved for use in 2000 are presented in Exhibit 6-3.

6.4 HAZARDOUS WASTES

As a SQG, Jefferson Lab does not need to file a regular report with the DEQ about our hazardous wastestreams. The hazardous wastes generated in the largest volumes in 2000 are waste buffered chemical polish (an acid mixture) that is used for niobium cavity processing and waste solvents (acetone, methanol, and isopropanol) from cleaning operations. The Jefferson Lab HWC manages the site program. All wastes are disposed of through licensed waste handling facilities. Refer to Section 3.11 for compliance information.

6.5 ENVIRONMENTAL OCCURRENCES

No reports to the DEQ or to the National Response Center were made in 2000, as there were no releases that required any form of notification.

EXHIBIT 6-3

CONTROL CHEMICALS AND PRODUCTS APPROVED FOR USE IN 2000

Control Chemical or Product	Control Chemical or Product
Pest Control	**Herbicides/Landscape Maintenance**
Contrac	Damoil
Demand CS	Diazinon 4E
Dicofol 4EC	Dicofol 4EC
Dursban Pro	Dimension
Flyteck	Diometom
Insect Guard	Fore Tree & Ornamental Fungicide
MaxForce Bait	Fusilade II
Mosquito Dunks	Merit
Precor 1%	MSMA Target 6.6
PT 270 Dursban	Roundup
PT 515 Wasp-Freeze	Super Trimec
Quintox Rat & Mouse Bait	
	Termite Control
	Cyrene TC

6.6 SARA TITLE III REPORTING REQUIREMENTS

Jefferson Lab conducted a sitewide chemical inventory in accordance with the reporting requirements of SARA Title III for CY 2000. The EPCRA Tier II report for CY 2000 was provided to the DEQ along with some additional maps and contact information as requested by the Peninsula Local Emergency Planning Committee. Exhibit 6-4 lists the chemicals reported and their hazard class or classes. Refer to Section 3.9 for compliance information.

Though Jefferson Lab does not exceed threshold amounts for listed toxic chemicals, the Lab completed a review of applicable usage to determine if reporting in 2000, for CY 1999, was necessary. It was determined no reporting was required and such notice was provided to the DOE Site Office.

6.7 SAFETY

Jefferson Lab's performance, with respect to worker safety for the 2000 CY, was as follows:

- Recordable injury case rate: 1.8 per 100 employees;
- Lost Work Day case rate: 0.7 per 100 employees;
- Lost Work Day rate: 4.2 per 100 employees;
- Number of radioactive contaminations: (external): 0;
- Number of Safety Occurrence Reports: (OSHA confined space, chemical exposure, and lockout/tagout incidents): 0.

EXHIBIT 6-4

CHEMICALS REPORTED FOR 2000

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			√	√	
Hydraulic Oil (Various including vacuum oil)	√				√
Lead (Sheeting)					√
Bromine				√	√

SECTION 7

GROUNDWATER PROTECTION

7.1 INTRODUCTION

Groundwater is a vital natural resource. The contamination of groundwater 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.

7.2 HYDROGEOLOGY ISSUES

7.2.1 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 northern section of Newport News, Virginia, at an average elevation of 34 feet above MSL, which is above the 100-year floodplain level of 13 feet above MSL. The site is located in the watershed of Brick Kiln Creek, which discharges to Big Bethel Reservoir. The reservoir serves as a drinking water source for local military installations. 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.

7.2.2 Aquifer Information

The uppermost hydrostratigraphic unit encountered at the site is the water table aquifer, the Columbia aquifer, 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 indicated that the groundwater flow pattern 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 towards the halls and ultimately be cycled through the dewatering system and into a site surface water channel.

7.2.3 Potential Groundwater 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 appropriate RCRA authorization.

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 on Exhibit 7-1. Jefferson Lab will maintain the capability to sample and analyze groundwater more frequently, as necessary, to ensure

EXHIBIT 7-1

GROUNDWATER SAMPLING PARAMETERS

Wells	Sampling Frequency	Environmental Parameters
* GW-15a	Annual	groundwater elevation, pH, conductivity, TSS, TDS, and radionuclides listed
A Ring Wells	Quarterly	groundwater elevation, pH, conductivity, TSS, TDS, manmade radioactivity, and radionuclides listed
* GW-20		
* 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

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 effect offsite.

7.2.4 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 3.4.5. There are no projected needs for the use of groundwater on the Jefferson Lab site. The surrounding area, however, is expanding and additional sources of water to serve the city remain under investigation.

7.3 GROUNDWATER PROTECTION PROGRAM SUMMARY

Jefferson Lab's environmental protection 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 3.4.

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.

The 1987 EA concluded "no significant environmental impacts are predicted." The EA concluded that proper design and careful operation of the accelerator would minimize any impacts, including those to the groundwater. The Commonwealth's largest concern is the potential for radiological activation of the groundwater and 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, and resulted in a FONSI. See Section 3.15.1 for additional information.

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, and the RCG addresses any activated water spills, thus minimizing potential groundwater impacts. An emergency management exercise, using a simulated oil spill, was conducted this year to test the response program effectiveness. Jefferson Lab staff, local Fire Department, and Dominion Virginia Power staff participated. Opportunities for improvement were identified and are being addressed.

7.3.1 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. The water eventually flows to the Big Bethel reservoir. This dewatering is allowed by the Permit to Withdraw Groundwater and is discussed further in Sections 3.4.5 and 6.1.2. 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.

7.3.2 Groundwater Resource Protection - Quality

Accelerator-produced radionuclides potentially present in the groundwater are regulated by the Commonwealth through authorized discharge limits in VPDES Permit No. VA0089320. It superseded the VPA Permit in July 1996, which primarily established a groundwater quality baseline for comparison with measurements during long-term operations.

This 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 groundwater quality.

7.3.3 Surface Water Protection

Surface water quality is maintained by discharging only unpolluted waters, such as rainwater or groundwater, to the environment. The potential sources of contamination of surface waters and associated control measures are:

- Using proper procedures prevents releases of EHMs to surface water or to the ground.
- The prevention of potential oil leaks from equipment or system malfunctions 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 RCG procedures that address activated water management provide for sampling and monitoring of water 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 minimal amounts of radiation are expected. The pumped groundwater is monitored under VPDES Permit No. VA0089320.

7.4 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 5-2 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 on Exhibit 5-3. Note that the Commonwealth restricts water contamination to 1 mrem/yr., which is one-quarter of the regulated drinking water quality limit. Sampling requirements under the VPDES Permit are presented in Exhibit 7-1. Under the permit, Jefferson Lab has to take specific corrective action if the following values are detected at either the "A" and/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 VPDES 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 8
QUALITY ASSURANCE

Regular quality assurance (QA) efforts, which include quality control (QC) measures, are being made to ensure that the 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 the method and direction for critical and objective examination of Jefferson Lab's environmental protection programs, practices, and performance.

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 RCG 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 and implementing relevant QA procedures. The Jefferson Lab SA/QA function performs independent assessments of all functional areas, including those for environmental protection activities. The DOE oversight organizations, in their independent overview capacity, also perform periodic audits and surveillance of Jefferson Lab. No quality assurance concerns were noted for CY 2000 regarding sampling protocols or results.

The line management responsible for the 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. All non-radiological analyses on these samples were performed by Universal Labs and the radiological analysis by their subcontractor, McDermott Technologies (McDermott). 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 RCG and analyzed in the RCG radiological analysis lab (Building 52). Qualified Jefferson Lab staff collect samples that require general chemical analysis, which are usually not permit-related. In 2000, Jefferson Lab subcontracted with Marine Chemist, Inc. and American Medical Lab to provide general chemical analysis on samples that were not potentially radioactive.

8.2 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 RCG, 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 McDermott on a biennial basis. These visits confirmed that analytical practices being performed were 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. The quality of the data is then evaluated and compared to regulatory limits to determine acceptability. 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, as specified in VPDES Permit No. VA0089320.

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

Universal Labs and the RCG radiological analysis lab participate in DOE's Quality Assessment Program (QAP) run by Environmental Measurements Laboratory (EML). McDermott participates in two DOE crosscheck evaluation programs: one from the EML, and one from the Mixed Analyte Performance Evaluation Program (MAPEP). McDermott is also certified by the National Environmental Laboratory Accreditation Conference (NELAC), whose purpose is to establish and promote mutually acceptable performance standards for the operation of environmental laboratories. They are also EPA sample certified by both NELAC and 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.

8.2.1 Radiological

Independent QA under the DOE

EML administers the DOE quality assessment program for environmental radiological analyses. The EML QA Program 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 2000, McDermott and the RCG Lab participated in the EML's QAP for radionuclides. Two sets of results for McDermott and one for the RCG Lab under the QAP were available. The results, for the parameters analyzed by Jefferson Lab and those analyzed by McDermott that are applicable at Jefferson Lab, are provided as Exhibit 8-1. Results indicated as warnings mean they are near the limits of acceptability. McDermott's overall results for QAP 52 were 71% acceptable, 22% warning and 7% not acceptable. Results for the water program, which is of greatest

importance for Jefferson Lab, were 77% acceptable and 23% noted warning. Note that only selected results are presented in the Exhibit. Overall results on QAP 53 were 82% acceptable and 18% warning for McDermott, though only selected results are presented, with RCG Lab results at 100% acceptable.

McDermott participated in a QA program for analysis of samples under the MAPEP. Performance results for MAPEP-00-57 were received. The results of 92%, which addressed metals and radionuclides, were acceptable or noted as warning. Refer to Exhibit 8-2.

Other QA Activities

McDermott Technologies also participates in an RCG-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 RCG Lab runs parallel analyses on selected groundwater monitoring samples and HRSD quarterly composite samples as a QA verification.

8.2.2 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 2000, they received blind samples and conducted analysis on the samples. Exhibits 8-3 through 8-6 show the results of the parameters of interest to Jefferson Lab. Exhibit 8-3 was conducted under the protocol of an ERA WatR™ Supply Proficiency Testing Study. Exhibits 8-4 through 8-6 were done through the NSI Laboratory Proficiency Testing Program. The overall results for the four samples ranged from a high score of 94% acceptance and warnings to a low score of 84% of same. These scores translate to a "very good" and "good" rating respectively. 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. RCG staff review the test results to ensure Universal Labs is maintaining its ability to provide quality services.

EXHIBIT 8-1
QUALITY ASSURANCE PROGRAM (QAP) SELECTED RESULTS FOR 2000

		Reported		EML Known		Ratio	
Matrix	Analyte	Value	Error	Value	Error	Rep/EML	Result
QAP 52		(Bq/l)		(Bq/l)			
Water (McD)	Gross Alpha	1850.000	30.000	1700.000	170.000	1.088	Accept
	Gross Beta	925.000	16.000	690.000	70.000	1.341	Warning
	Co-60	53.300	1.760	48.900	1.800	1.090	Accept
	Cs-137	105.000	2.000	103.000	4.000	1.019	Accept
		(Bq/filter		(Bq/l)			
Air (McD)	Gross Alpha	2.930	0.050	3.020	0.300	0.970	Accept
	Gross Beta	3.320	0.050	2.420	0.200	1.372	Accept
	Co-57	4.610	0.190	5.310	0.220	0.868	Accept
	Co-60	5.720	0.150	5.320	0.260	1.075	Accept
	Cs-137	6.130	0.200	6.100	0.300	1.005	Accept
QAP 53		(Bq/l)		(Bq/l)			
Water (McD)	Gross Alpha	1190.000	50.000	1070.000	100.000	1.112	Accept
	Gross Beta	899.000	36.000	950.000	90.000	0.946	Accept
	Tritium	129.000	25.000	91.300	0.300	1.413	Warning
	Co-60	75.100	3.400	73.700	2.900	1.019	Accept
	Cs-137	66.600	2.200	67.000	3.500	0.994	Accept
Water (JLab)	Co-60	78.070	1.970	73.700	2.900	1.059	Accept
	Co-60	74.740	1.900	73.700	2.900	1.014	Accept
	Co-60	75.650	2.280	73.700	2.900	1.026	Accept
	Cs-137	66.230	2.410	67.000	3.500	0.989	Accept
	Cs-137	66.970	2.390	67.000	3.500	1.000	Accept
	Cs-137	65.820	2.710	67.000	3.500	0.982	Accept
		(Bq/filter)		(Bq/l)			
Air (McD)	Gross Alpha	1.830	0.070	2.350	0.150	0.779	Warning
	Gross Beta	1.210	0.040	1.520	0.150	0.796	Warning
	Mn-54	47.700	3.700	43.200	1.300	1.104	Accept
	Co-57	15.000	0.400	14.550	0.460	1.031	Accept
	Co-60	9.250	0.530	8.430	0.480	1.097	Accept
	Cs-137	7.960	0.370	7.410	0.360	1.074	Accept

McD: McDermott Technologies; JLab: Jefferson Lab
Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.

EXHIBIT 8-2

MIXED ANALYTE PERFORMANCE EVALUATION PROGRAM (MAPEP)
Sample ID: MAPEP-00-57

Parameter	Results	Reference Value (Bq/kg)	Flag	Bias (%)	Acceptance Range (Bq/kg)
Co-57	1021	949	A	7.6	664.30 – 1233.70
Co-60	1339	1180	A	13.5	826.00 – 1534.00
Cs-137	992	930	A	6.7	651.00 – 1209.00
Manganese-54	1166	1023	A	14.0	716.10 – 1329.90

Note:
A: mean result acceptable (Bias ≤ 10%)
-A, +A: mean result acceptable (10% < bias ≤ 20%)
W, +W: mean result acceptable with warning (20% < bias ≤ 30%)
+N, -N: mean result not acceptable (bias >30%)

EXHIBIT 8-3

SELECTED RESULTS FROM UNIVERSAL LABORATORIES PERFORMANCE EVALUATION REPORTS
ERA WatR™ Supply Proficiency Testing Study WS-43

Sample Category	Parameter	Units	Reported Value	True Value	Acceptance Limits	Results
Metals	Aluminum	µg/l	556	559	473 - 665	Acceptable
	Arsenic	µg/l	65.5	73.5	64.1 – 82.1	Acceptable
	Beryllium	µg/l	7.16	6.63	5.64 – 7.62	Acceptable
	Cadmium	µg/l	5.16	5.63	4.50 – 6.76	Acceptable
	Calcium	mg/l	63.1	66.7	58.0 – 77.7	Acceptable
	Chromium (1)	µg/l	24.8	25.5	21.7 – 29.3	Acceptable
	Chromium (2)	µg/l	25.4	25.5	21.7 – 29.3	Acceptable
	Copper	µg/l	163	179	161 – 197	Acceptable
	Lead	µg/l	18.8	17.7	12.4 – 23.0	Acceptable
	Manganese	µg/l	491	489	455 – 514	Acceptable
	Nickel	µg/l	119	130	111 – 150	Acceptable
	Silver	µg/l	112.4	94.6	81.4 – 109	Not Acceptable
	Zinc	µg/l	955	972	893 – 1040	Acceptable
	Ca Hardness as $CaCO_3$	mg/l	158	167	156 – 178	Acceptable
pH	pH	S.U.	8.0	7.8	7.02 – 8.58	Acceptable
Mercury	Mercury	µg/l	4.46	3.65	2.56 – 4.75	Acceptable

(Continued)

EXHIBIT 8-3 (Continued)

Titration Hardness	Ca Hardness as $CaCO_3$	mg/l	210	203	190 – 216	Acceptable
Inorganics	Chloride	mg/l	6.85	6.68	4.92 – 8.58	Acceptable
	Conductivity	µmhos	546	502	420 – 571	Acceptable
	TDS	mg/l	417	429	275 - 583	Acceptable
Residual Chlorine	Total Residual Chlorine	mg/l	4	3.52	2.63 – 4.18	Acceptable
Total Organic Carbon (TOC)	TOC	mg/l	3.72	3.61	3.24 – 4.17	Acceptable

Note:
Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.
The full report also evaluated regulated and unregulated volatiles and other parameters.

EXHIBIT 8-4

SELECTED RESULTS FROM UNIVERSAL LABORATORIES PERFORMANCE EVALUATION REPORTS
NSI Laboratory Proficiency Testing Program Study WS-00-4

Sample Category	Parameter	Units	Reported Value	True Value	Acceptance Limits	Results
Metals	Aluminum	µg/l	1490.0	1461.0	1294 – 1628	Acceptable
	Arsenic	µg/l	82.3	75.0	65.6 – 83.8	Acceptable
	Beryllium	µg/l	3.46	3.10	2.64 – 3.57	Acceptable
	Cadmium	µg/l	24.4	24.2	19.4 – 29.0	Acceptable
	Chromium	µg/l	103.0	100.0	85.0 – 115	Acceptable
	Copper	µg/l	620.0	610.0	549 – 671	Acceptable
	Lead	µg/l	27.2	27.5	19.3 – 35.8	Acceptable
	Manganese	µg/l	492.0	500.0	465 – 526	Acceptable
	Nickel	µg/l	379.0	419.0	356 – 482	Acceptable
	Silver	µg/l	303.0	300.0	240 – 360	Acceptable
	Zinc	µg/l	1000.0	1000.0	919 – 1074	Acceptable
Mercury	Mercury (Total)	µg/l	1.53	1.41	0.987 – 1.83	Acceptable
Titration Hardness	Ca Hardness as $CaCO_3$	mg/l	189.0	223	209 – 237	Not Acceptable
Minerals	Specific Conductance	µmhos/cm	600.0	591	511 – 670	Acceptable
	TDS	mg/l	341.0	457	237 – 678	Acceptable
Residual Chlorine	Total Residual Chlorine	mg/l	1.0	1.14	0.946 – 1.32	Acceptable
pH	pH	S.U.	8.29	8.4	7.56 – 9.24	Acceptable

Note:
Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.
The full report also evaluated nutrients, trihalomethanes, and other parameters.

EXHIBIT 8-5

SELECTED RESULTS FROM UNIVERSAL LABORATORIES PERFORMANCE EVALUATION REPORTS
NSI Laboratory Proficiency Testing Program Study WP-00-5

Sample Category	Parameter	Units	Reported Value	True Value	Acceptance Limits	Results
Metals	Aluminum	µg/l	994.0	950	808 – 1088	Acceptable
	Arsenic	µg/l	125.0	125	101 – 149	Acceptable
	Beryllium	µg/l	555.0	600	510 – 678	Acceptable
	Cadmium	µg/l	170.0	180	153 – 205	Acceptable
	Chromium	µg/l	440.0	490	426 – 555	Check for Error
	Copper	µg/l	606.0	600	545 – 659	Acceptable
	Lead	µg/l	904.0	938	822 – 1050	Acceptable
	Manganese	µg/l	1842.0	1850	1664 – 2056	Acceptable
	Nickel	µg/l	290.0	288	255 – 325	Acceptable
	Silver	µg/l	194.0	200	171 – 229	Acceptable
	Zinc	µg/l	963.0	950	842 – 1067	Acceptable
Mercury	Mercury (Total)	µg/l	6.14	7.31	5.41 – 9.18	Acceptable
Minerals	Specific Conductance	µmhos/cm	620.0	608	559 – 657	Acceptable
	TDS	mg/l	366.0	342	355 – 425	Acceptable
	Ca Hardness as $CaCO_3$	mg/l	145.0	130	118 – 143	Not Acceptable
Residual Chlorine	Total Residual Chlorine	mg/l	2.0	2.34	1.90 – 2.78	Check for Error
Residue	Non-filterable (TSS)	mg/l	68.0	74.8	57.7 – 80.7	Acceptable
	Filterable (TDS)	mg/l	261.0	420	316 - 524	Not Acceptable
pH	pH	S.U.	8.58	8.70	8.44 – 8.95	Acceptable

Note:
The full report also evaluated nutrients, trihalomethanes, and volatile organic compounds.
Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.

EXHIBIT 8-6

SELECTED RESULTS FROM UNIVERSAL LABORATORIES PERFORMANCE EVALUATION REPORTS
NSI Laboratory Proficiency Testing Program Study WP-00-7

Sample Category	Parameter	Units	Reported Value	True Value	Acceptance Limits	Results
Metals	Aluminum	µg/l	2560.0	2500	2152 – 2689	Acceptable
	Arsenic	µg/l	442.0	430	359 – 504	Acceptable
	Beryllium	µg/l	510.0	506	430 – 571	Acceptable
	Cadmium	µg/l	346.0	350	298 – 398	Acceptable
	Chromium	µg/l	209.0	210	181 – 239	Acceptable
	Copper	µg/l	203.0	200	179 – 222	Acceptable
	Lead	µg/l	1637.0	1650	1452 – 1840	Acceptable
	Manganese	µg/l	610.0	650	583 – 722	Acceptable
	Nickel	µg/l	2336.0	2250	2046 – 2507	Acceptable
	Silver	µg/l	89.0	96.0	81.8 – 110	Acceptable
	Zinc	µg/l	715.0	700	619 – 788	Acceptable
Mercury	Mercury (Total)	µg/l	9.83	9.780	7.28 – 12.2	Acceptable
Tritration Hardness	Ca Hardness as $CaCO_3$	mg/l	212.0	220	201 – 240	Acceptable
Minerals	Specific Conductance	µmhos/cm	800.0	717	658 – 776	Not Acceptable
	TDS	mg/l	378.0	441	337 – 545	Acceptable
Residual Chlorine Residue	Total Residual Chlorine	mg/l	0.45	0.525	0.371 – 0.679	Acceptable
	Non-filterable (TSS)	mg/l	66.0	83.4	64.6 – 90.0	Check for Error
	Filterable (TDS)	mg/l	224.0	224	187 – 261	Acceptable
pH	pH	S.U.	8.0	8.0	7.77 – 8.23	Acceptable

Note:
Only selected results that had some relevance to Jefferson Lab operations are provided in this Exhibit.
The full report also evaluated nutrients and other compounds.

SECTION 9
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