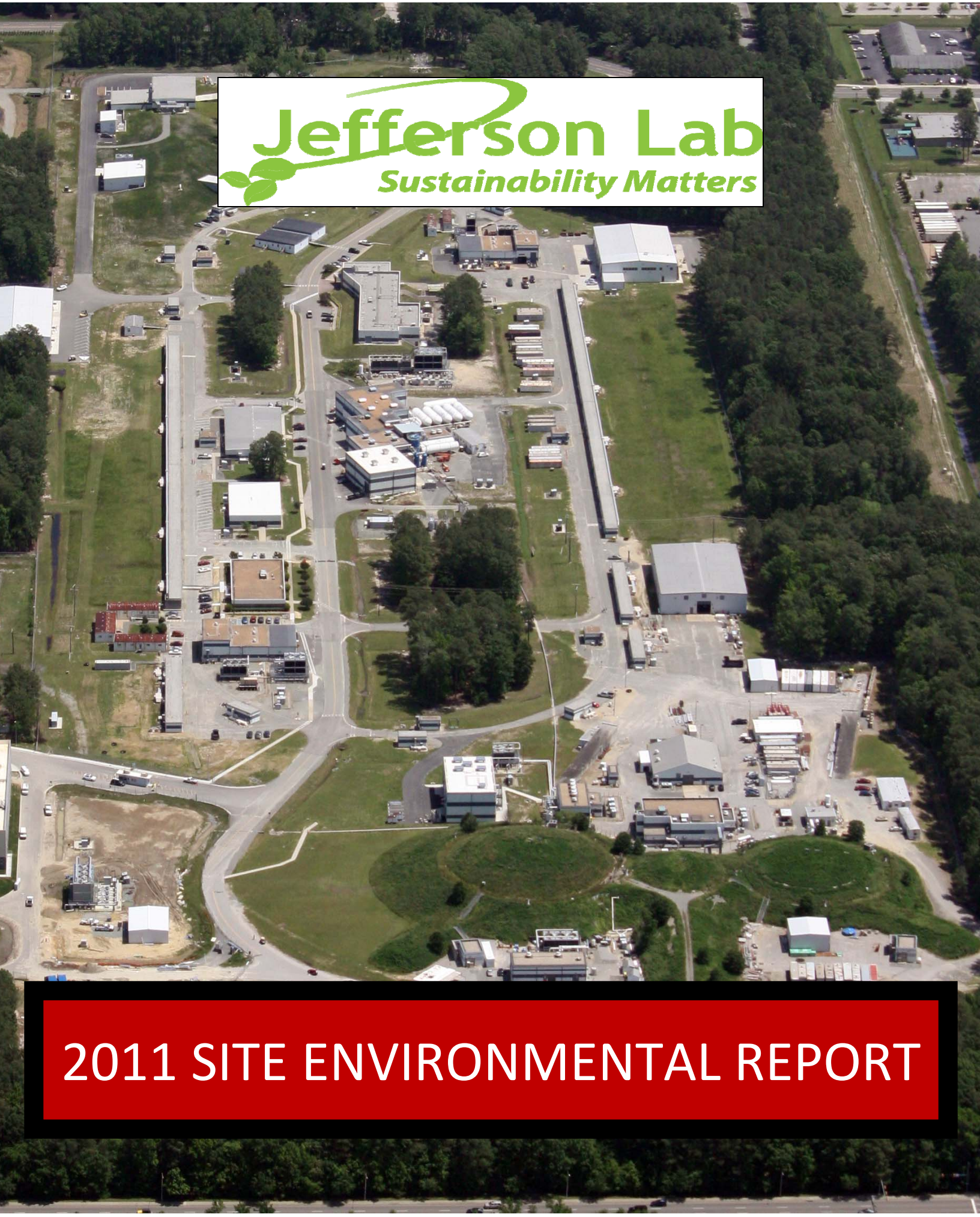

2011 SITE ENVIRONMENTAL REPORT

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Jefferson Lab
Sustainability Matters

EXECUTIVE SUMMARY

The purpose of the Jefferson Lab Annual Site Environmental Report is to document the U.S. Department of Energy's (DOE) Thomas Jefferson National Accelerator Facility's (Jefferson Lab) active environmental protection program and its performance in 2011. This report presents results of environmental activities and monitoring programs that are within the scope of Jefferson Lab's Environmental Management System (EMS) and compliance status with environmental requirements. The report provides the DOE and the public with information on the impact of radioactive and non-radioactive pollutants, if any, resulting from Jefferson Lab operations.

Jefferson Lab is managed and operated for the DOE by Jefferson Science Associates, LLC (JSA), which is a joint venture of the Southeastern Universities Research Association, Inc. and Computer Sciences Corporation.

Major Scientific and Research Programs: Jefferson Lab's mission is to make available a research facility to support goals of the global nuclear physics community and the nation.

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

In 2011, work continued on a planned upgrade of the CEBAF which, when completed, will double the beam's energy from 6 Giga-electron Volts (GeV) to 12 GeV. This upgrade includes making improvements to the experimental apparatus in the three existing experimental halls, and building a fourth hall -Hall D- to serve as another research tool. Major progress was seen on the construction of the Hall D complex and additional site infrastructure.

Free-Electron Laser (FEL)

The FEL supports basic science research and serves universities, private industry, National Aeronautics and Space Administration (NASA), the U.S. Navy, the U.S. Air Force and the U.S. Army. Designed and built with Jefferson Lab's expertise in SRF accelerator technology, the FEL provides intense, powerful beams of laser light that can be tuned to a precise wavelength or color. The FEL is the most powerful tunable laser in the world and has produced well beyond its design level of 10 kilowatts (kW) average power. It attained a record 14.2 kW at a wavelength of 1.61 microns on Oct. 30, 2006, an important

wavelength for both the optimal transmission of laser light through the atmosphere and for materials processing. The lab also operates an ultraviolet FEL which lases in the spectral region down to 363 nm with 100W average power levels. The FEL also holds the world's record in generating terahertz wavelengths.

Research Areas

Staff and visiting scientists continued using the Center for Advanced Studies of Accelerators (CASA), the Institute for SRF Science and Technology, and the Lattice Quantum Chromodynamics Computing Project to perform research and development programs to lead the world in both SRF and energy-recovering Linear Accelerator technologies. This research also provides technology and associated experience for the construction of new accelerators for DOE Office of Science research projects at other laboratories in nuclear physics, basic energy sciences and high energy physics.

Integrated Safety Management (ISM) System

Through ISM, Jefferson Lab incorporates environmental, safety, and health (ES&H) requirements into all work procedures. The primary objective of ISM is to make safety, health and environmental protection a part of routine work.

Environmental Management System

Jefferson Lab's EMS has been established and maintained to meet International Organization for Standardization 14001 and DOE Order requirements. The principle is to continually improve the manner in which the lab practices environmental stewardship. The EMS is discussed further in this report.

Requirements Identification Process

Requirements are comprised of the laws, regulations, and standards necessary and sufficient to ensure worker and public health and safety, and to protect the environment. Jefferson Lab continually identifies new and changing requirements for inclusion into its programs.

Implementation of the National Environmental Policy Act (NEPA)

Most facility construction activities and all accelerator upgrades are subject to review under the NEPA. The initial construction, two upgrades to CEBAF, and some major new buildings have been the subject of Environmental Assessments (EAs). An EA published in January 2007 focused on both the planned 12 GeV Upgrade and other activities identified in the lab's Ten-Year Master Plan. Routine Jefferson Lab activities and special projects are usually covered under site-specific NEPA Categorical Exclusions.

Radiological and non-radiological releases to the public from site operations

There were no unplanned radiological or non-radiological releases to the public due to accelerator operations during 2011. Releases from normal operations were within permit and regulatory limits and had very minor impact to the public and no health or safety implications. The doses from all pathways to the maximally exposed individual (MEI) from Jefferson Lab operations in 2011 was 0.0244 millirem (mrem). The MEI dose was predominantly from direct radiation.

ESH&Q Performance Measures

The DOE/JSA contract-based measures are used to evaluate Jefferson Lab's ES&H performance. The 2011 measures included integration of the EMS with a focus on more efficient use of water and electricity and to minimize short-term impact of site construction activities.

Inspection

Jefferson Lab's commitment to protection of the environment, public health and safety is demonstrated through its inspection programs. Both staff and external agencies, including the State of Virginia, local sanitation district and DOE Site Office staff, conduct inspections to ensure operations and activities are being performed effectively. Inspection results, including detailed comments on Jefferson Lab's record of compliance with applicable laws and regulations, are provided in this report.

General Compliance

Jefferson Lab's environmental compliance performance is discussed further in the "Compliance Summary" section of this report. Radiation-related issues, especially those dealing with water resources and public health, are highlighted in the "Environmental Radiological Protection Program & Dose Assessment" section. Jefferson Lab's ES&H Manual facilitates integration of new environmental compliance initiatives into site operations.

Shadow Dogs - strategically placed around campus to protect migratory birds from vehicle traffic.

Awards and Recognitions

Jefferson Lab earned a Platinum Award in 2011 from the Hampton Roads Sanitation District (HRSD) by having perfect compliance for five consecutive years (2007-2011); and the DOE Bronze GreenBuy Award for reaching the leadership goal for procuring environmentally friendly products.

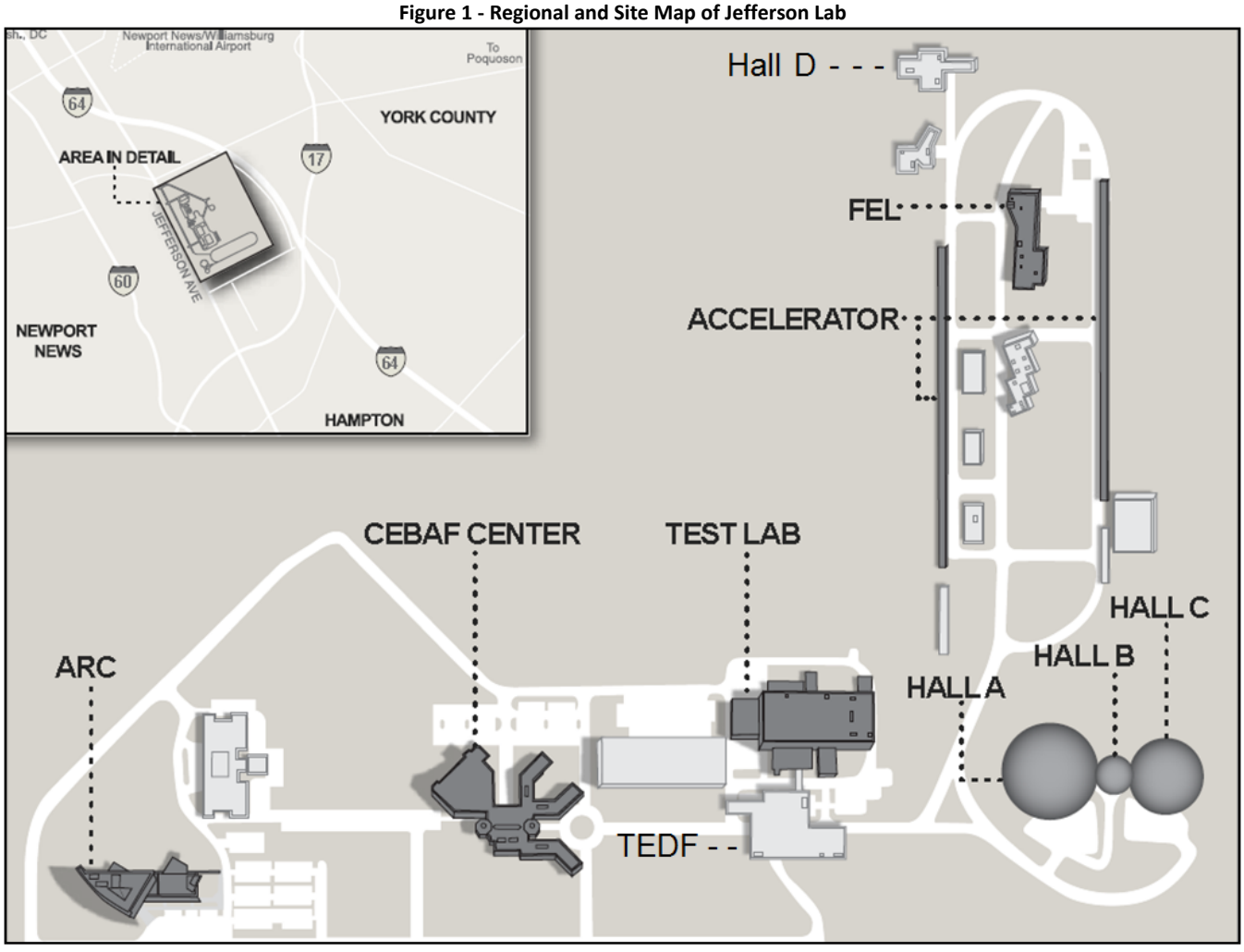
Entrance to CEBAF Center

INTRODUCTION

SITE LOCATION

Jefferson Lab is located in the Oyster Point Business Park within the City of Newport News, Virginia. The facility's location and buildings are depicted on Figure 1 - Regional and Site Map of Jefferson Lab.

Figure 1 - Regional and Site Map of Jefferson Lab



General Environmental Setting

A 1987 Environmental Assessment, yielded a "Finding of No Significant Impact (FONSI)" associated with the initial construction of the CEBAF. EAs performed in 1997 for a

CEBAF upgrade; 2002 for an FEL upgrade and five building construction projects; and 2007 in relation to Jefferson Lab's 12GeV upgrade project, also yielded FONSIs.

SITE MISSION

Jefferson Lab's overall operating mission is "… to provide forefront scientific facilities, opportunities and leadership essential for discovering the fundamental nature of nuclear matter, to partner with industry to apply its advanced technology, and to serve the nation and its communities through education and public outreach, all with uncompromising excellence in environment, health and safety." [Excerpt from Jefferson Lab's Visitor's Information Center.] Jefferson Lab's ES&H programs play an important role in support of this mission by: Enforcing its ES&H policy statement, which is: "… no activity [is] so urgent or important that standards for environmental protection, safety, or health may be compromised." [Excerpt from the ES&H Manual Chapter 1100 Environment, Safety, and Health Policy.]

This is accomplished by:

- Identifying and adhering to all applicable ES&H laws, regulations, standards, and DOE's contractual commitments.
- Adhering to ISM principles in the planning and execution of all work including:
  - Defining the scope of work
  - Analyzing the hazards
  - Developing and implementing hazard controls
  - Performing work within controls
  - Providing feedback and continuous improvement
- Empowering employees, subcontractors, and users with the responsibility and expectation - without reprisal - to stop work that endangers people, environment or quality.
- Involving all levels of the organization in establishing ESH&Q objectives and targets.
- Ensuring that employees at all levels of the organization have defined processes and procedures commensurate with work activities; and are appropriately trained and authorized prior to performance.

PRIMARY OPERATIONS AND ACTIVITIES AT THE SITE

The primary operations and activities performed at Jefferson Lab include:

Continuous Electron Beam Accelerator Facility (CEBAF)

Provides continuous wave electron beams with energies of 0.5 to 5.7 GeV. CEBAF is used as a tool for exploring the transition area or range where strongly interacting (nuclear) matter can be understood as bound states of protons and neutrons, and the

regime where the underlying fundamental quark-and gluon structure of matter is evident. The nature of this transition is at the frontier of our understanding of matter.

End Stations (Halls A, B, and C)

Hall end stations have complementary experimental equipment to support their primary functions.

- Hall A has a pair of superconducting, high-resolution magnetic spectrometers optimized for precision electron scattering coincidence experiments.
- Hall B houses the CEBAF Large Acceptance Spectrometer, which supports studies of both electron- and photon- induced reactions.
- Jefferson Lab's Hall C contains a pair of moderate resolution spectrometers. One is capable of high momentum particle detection, and the second is optimized for the detection of short-lived reaction products.

Institute for Superconducting Radio Frequency (SRF) Science and Technology

This is Jefferson Lab's primary research and development facility that provides improvements to the CEBAF and the FEL. Work includes:

- Support of the operation, improvement, and upgrade of the CEBAF.
- Development of SRF-based drivers for free electron lasers for possible industrial applications.
- Exploration of techniques for producing improved-performance SRF systems.

Center for Advanced Studies of Accelerators (CASA)

CASA supports the site accelerators and evaluates future opportunities. Its primary mission is to generate, investigate deeply, and distribute forefront knowledge about advanced accelerator and beam physics, especially the knowledge generated as a result of work at Jefferson Lab. A secondary goal for the organization is to provide an organized archive for retaining information generated by Jefferson Laboratory's Accelerator Division activities, so that such information is available to guide future projects.

Free-Electron Laser (FEL)

The FEL supports basic science research and serves universities, private industry, NASA, the U.S. Navy, the U.S. Air Force, and the U.S. Army. Designed and built with Jefferson Lab's expertise in SRF accelerator technology, the FEL provides intense, powerful beams of laser light that can be tuned to a precise wavelength or color. The FEL is the most

powerful tunable laser in the world and has produced well beyond its design level of 10 kW average power. It attained a record 14.2 kW at a wavelength of 1.61 microns on October 30, 2006, an important wavelength for both the optimal transmission of laser light through the atmosphere and for materials processing. The FEL also holds the world's record in generating terahertz wavelengths.

RELEVANT DEMOGRAPHIC INFORMATION

Jefferson Lab is a world-class research institution that attracts resident and visiting physicists and other scientists from around the world. Approximately 830 full-time physicists, engineers, technicians, and support staff work at Jefferson Lab and more than 1,350 academic and industrial researchers, from across the United States and approximately 30 countries and 187 institutions, participate in scientific collaborations.

Each year more than one-third of all Nuclear Physics PhDs awarded in the United States are based on research conducted at Jefferson Lab. Cumulatively, through the end of 2011, research at Jefferson Lab produced eight patents.

COMPLIANCE SUMMARY

The following sections summarize Jefferson Lab's 2011 compliance status related to local, state, Federal, and DOE requirements.

ENVIRONMENTAL RESTORATION AND WASTE MANAGEMENT

Waste streams at Jefferson Lab include Resource Conservation and Recovery Act (RCRA) hazardous waste, non-hazardous solid waste, and non-RCRA low-level radioactive and medical wastes. Jefferson Lab's 2011 waste management activities were conducted in accordance with all standards and requirements. No environmental restoration activities were required under the Comprehensive Environmental Response, Compensation, and Liability Act.

Emergency Planning & Community Right to Know Act (EPCRA)

Under EPCRA, as aligned with the Superfund Amendments and Reauthorization Act, Jefferson Lab provides information on its hazardous material quantities to local entities so chemical emergency response services can be provided.

Jefferson Lab also meets applicable reporting requirements, such as toxic chemical usage and environmental releases, if there are any, see Figure 2 - Status of EPCRA Reporting in 2011.

Figure 2 - Status of EPCRA Reporting in 2011

STATUS OF EPCRA REPORTING IN 2011		
EPCRA Section	**Description of Reporting**	**Status**
EPCRA § 302-303	Planning Notification	Completed
EPCRA § 304	EHS Release Notification	Not Required
EPCRA § 311-312	Material Safety Data Sheets/Chemical Inventory	Completed
EPCRA § 313	Toxic Release Inventory Reporting	Not Required

Resource Conservation and Recovery Act (RCRA)

RCRA promotes the protection of health and the environment and the conservation of valuable material and energy resources. In 2011, approximately 25,800 pounds of routine RCRA hazardous wastes were generated. Jefferson Lab generates such a small

volume of hazardous waste per month that it is considered a "Small-Quantity Generator."

The two largest-volume hazardous wastes generated were acid mixtures, used for niobium cavity and component processing; and waste copper electropolish acid/acid rinsewater for SRF thin films research. Jefferson Lab neither transports hazardous wastes nor operates any regulated treatment or disposal units. All wastes are disposed of through licensed waste handling transporters and facilities.

Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)

FIFRA applies to the storage and use of herbicides and pesticides. Use of these substances has environmental implications, especially where water quality is concerned. Consequently, the application of herbicides and pesticides at Jefferson Lab is performed by subcontractors who have completed the certification program administered by the Virginia Commonwealth.

In order to minimize the chances of herbicides and pesticides washing into local stormwater channels, Jefferson Lab requires that there be no outdoor application of these compounds when rain is expected. To further minimize the chances of pollution, no industrial-strength herbicides or pesticides are stored or disposed of on Jefferson Lab property. Only small amounts are mixed on site.

National Environmental Policy Act (NEPA)

NEPA requires that projects with potentially significant environmental impacts be evaluated and that alternative actions are explored. These evaluations are to be performed and reported as either an EA or an Environmental Impact Statement. Only one NEPA review was conducted in 2011. This review indicated that the environmental impact of the activity was well understood, in control and categorically excluded from NEPA regulations.

Other Wastes

Other wastes generated at Jefferson Lab include radioactive, medical and solid wastes. The vast majority of this waste is general solid waste (approximately 4200 tons in 2011). It consists of routine office trash and material and debris from construction activities. Jefferson Lab has an extensive recycling program that segregates paper, metal, aluminum cans, etc. This program resulted in the recycling over 3900 tons of material in 2011. Jefferson Lab also recycles almost 100% of its used oil and computer equipment.

Radioactive waste is managed in accordance with DOE Order and Manual 435.1-1, Radioactive Waste Management. Approximately 28 yd^3 of low-level radioactive waste was transferred for off-site disposal in 2011. This amount was higher than last year due to construction material storage requirements. Items designated as "saved for re-use" were inventoried and many were re-categorized as "waste" to free up storage space for construction material.

Only a minor amount of medical waste is generated from the on-site clinic, and its disposal was in accordance with all applicable regulations.

RADIATION PROTECTION

All Jefferson Lab activities in 2011 were in full compliance with applicable limits for radiation protection. Activities and results associated with Jefferson Lab's radiation protection program are summarized in the "Environmental Radiological Protection Program and Dose Assessment" section (below).

AIR QUALITY AND PROTECTION

Jefferson Lab has no processes that require air permitting. Internal calculations are conducted routinely to confirm our status and all emissions remained below reportable thresholds in 2011.

Stratospheric Ozone-Depleting Substances (ODSs)

Jefferson Lab minimizes the use of ODSs by using safe, cost-effective, environmentally preferable alternatives where possible.

To reduce the potential for emissions of ODSs, Jefferson Lab utilizes Environmental Protection Agency (EPA) certified subcontractors and staff to perform all work involving ODS-containing refrigeration and air conditioning equipment. Also, there is one ODS recovery machine on-site. The one remaining chlorofluorocarbon (CFC)-based chiller on-site receives preventive and corrective maintenance by a qualified mechanical subcontractor to ensure optimal performance and minimal CFC losses.

Greenhouse Gas (GHG) Emissions

During 2011, Jefferson Lab and DOE have continued to assess GHG emissions. Efforts to understand these various emissions allowed us to develop ways to minimize them. Additional information on our efforts to reduce GHG emissions and other environmental performance improvement activities is described in the "Department of Energy Executive Orders" section below.

WATER QUALITY AND PROTECTION

Jefferson Lab complies with all water quality protection requirements and performs monitoring under applicable water quality permits. Groundwater quality is maintained during operations through use of controls such as shielding and other measures. Surface water quality is maintained by discharging only controlled process wastewater, and significant stormwater controls are in place. Operational control measures include minimizing the use and storage of products that could pollute ground and surface water.

Jefferson Lab held five active water permits in 2011 (See Figure 3 - Jefferson Lab's Active Water Permits 2011). No regulatory limits were exceeded and all water quality programs were effective.

Figure 3 - Jefferson Lab's Active Water Permits 2011

JEFFERSON LAB'S ACTIVE WATER PERMITS 2011								
Permit Type	**Number of Outfall**	**Parameter**	**# of Permit Exceedances**	**# of Samples Taken**	**# of Compliant Samples**	**Percent Compliance**	**Date(s) Exceeded**	**Description/ Solution**
Industrial Wastewater Discharge to Surface	4*	Radionuclides Inorganic Chemicals Organic Chemicals pH Flow	0	41	41	100		
Construction Stormwater Discharge	0**	NA	0	NA	NA	100		
Municipal Separate Storm Sewer System (MS4)	0***	NA	0	NA	NA	100		
Industrial Wastewater Discharge to Sewer	2	Radionuclides Inorganic Chemicals Organic Chemicals pH Flow	0	12	12	100		
Groundwater Withdrawal	NA	Volume	0	12	12	100		

*Jefferson Lab's Virginia Pollutant Discharge Elimination System permit includes three outfalls and the collection and reporting or radionuclide monitoring data from 15 groundwater monitoring wells located throughout the site. This system of wells is considered one outfall for the purpose of this table.
**Virginia's General Permit for Discharges of Stormwater from Construction Activities does not require the sampling, analysis, and reporting of chemical constituents. Instead, it requires a series of protective measures that are applied to construction activities and routine site inspections.
***Much like the General Permit for Construction Activities, the MS4 program requires Jefferson Lab to implement a wide variety of P2 activities across the site to prevent contamination from entering the stormwater system and leaving the site. No sampling, analysis, and reporting of chemical constituents is required.

Conformance with Energy Independence and Security Act (EISA) Section 438

With the exception of the Technology and Engineering Development Facility (TEDF) project, all construction projects at Jefferson Lab with a footprint >5,000 square feet were designed prior to the release of the technical guidance in December of 2009.

As currently designed, the completed TEDF project will not capture up to and including the 95th percentile rainfall, however, it is estimated that the project will capture up to the 50-75th percentile event through the use of low impact development/green infrastructure (LID/GI):

The majority of stormwater runoff in the southern portion of the site is directed through a bioretention cell designed to treat up to a 1-inch rain event through infiltration and evapotranspiration.

Stormwater runoff in the northern portion of the site is mostly directed to the adjacent CEBAF retention pond, with some flows being treated by pervious pavers (infiltration) prior to discharging off-site.

Therefore the TEDF project is in conformance with EISA Section 438 because it has utilized LID/GI as recommended in the technical guidance, to the Maximum Extent Technically Feasible.

Future Strategies for EISA Section 438 Conformance

For future development or redevelopment projects >5,000 square feet, EISA Section 438 conformance will be satisfied by implementing planning, design, construction, and maintenance strategies that achieve Option 1 (Retain the 95th percentile rainfall event). This will be accomplished through review of project design criteria to assure the following strategies have been considered:

- Apply 'runoff reduction' as central stormwater management tool during planning stages of future development by incorporating the use of LID/GI for stormwater management to the METF as mentioned above;
- Reduce clearing by preserving remaining natural areas as much as possible;
- Reduce regrading by preserving natural runoff patterns on a development site, where feasible;
- Minimize amount of imperviousness for planned development, where feasible;
- Promote runoff across natural features to reduce runoff volumes and pollutant loads.

DEPARTMENT OF ENERGY/EXECUTIVE ORDERS

DOE Order 436.1 Departmental Sustainability

This order defines the requirements and responsibilities for managing sustainability DOE to ensure that the Department carries out its mission in a sustainable manner that addresses national energy security and global environmental challenges, and advances sustainable, efficient and reliable energy for the future; institute wholesale cultural change to factor sustainability and greenhouse gas reductions into all DOE corporate management decisions; and ensure that DOE achieves the sustainability goals established in its Strategic Sustainability Performance Plan. Jefferson Lab satisfies the

requirements of this order through the implementation of its EMS (see Environmental Management System below) and its site sustainability program summarized below.

Jefferson Lab is an active participant in these efforts. In 2011, the Lab issued its Site Sustainability Plan. The plan addresses each specific goal in the Executive Orders, assesses the lab's current status, and lays out actions and schedules for meeting all the goals. Major 2011 activities associated with this program are summarized in Figure 4 - Jefferson Lab's Sustainability Goal Performance.

Figure 4 - Jefferson Lab's Sustainability Goal Performance

JEFFERSON LAB'S SUSTAINABILITY GOAL PERFORMANCE				
Goal#	**DOE Goal**	**Performance Status**	**Planned Actions & Contributions**	**Risk of Non-Attainment (H / M / L)**
1.1	28% Scope 1 & 2 GHG reduction by FY20 from a FY08 baseline	Scope 1 GHG: FY08 3,008 MTCO2e FY11 2,748.15 MTCO2e Scope 2 GHG: FY08 64,641 MTCO2e FY11 68,856 MTCO2e **Scope 1&2** = 5.8% increase vs. FY08	**Scope 1** maintain and improve successful fugitive emission reduction practices (i.e.: SF6 capture program) **Scope 2** (electricity) requires multiple supply & demand strategies to achieve reduction targets	H
1.2	30% energy intensity reduction by FY15 from a FY03 baseline	Energy Intensity Utilization reduction 22.1% to date vs. FY03 baseline	Additional existing building ECMs identified and funded to reduce BTUs / Sq Ft and low BTU / Sq Ft new construction projects on line prior to FY15	L
1.3	Individual buildings or processes metering for 90% of electricity (by Oct. 1, '12); for 90% of steam, natural gas, and water (by Oct 1, '15)	Completed installation of Advanced Metering System for all individual building and processes for electric, natural gas, and water.	Additional metering of new construction and renovation projects planned in FY12.	L
1.4	Cool roofs, unless uneconomical, for roof replacements unless project already has CD-2 approval. New roofs must have thermal resistance of at least R-30	Approximately 23% (193K Sq Ft) of total site roof area comply with cool roof requirements to date.	Additional 108,900 Sq Ft of roof replacement / cool roof upgrade scheduled in FY12. A site wide condition assessment of an additional 333K Sq Ft of existing roof is scheduled in FY12. All new construction projects will comply with cool roof requirements.	L
1.5	7.5% of annual electricity consumption from renewable sources by FY13 and thereafter (5% FY '10 – FY12)	Purchased Renewable Energy Credit certificates in FY11 equal to 5% of total Mwh consumption of electricity	Continue purchase of Renewable Energy Credits in FY12 equal to 5% of total electric energy consumption and evaluate on-site renewable energy generation opportunities	L

JEFFERSON LAB'S SUSTAINABILITY GOAL PERFORMANCE				
Goal#	**DOE Goal**	**Performance Status**	**Planned Actions & Contributions**	**Risk of Non-Attainment (H / M / L)**
1.6	10% annual increase in fleet alternative fuel consumption by FY15 relative to a FY05 baseline	Alternative fuel consumption increased annually to 2,195 Gallons in FY11 vs. 0 Gallons in FY05	Jefferson Lab achieved the 100% fleet alternative fuel consumption goal.	L
1.7	2% annual reduction in fleet petroleum by FY15 relative to a FY05 baseline	FY11 reduction target = 12% (2% / year) vs. FY05. Fleet petroleum consumption decreased 19% to date vs. FY05 baseline.	Construction projects required gasoline powered leased vehicles and temporary increase in gasoline consumption. Jefferson Lab will achieve the fleet petroleum reduction goal.	L
1.8	75% of light duty vehicle purchases must consist of alternative fuel vehicles by FY15	Light Duty Fleet = 15 Vehicles Light Duty AFV = 13 vehicles 86% of fleet AFV	Jefferson Lab will achieve the 75% light duty AFV goal.	L
1.9	Reduce fleet inventory by 35% within the next 3 years relative to a FY05 baseline	Current fleet and / or authorizations = 30 vehicles	Phase 1 – reduce fleet by 5 vehicles in CY 2011 (4 GSA leased vehicles and 1 authorization) Phase 2 – return 6 vehicles by FY13 end. 36% reduction	L
2.1	13% Scope 3 GHG reduction by FY20 from FY08 baseline	Scope 3 increased 12.5% vs. FY08 primarily from increased staff / commuting GHG and increased T&D losses from increased electrical consumption	Develop policies for telework, alternative work schedule and car pooling programs to reduce staff commuting emissions in FY12. Recalculate T&D loss % based on actual utility value vs. national average	L/M
3.1	15% of existing buildings greater than 5K GSF are compliant with the Guiding Principles of High Performance and Sustainable Building (HPSB) by FY15	HPSB base = 15 Buildings Targeted HPSB compliance = 5 buildings (33%) by FY15	Two new LEED Gold certified buildings and 3 existing facilities scheduled for renovation projects prior to FY15 will comply with HPSB Guiding Principles	L
3.2	All new construction, major renovation, where the work exceeds $5 Million, are LEED Gold certified or equivalent	One new construction (TEDF bldg) and one major renovation project (Test Lab) are designed to achieve LEED Gold certification	TEDF & Test Lab new construction projects are scheduled for occupancy in FY12 and FY13	L

JEFFERSON LAB'S SUSTAINABILITY GOAL PERFORMANCE				
Goal#	**DOE Goal**	**Performance Status**	**Planned Actions & Contributions**	**Risk of Non-Attainment (H / M / L)**
4.1	26% water intensity reduction by FY20 from a FY07 baseline	Potable water intensity increased 5.5% to date vs. FY07 baseline due primarily to increased thermal energy (cooling tower) requirements	Alternative water supply strategies are under evaluation including utilization of reuse water from the local sanitation authority or on-site desalination of deep water well to meet cooling tower requirements. Jefferson lab will exceed the 26% water intensity reduction goal with funding for either project.	M
4.2	20% water consumption reduction of industrial, landscaping and agricultural water by FY20	Jefferson Lab does not utilize ILA water	Jefferson Lab does not plan to use industrial, landscaping or agricultural water	L
5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY15	Annual non-hazardous solid waste diverted from landfill / recycled = 61%	Continue current practices that exceed the 50% diversion goal	L
5.2	Divert at least 50% of construction and demolition materials and debris by FY15	Annual construction materials diverted from landfill / recycled = 97%	Continue current practices that exceed the 50% diversion goal	L
6.1	Procurements meet sustainability requirements and include acquisition clause (95% each year)	FAR clauses regarding sustainability included in all appropriate acquisition contracts	Continue current practices that achieve the 95% goal. Implement measurement procedures in FY12 to assure 95% compliance is achieved	L
7.1	All data centers are metered to measure monthly Power Utilization Effectiveness (PUE) (100% by FY15)	Data centers are metered to measure electrical consumption	Expand metering system in FY12 to include additional electric meter for measurement of data center HVAC systems	L
7.2	Maximum annual weighted PUE of 1.4 by FY15	Current calculated weighted average PUE value for two data centers = 2.29	Renovation project in progress to significantly reduce both size and cooling requirements of one data center to improve PUE. Development of PUE reduction strategies for main data center and cost analysis to be completed in FY12 to determine potential achievement of this new goal.	H

JEFFERSON LAB'S SUSTAINABILITY GOAL PERFORMANCE				
Goal#	**DOE Goal**	**Performance Status**	**Planned Actions & Contributions**	**Risk of Non-Attainment (H / M / L)**
7.3	Electronic Stewardship – 100% of eligible PC's, and monitors with power management actively in use by FY12	Power management system actively manages 100% of PC's and monitor hibernation	Continue current practices that achieve the power management goal	L

Reductions in the Generation and/or Toxicity of Hazardous Waste through Pollution Prevention (P2)

Jefferson Lab's Waste Minimization/P2 Awareness program, as implemented by the EMS, fosters the philosophy that waste prevention is superior to paying for special disposal or remediation.

Reduction or Elimination of Acquisition of Toxic and Hazardous Chemicals and Materials

Jefferson Lab's ESH&Q staff routinely review purchase requests for hazardous materials to help identify environmentally preferable products.

Environmentally Preferable Purchasing

Jefferson Lab continues to increase employee awareness of EPA-designated products and provide ready access to these recycled content/remanufactured products. Facilities Management & Logistics and other staff continue to explore opportunities to find users or vendors that will recycle items that are no longer needed for operations.

Wildflowers planted in Free Green Space

Electronic Stewardship

Jefferson Lab utilizes the EPA's Electronic Product Environmental Assessment Tool when selecting energy efficient desktop and laptop computers and computer monitors. The laboratory tracks the purchase of this type of equipment. Energy savings, based on the rated efficiencies of the equipment, can then be calculated and reported.

Recycling Practices

Jefferson Lab staff, users, and subcontractors continued to utilize lab-wide office product recycling centers. Products collected at these local centers are: aluminum cans, small batteries, cardboard, copier/ fax/inkjet/laser cartridges, paper wastes, telephone books, and plastic and glass bottles. The presence of recycling containers throughout the lab has considerably increased staff recycling awareness and participation. In 2011, with construction debris, scrap metal and automatic data processing equipment included in the total, the lab recycled approximately 3900 tons of materials.

OTHER ENVIRONMENTAL STATUTES

Oil Pollution Control

Jefferson Lab has a current Spill Prevention, Control, and Countermeasure (SPCC) Plan. The SPCC outlines a program to inspect and respond to spills from large oil-containing storage tanks and equipment on-site. Oil inventory at Jefferson Lab comprises numerous oil-filled electrical transformers, ranging in volume from 2 gallons to about 4,800 gallons, and emergency generators (including one holding 5,000 gallons). Jefferson Lab's total volume of oil is estimated to be about 40,000 gallons. To ensure proper handling and response (in the event of a spill or release), all staff who work with oil receive SPCC training. There were no significant releases of petroleum products from the Lab in 2011.

UNPLANNED RELEASES

In April 2011 a chiller unit purge switch was inadvertently activated allowing an estimated 370lbs of refrigerant to slowly release. The unit's alarm activated and the release was halted. The released quantity did not approach reportable limits and had negligible impact to the public and no health or safety implications. There were no other unplanned releases in 2011.

SUMMARY OF PERMITS

Jefferson Lab held five active environmental permits in 2011:

Figure 5 - Environmental Permits in 2011

ENVIRONMENTAL PERMITS IN 2011	
Permit Number	**Permit Type**
GW0047200	Groundwater withdrawal
VAR10-101819	Construction Stormwater
VA0089320	Ground and surface water discharge
VAR40079	Stormwater discharge
HRSD 0117	Discharges to sanitary sewer

ENVIRONMENTAL OVERSIGHT

Jefferson Lab's exemplary environmental performance is due to the constant attention it receives from all the parties involved in laboratory operations. The DOE Site Office, the operating contractor, subcontractors, and various Commonwealth and local authorities provide

continuous oversight of the Lab's environmental program. This includes routine inspections of construction projects and waste storage.

Program effectiveness is also measured through self-assessments, inspections, and work observation programs.

ENVIRONMENTAL MANAGEMENT SYSTEM

Jefferson Lab's EMS is designed and implemented to:

- Identify lab activities with the potential for environmental impacts.
- Mitigate and otherwise manage the impacts of these activities.
- Maintain compliance with applicable environmental protection requirements.
- Promote the long-term stewardship of the lab's and our neighbors' natural resources.
- Encourage understanding and promote dialogue with interested parties.
- Assess performance, implement corrective actions where needed, and ensure continual improvement.

Jefferson Lab has invested in a multi-dimensional process to assure that its staff and contractors understand the potential impacts (both positive and negative) of their work on the environment and have the tools and training necessary to minimize the negative ones and maximize the positive ones.

As our compliance history and awards demonstrate, that on-going process has been successful.

Because EMS is all about improvement, at least annually, a cross-cutting team of lab scientists, engineers, and other professionals are assembled to discuss how we can do better. This group reviews the previous year's EMS performance, discusses changes to lab operations and what that could mean for the environment, and determines where the lab should focus its improvement activities. This analysis, reviewed by (among others) the Laboratory Director, identifies major focus areas (Objectives) as well as specific projects to support each focus area (Targets).

Figure 6 - 2011 EMS Objectives and Target Summary below summarizes the Objectives and Targets for 2011.

Figure 6 - 2011 EMS Objectives and Target Summary

2011 OBJECTIVES AND TARGETS SUMMARY		
EMS Objective	**Annual Targets**	**Status**
OBJECTIVE 1 More fully integrate EMS planning and awareness into mission planning and execution	Benchmark EMS training and best management practices at similar facilities	Complete
	Benchmark environmental procedures at other laboratories	Complete
	Review 100% of ES&H Manual environmental chapters.	Complete
	Manage EMS - conduct annual EMS planning activities	Complete
	Manage Lab's EMS – provide support necessary to meet Laboratory's 2011 EMS Objectives and Targets	Complete (25 of 26)
	Provide audience-specific EMS training to managers / supervisors/EP Committee members, Safety Wardens, construction / service SOTRs, others.	Complete
	Review and upgrade Environmental Program web site	Complete
OBJECTIVE 2 Implement the 2011 Site Sustainability Plan	Purchase 5.0% renewable energy credits in FY 2011.	Complete
	Renew JLab's E-3 application for the Virginia Environmental Excellent Program and submit annual report in April.	Complete
	ARC Building lighting sensors	Complete
	Re commission HVAC in ARC	Complete
	Install advanced metering systems for electricity	Complete
	Design geothermal heat pump system for TEDF building; order equipment and begin site preparation.	Complete
	Complete GHG inventory	Complete
	Evaluate feasibility of on-site utility scale renewable electric energy generation from solar photovoltaic.	A new direction announced. It involved Dominion Power placing solar panels. Carried this target over to CY2012.

2011 OBJECTIVES AND TARGETS SUMMARY		
EMS Objective	**Annual Targets**	**Status**
OBJECTIVE 3 Balance environmental stewardship with site development	Provide support to Facilities Management and Logistics focusing on proactive environmental consultation during planning and construction activities. Activities will center on establishing effective relationships with project personnel through routine interactions and visibility in the field.	Complete
	Provide 12 GeV support focusing on pro-active environmental consultation during planning and construction activities. Activities will center on establishing effective relationships with project personnel through routine interactions and visibility in the field.	Complete
	Establish environmental metrics	Complete
	Improve development planning process	Complete
	Improve storm water conveyance inspections	Complete
OBJECTIVE 4 More efficiently manage the Lab's environmental compliance program	Upgrade our program for transporting hazardous materials based on the Joint Assessment of the TJNAF Transportation Mgmt Program.	Complete
	Maximize recycled radioactive material quantity and minimize waste production	Complete
	Complete Wetland Survey update	Complete
	Review VPDES Permit	Complete
	Review HRSD Permit	Complete
	Review MS4 Permit	Complete

ENVIRONMENTAL PERFORMANCE MEASUREMENT

Jefferson Lab conducts a quarterly review of contract performance for various topical areas, including the implementation of the environmental program. The DOE then grades this performance annually. In 2011, the Lab received a score of A- for its ability to "Sustain Excellence and Enhance Effectiveness of Integrated Safety, Health, and Environmental Protection." Additionally, Jefferson Lab evaluates the Environmental Management System performance in several ways. First, the completion rate of the improvement targets summarized in Figure 6 - 2011 EMS Objectives and Target Summary is tracked. The lab successfully completed 96% of these targets in 2011. Second, Jefferson Lab reports on the health of the EMS annually to the Office of the Federal Environmental Executive, which is housed within the President's Council on Environmental Quality. In 2011, Jefferson Lab received a perfect score.

AWARDS

Jefferson Lab earned a Platinum Award in 2011 from the HRSD. This award was earned by having perfect compliance for five consecutive years (2007-2011). The award was presented to Jefferson Lab in April 2012. (http://www.hrsd.com/pdf/P2_P3/HRSD%20Web%20Final%20P2%20Awards%2011.pdf)

Jefferson Lab received a U.S. DOE Bronze GreenBuy Award for reaching the leadership goal for three products in three different categories, achieving excellence in sustainable acquisition. The minimum level for this award is three products in two categories. (http://www.hss.doe.gov/sesa/sustainability/earthday/2011_green_buy_awards.pdf)

ENVIRONMENTAL RADIOLOGICAL PROTECTION PROGRAM AND DOSE ASSESSMENT

ENVIRONMENTAL RADIOLOGICAL MONITORING

Ionizing radiation and a variety of radioactive materials are by-products of research activities at Jefferson Lab. Any potential impacts have been significantly reduced by adhering to the philosophy of "as low as reasonably achievable" (ALARA) in dealing with potential sources of radiation. The potential dose to members of the public from various pathways, such as inhalation, ingestion, and skin absorption, is evaluated by the ESH&Q Division to demonstrate compliance with regulatory limits (as required by DOE Order 458.1, "Radiation Protection of the Public and the Environment").

Radiation in the Environment

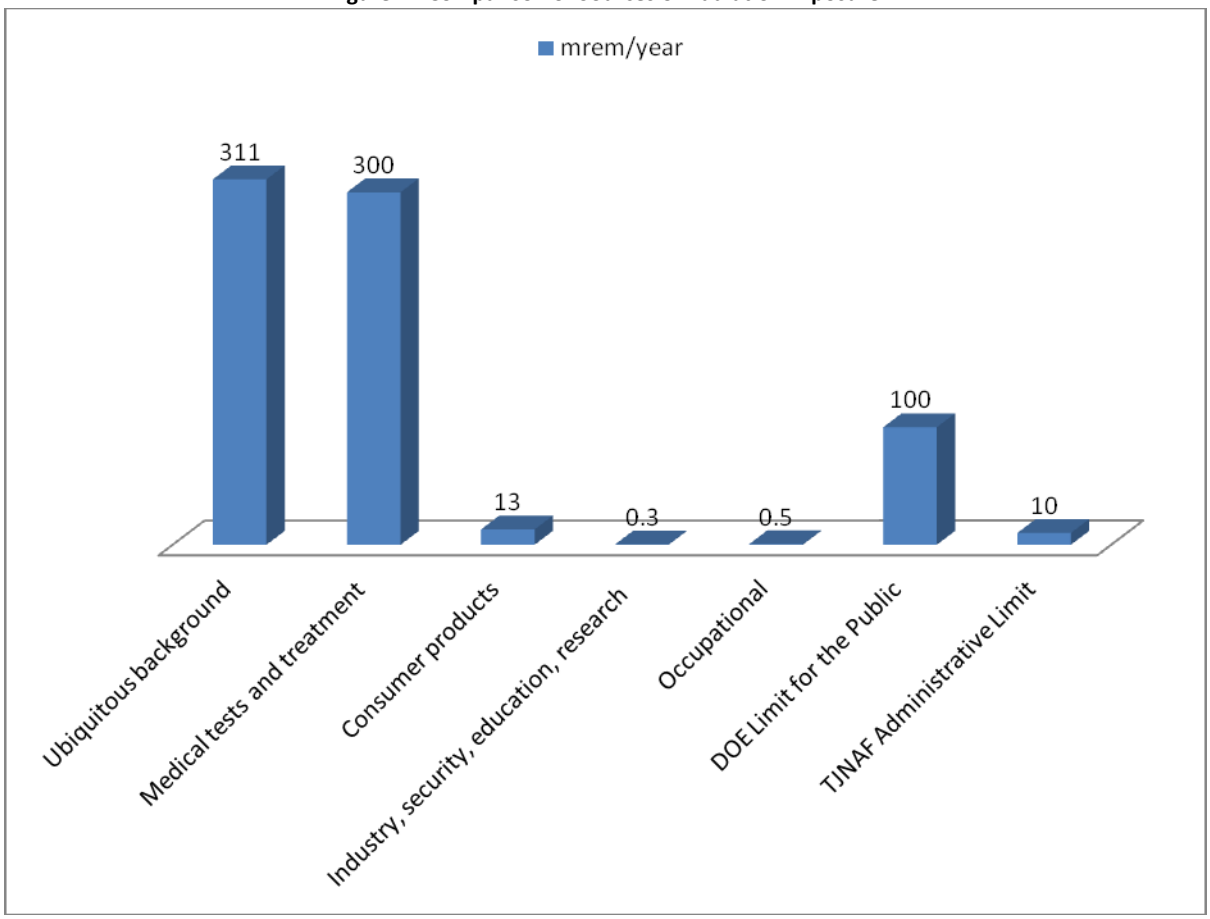
People are exposed to natural sources of radioactivity constantly:

- cosmic radiation from extraterrestrial sources
- terrestrial radiation from naturally-occurring elements in the earth's crust
- man-made sources of radiation, notably from medical procedures

Radiation exposure or "dose" is quantified in units of rems, and may be expressed as an individual dose or average amounts among groups or populations. Usually the millirem (mrem) is used to express the small doses associated with occupational and environmental exposure (1 mrem is 1/1000 of a rem). The Standard International unit in which dose is expressed is the sievert or milliSievert. A sievert is equal to 100 rems, so 1 milliSievert is equal to 100 mrem.

Figure 7 - Comparison of Sources of Radiation Exposure shows the relative significance of various sources of radioactivity exposure to the average member of the public. According to the National Council on Radiation Protection and Measurements, as of 2006, the average individual radiation exposure in the U.S. from all sources now totals 620 mrem per year, up from an estimated 360 mrem in the early 1980's. The increase can be attributed to medical uses of radiation.

Figure 7 - Comparison of Sources of Radiation Exposure



The DOE limits the potential dose to the public that is attributable to DOE facility operations to 100 mrem per year. Jefferson Lab has established an Alert Level of 10 mrem, either measured or estimated, for protection of the general public.

Radiation Exposure Pathways at Jefferson Lab

Two broadly-defined sources of potential radiation exposure exist at the Lab: *direct radiation* and *induced radioactivity*. Both types are produced during accelerator operations, but direct radiation has a potential impact only within close proximity to an operating accelerator on the site. Accelerator operation (i.e., running an electron beam) produces significant levels of direct radiation within the accelerator enclosure. This radiation is produced within the beam enclosure and its production stops when an accelerator is turned off. Almost all direct radiation is absorbed by extensive shielding, which is an integral part of accelerator design. Any possible exposure to this radiation decreases with distance from the accelerators, and is extremely small at the site boundary.

Jefferson Lab has an extensive monitoring network in and around the accelerator. There are approximately 50 active, real-time radiation monitors and a series of passive integrating detectors deployed around the accelerator site. Five site boundary monitoring stations also collected direct radiation data in 2011. These monitoring stations are equipped with specialized detection devices, optimized for measuring radiation at close to background levels.

In addition to prompt radiation, the interaction of the accelerator beam with matter can cause the formation of radioactive materials through activation of matter (*induced radioactivity*). The beam lines, magnets, beam line 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 water, ground water, lubricants, and air in the beam enclosure may also become activated. Strict controls limit possible radiation exposure from these activated items and materials.

All materials exposed to the beam or to potential sources of transferable contamination are monitored for radioactivity prior to being released from local control. Jefferson Lab adhered to the DOE release limits for surface contamination, and follows DOE guidance for ensuring that materials being released contain no detectable induced radioactivity.

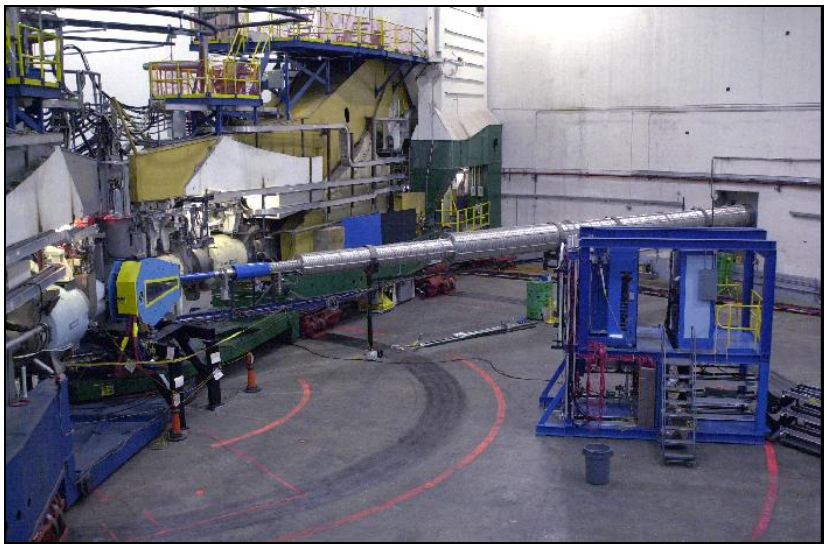
Controls are in place to minimize exposure from both direct and induced radiation to lab personnel, the environment, and the public. Access to the accelerator site and to areas containing radioactive material is strictly limited. Fencing, safety interlocks, signs, training, and other engineered and administrative controls prevent inadvertent or unnecessary exposures to direct radiation and induced radioactivity.

Monitoring of Potentially Activated Wastewater

Water that could potentially become activated is sampled, analyzed, and discharged under HRSD Permit No. 0117. These wastewaters can include:

- CEBAF accelerator enclosure and experimental hall floor drainage*
- Beam dump and target cooling water
- Environmental samples, once analyzed

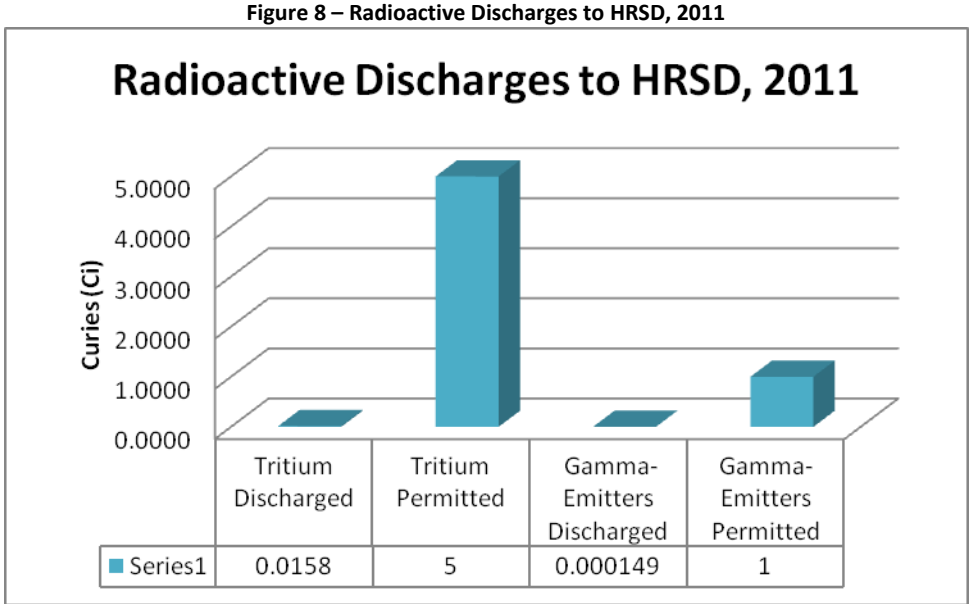
*The floor drain system is routed to a common sump. The system accumulates water from A/C condensate drains, spills and leaks from cooling water systems, cleaning activities, and minor in-leakage from surface/ground water.



Hall A Beam Line to Beam Dump toward Right

Figure 8 – Radioactive Discharges to HRSD, 2011 summarizes the 2011 monitoring data for the potential radiological constituents of Jefferson Lab's wastewater discharge to HRSD.

Figure 8 – Radioactive Discharges to HRSD, 2011

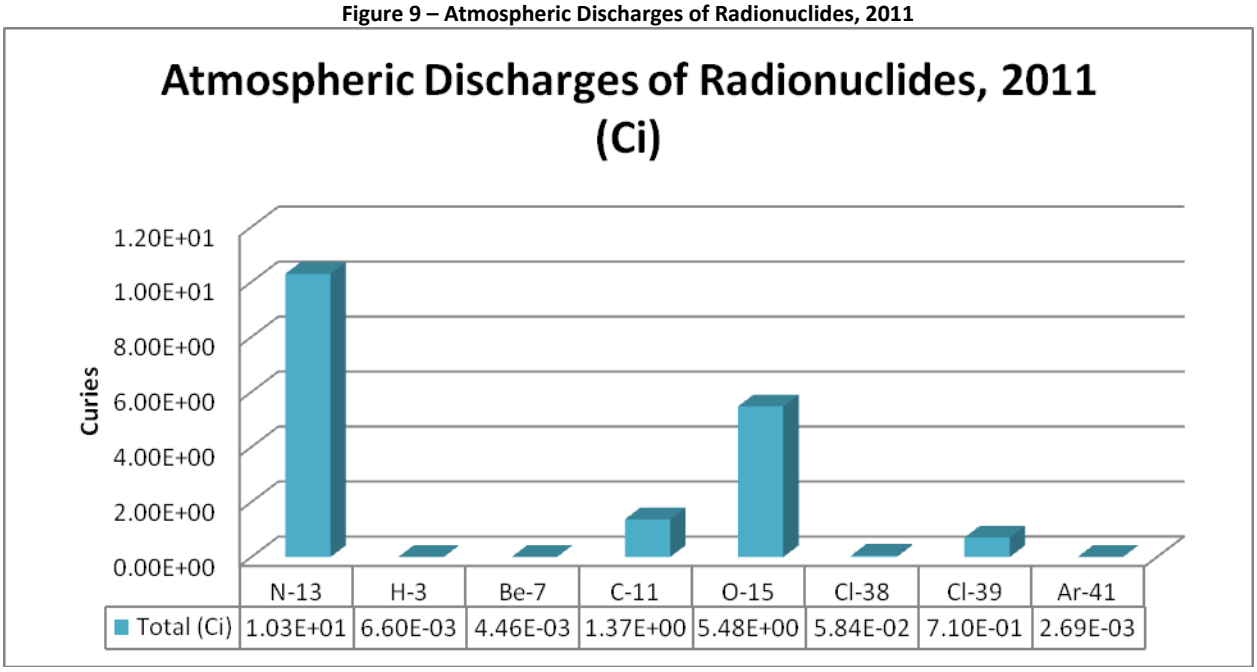


DOE regulates wastewater effluents under DOE Order 458.1. The Order requires wastewater treatment to reduce radioactivity content at specified concentration thresholds, in keeping with the ALARA principle. Average discharge concentrations in 2011 remained a small fraction of the best available technology treatment threshold.

Airborne Radionuclides

Essentially all airborne radionuclide emissions from the Lab are the result of the release of air from accelerator enclosure vaults containing activation products resulting from beam interactions with the air. The interaction of the beam with air produces short-lived radionuclides such as ^{15}Oxygen, ^{13} Nitrogen, and ^{11}Carbon, and smaller amounts of the longer-lived ^{3}Hydrogen (tritium). Airborne radionuclide production (and emission) occurs almost exclusively in the CEBAF accelerator at experimental Halls A and C and the beam switchyard (BSY) portion of the accelerator. Other areas of CEBAF and the FEL contribute only a very small amount to the total emissions. See Figure 9 – Atmospheric Discharges of Radionuclides, 2011 below for a summary of estimated atmospheric releases from Jefferson Lab in 2011.

Figure 9 – Atmospheric Discharges of Radionuclides, 2011



Compliance with EPA regulations (40CFR61) requires Jefferson Lab to determine the potential for the maximum exposure to this radioactivity by a member of the public. Annual calculations using an EPA-approved computer model (CAP-88, Ver. 3), show that the Lab's operational emissions remain several orders of magnitude lower than the EPA's 10 mrem/yr dose limit for a member of the general public. Jefferson Lab continued making measurements to verify the very low calculated release rate. The calculated 2011 dose to the MEI of the public was 0.0244 mrem/yr due to airborne releases. The location of the MEI was 300 meters due south of the accelerator, in the Oyster Point office park.

Direct Radiation Monitoring

Figure 10 – Direct Radiation Dose at Site Boundary, 2011 displays the radiation doses in mrem at the detector that saw the largest dose from accelerator and experimental hall operations in 2011 (RBM-3). This dose represents prompt, or direct, radiation exposure that would be experienced at the actual on-site boundary monitor location during accelerator operations. Note that the boundary dose shown is the total cumulative dose for the year. This does not, however, represent an estimate of the potential dose to a member of the public; under any credible scenario, that dose would be a small fraction of this amount.

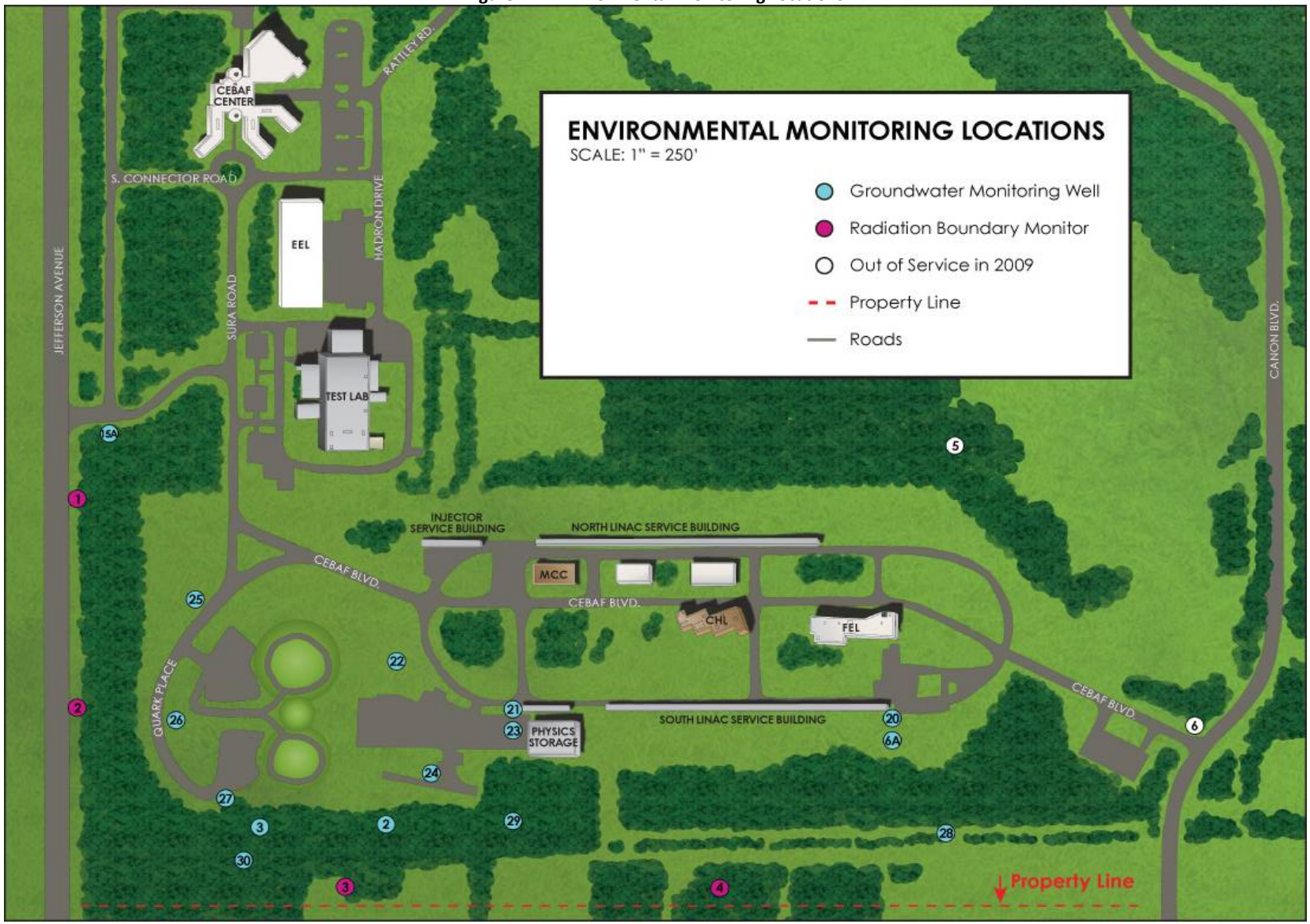
Figure 10 – Direct Radiation Dose at Site Boundary, 2011

DIRECT RADIATION DOSE AT SITE BOUNDARY, 2011			
Period	**Neutron (mrem)**	**Gamma (mrem)**	**Total (mrem)**
Jan-June (RBM-3)	2.86	0.72	3.58
July-Dec (RBM-3)	0.86	0.22	1.08
TOTAL	3.72	0.94	4.66 (0.0466 mSv)
Note: Gamma dose equivalent rates are estimated based on best known statistical correlation techniques.			

The dose was approximately one half of the Lab's design goal of 10 mrem/year (which is one-tenth of the DOE dose limit). See Potential Dose to the Public and to Biota for estimates of potential doses to the public.

Active (real-time) radiation measurement devices installed along the accelerator site boundary continued to be used to measure dose from direct radiation attributable to lab operations. Figure 11 – Environmental Monitoring Locations shows the approximate locations of the radiation boundary monitors (RBMs) that measure and log radiological information.

Figure 11 – Environmental Monitoring Locations



Groundwater Monitoring

The underground CEBAF and associated experimental end stations overlay in the Yorktown Formation. Groundwater occurs site-wide at a depth of approximately 3 to 25 feet below ground surface. Groundwater quality in the soil surrounding the accelerator complex is the Commonwealth's greatest concern with site operations.

Under Virginia Pollutant Discharge Elimination System (VPDES) Permit No. 0089320, Jefferson Lab monitors groundwater that is pumped from around the experimental halls and is discharged to the surface. The vast majority of the surface water leaving the site flows to the Big Bethel reservoir via Brick Kiln Creek.

Jefferson Lab's groundwater monitoring well program, also under VPDES Permit No. 0089320, serves to assess the effect of Laboratory activities on groundwater quality. No accelerator-produced radioactivity was statistically different from background levels detected in site groundwater or surface water in 2011.

Figure 11 – Environmental Monitoring Locations also shows the facility's network of groundwater monitoring wells. Fifteen of these wells were routinely monitored for radioactivity, using EPA or other approved sampling and analysis protocols. Wells are designated either as up-gradient, A-ring, B-ring, or C-ring. The A-ring wells are located closest to the accelerator and are the most likely to show any effects of soil and groundwater activation. A-ring wells were sampled quarterly. B-ring wells are further from potential sources of activation, and were sampled semi-annually. The C-ring wells are positioned to represent conditions near the Lab's boundary, and were sampled annually.

Groundwater samples are analyzed for: ^{3}H (tritium), ^{7}Be, ^{54}Mn, ^{22}Na, and gross beta activity. The VPDES permit specifies limits for radioactivity in the wells based on their location with respect to the accelerators. Only gross beta activity, attributable to naturally occurring geologic materials, was occasionally detected.

The Virginia Department of Environmental Quality (DEQ) revised Jefferson Lab's VPDES permit in November 2011. The frequency of testing the A-ring wells was changes to semiannual, along with the B-ring wells. Two B-ring wells were dropped altogether based on their close proximity to other wells that continue to be monitored. Gross beta activity was also deleted as a required parameter. Other parameters and permit limits remained unchanged.

Other Environmental Surveillance

Jefferson Lab routinely collects environmental samples not required by any regulation or permit. Sediments from storm drainage channels and soils in areas that could potentially be affected (by contaminated runoff or storage and handling of radioactive materials) are sampled at a variety of locations on a location-specific frequency. Results of sampling continue to show that no significant radioactivity is being released to the environment through these pathways.

POTENTIAL DOSE TO THE PUBLIC AND TO BIOTA

Controls are in place to minimize exposure from both direct radiation and radiation from activated materials to lab personnel, the environment, and the public. Access to the Accelerator Site and to areas housing radioactive material is strictly limited. Fencing, safety interlocks, signage, training, and other engineered and administrative controls prevent inadvertent exposures to direct and induced radiation.

The direct dose and air emissions are the only sources for which any plausible contribution to public dose exists. In Figure 12 - Jefferson Lab Radiological Dose Summary for 2011 the maximum possible dose to the public assumes a 24-hour a day, 365-days-a-year exposure to the highest levels measured at the site boundary. However, it is not credible under any possible conditions for a member of the public to actually receive this dose. The southern and western boundaries of the site, where the monitors are located, are heavily wooded and either undeveloped (to the south) or a major roadway (Jefferson Avenue, to the west). All site boundaries are also posted with "U.S. Government – No Trespassing" signs.

Figure 12 - Jefferson Lab Radiological Dose Summary for 2011

JEFFERSON LAB RADIOLOGICAL DOSE SUMMARY FOR 2011				
Pathway	**Dose to Maximally Exposed Individual, mrem**	**% of 100 mrem/yr DOE Limit**	**Estimated Population Dose, person-rem**	**Population within 80 km**
Air*	0.0244	0.0244	2.77	1,743,270
Water	~0	~0	~0	
Release of materials	<1	<1	<1	
Direct radiation**	4.66	4.66		-
Total, all pathways	4.68 (0.0468 mSv)	4.68	2.77	1,743,270

*From 2011 atmospheric modeling results for National Emission Standards for Hazardous Air Pollutants reporting.
** From Boundary Radiation Monitors, with conservative exposure scenario applied (see text).
mSv = milliSievert

One can construct an exposure scenario in which a more realistic estimate of the maximum potential dose to a member of the public is obtained. The potential dose from air releases is modeled using appropriate exposure conditions. A reasonably conservative scenario could involve exposure at the boundary in which an individual spent two hours per day walking along the site boundary or waiting for a Jefferson Avenue bus, and did so for 250 days of the year. We will conservatively assume that the individual is exposed at this rate for the entire two hours per day. This hypothetical case represents a reasonably conservative scenario for the MEI for this source. Given these conditions, the MEI for this exposure path would have received 0.266 mrem in 2011 from direct radiation, 0.266 % of the DOE limit of 100 mrem. Further, if we combine the dose from this source with the dose to the MEI from air emissions, the maximum postulated dose from all pathways to a member of the public from Jefferson Lab operations in 2011 is 0.268 mrem.

There is no public or private use of the shallow aquifer in the vicinity of Jefferson Lab; thus, there is no exposure to the public via contact with or ingestion of groundwater. No accelerator-produced radioactivity was detected in any of the samples from the End Station Sump or in surface water. Considering the extremely small quantities of radioactivity that is potentially present in this effluent, the potential dose to a member of the public or biota from this pathway is insignificant, and specific dose estimates from this pathway are not necessary.

The total "potentially exposed population" reported herein is defined by DOE as those living within 80 km (50 miles) of the site. That total, and resulting population doses, are extreme overestimates for this site, where dose beyond the site boundary is so low that it cannot be reliably measured.

Dose Via Unrestricted Release of Materials and Equipment

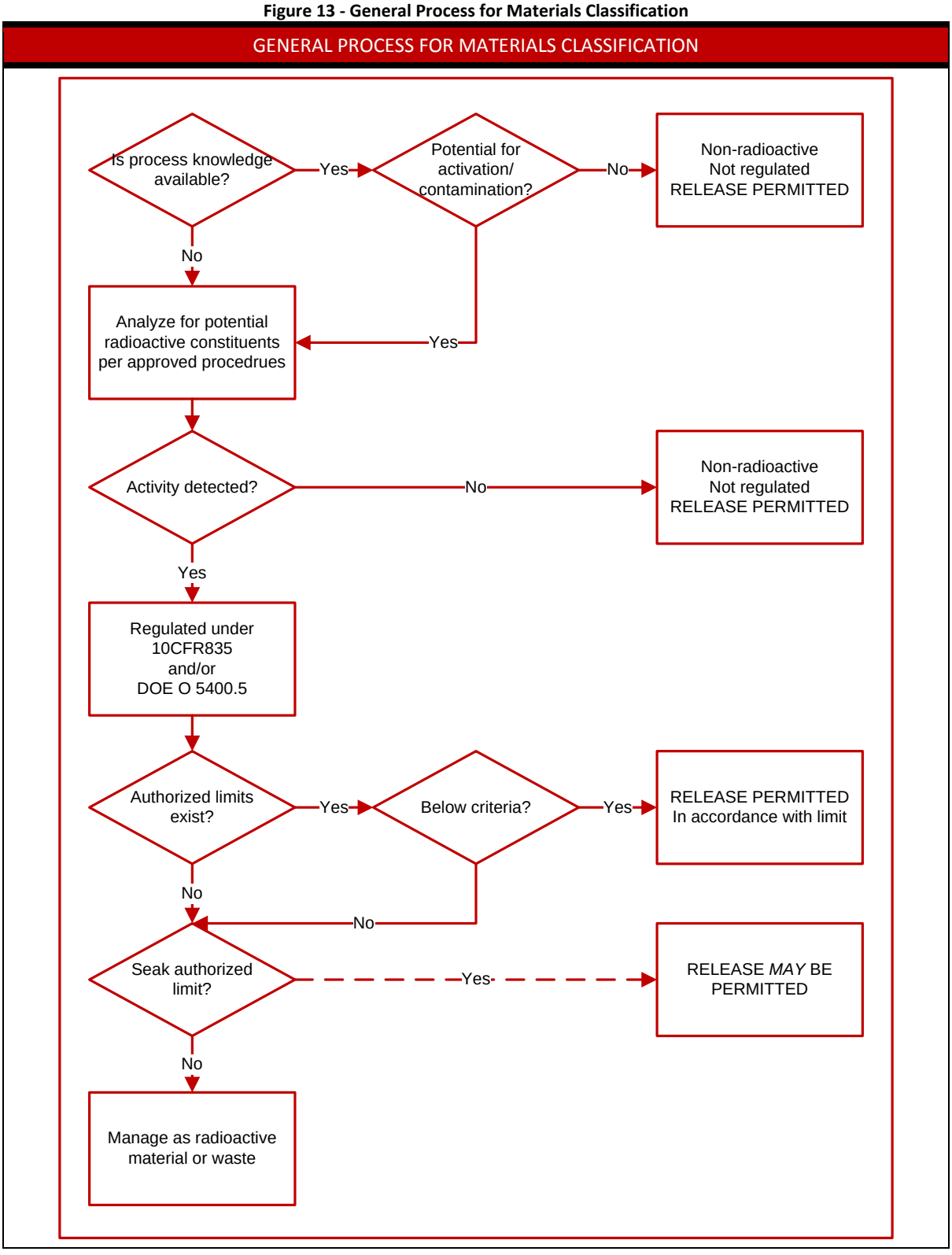
Jefferson Lab does not release any residual radioactive material, such as contaminated concrete or soil, so there are no resulting dose impacts to the public. The Lab has developed a process to determine if potentially radioactive materials are to be managed as material containing residual radioactivity or as non-radioactive. All potentially activated or contaminated material and equipment is monitored prior to release from control. This program involves literally hundreds of radiological surveys annually.

Release limits for surface contamination given in DOE Order 5400.5 remained in effect, and Jefferson Lab adheres to those limits (although little material with surface contamination is generated here). The Order does not prescribe a specific limit for release of volumetrically-activated materials; therefore, the Lab has adopted methods and procedures that ensure equipment and materials being released contain no radioactivity distinguishable from background. Materials with potential for internal

contamination or volumetric radioactivity that cannot be reliably assessed are treated as radioactive materials and are not released to the public.

Figure 13 - General Process for Materials Classification summarizes Jefferson Lab's process. From a process perspective, these assessments are consistent with the approach agreed upon by a multi-agency task group regarding defining impacted areas and classifications of material.

Figure 13 - General Process for Materials Classification



The application of process knowledge comprises the first step in the characterization of materials for possible release. The approach at Jefferson Lab has historically been a conservative one: if materials were in the accelerator enclosure during beam operations, it is assumed that they may be activated, and they are subject to further analysis. Surveys and sampling and analysis are conducted by trained technicians using written procedures. Results of the surveys or other analyses are documented appropriately.

In 2011, the estimated volume of materials released through the process described above was about 3 tons of solid waste and about 100 tons of scrap metals for recycling (most of the scrap metal had been previously released and stored on site pending determination that it was not encumbered by a DOE restriction on metals recycling).

Potential doses to the public from undetected radioactivity in released materials have been assessed and documented as prescribed in various national and international standards. These standards and DOE guidance apply a benchmark value of 1 mrem/y for determining the significance of potential dose to the public. The measurement sensitivity of the Lab's procedures was evaluated against this benchmark as part of its technical basis, confirming that potential dose to a member of the public through this pathway is insignificant.

Independent review of the lab's process for releasing materials from radiological control is conducted by DOE or a designated third party. These reviews are scheduled on a fiscal year basis; the 2011 review occurring in December of 2010. The review found no deficiencies in the lab's program for clearance of material.

No Authorized Limits for the release of material containing residual radiation have been sought by Jefferson Lab. All materials that exhibit radiation above background levels are managed as Radioactive Material, saved for beneficial reuse in the future, or disposed. The only radioactive waste Jefferson Lab generates is Low-Level Radioactive Wastes (LLW). There are no higher level wastes or any that would be categorized as special nuclear materials. A total of 28 yd^3 of LLW, comprising approximately 25,800 pounds, was shipped in 2011. Used protective equipment, contaminated materials from throughout the Lab, and waste oil are typical LLWs.

The following documents provide further detail on the criteria for release of materials and management of waste:

- Technical Basis for the Characterization, Management, and Disposal of Radioactive Waste Generated at Jefferson Lab (January 2010)
- Technical Basis for the Release of Solid Material From Radiological Control When Residual Radioactivity Levels are Indistinguishable From Background (March 2009)

Low-Level Radioactive Wastes

Dose to Local Biota

The absorbed dose to any local biota (aquatic or terrestrial) from lab operations can only be estimated. DOE has provided guidance on evaluating the dose that may be received by biota (DOE-STD-1153-2002), in which screening values are presented for both terrestrial and aquatic organisms. The internationally recommended dose limit for terrestrial biota, 0.1 rad/day, is the lowest limit for any biota. Therefore, if doses do not exceed 0.1 rad/day, then all criteria are met.

The best indicators of dose to biota are the passive dosimeters placed at various locations around the property. These are the same types of dosimeters used to monitor worker exposure.

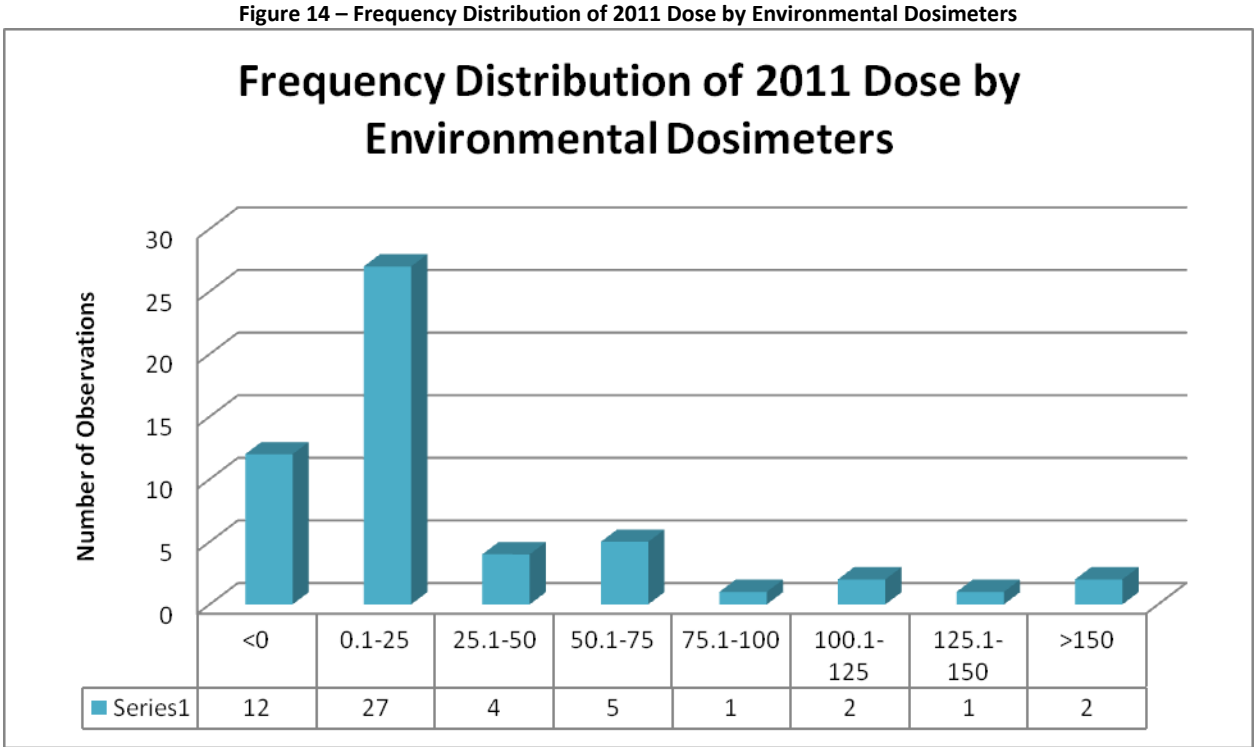
During 2011, a significant portion of the Lab's property was undergoing construction; however, the site still provided habitat for deer, foxes, raccoons, squirrels, groundhogs and other small mammals, reptiles, aquatic macroinvertebrates, and a wide variety of birds. The birds and some of the mammals roam the site, but others (like the

groundhogs) live in an established burrow. The biota expected to receive the maximum dose would be ground-dwelling animals living in the earthen domes over the experimental halls.

Local Wildlife

Figure 14 – Frequency Distribution of 2011 Dose by Environmental Dosimeters shows the frequency distribution of annual (2011) doses from the network of dosimeters. The mean of the values is 26.71 mrem/year, and the median is 7.54 mrem/year. The maximum recorded dose was 248 mrem/year, measured on the dome of one of the experimental halls. Dividing this value by 365 days yields a daily dose of 0.68 mrem/day, or approximately 0.00068 rad/day, far below the most stringent criteria.

Figure 14 – Frequency Distribution of 2011 Dose by Environmental Dosimeters



UNPLANNED RADIOLOGICAL RELEASES

Jefferson Lab had no unplanned radiological releases in 2011.

GROUNDWATER PROTECTION PROGRAM

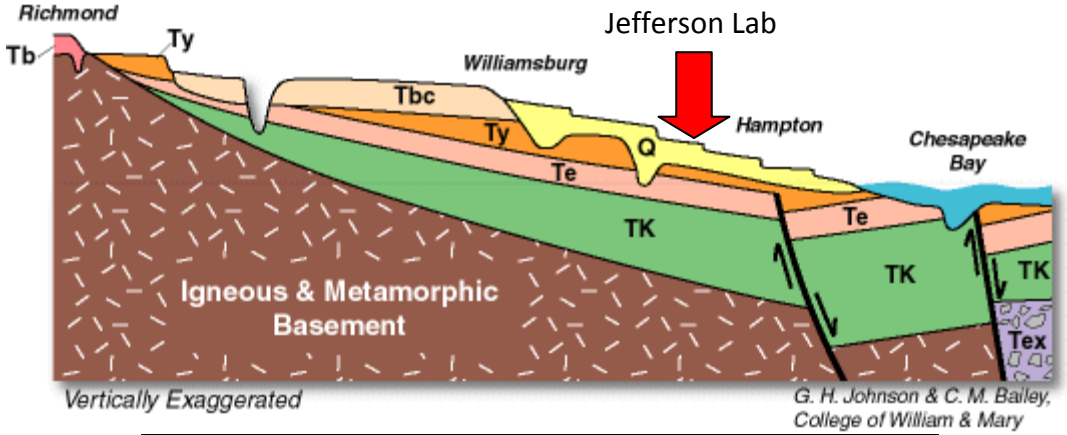
Figure 15 – Typical Geologic Cross Section of Jefferson Lab Site depicts a typical cross section of the area where Jefferson Lab is located. Its CEBAF tunnel and experimental end stations are underground in the Yorktown Formation. Activation of the groundwater is possible, and soil activation is also a potential source of groundwater contamination. Groundwater occurs site-wide at a depth of approximately 3 to 25 feet below grade. Groundwater quality in the soil surrounding the accelerator complex is the Commonwealth's greatest concern with site operations. The monitoring of VPDES-permitted wells for groundwater quality continued in 2011. Through a combination of engineered controls (e.g. shielding) designed into the CEBAF and FEL facilities, and adherence to operational limits, no significant amount of soil or groundwater activation on or offsite was produced.

Figure 15 – Typical Geologic Cross Section of Jefferson Lab Site

TYPICAL GEOLOGIC CROSS-SECTION OF JEFFERSON LAB SITE	
Depth (in feet)	**Description**
0	Loose to stiff, gray, sandy CLAY
5	Loose, orange brown clay, fine SAND
7	Loose gray silty fine SAND
12	Loose to firm, gray fine to medium SAND
22	Very stiff, gray, shelly, sandy SILT
27	Firm, white, cemented shells
32	Firm, gray, very silty, fine SAND with shell fragments
40	Boring terminated

TYPICAL GEOLOGIC CROSS-SECTION OF JEFFERSON LAB SITE

STRATIGRAPHY



Legend	
Q -	**Quaternary formations** fluvial and estuarine, *silt, sand, and clay*
Tbc -	**Bacons Castle Formation** fluvial-deltaic and tidal, *gravel, sand, and clay*
Ty -	**Yorktown Formation** marine, *fossiliferous sand*
Te -	**Eastover Formation** marine, *sand and clay*
Tb -	Bon Air Gravel fluvial, *gravelly sand, silt, and clay*
Tex -	Exmore Breccia
TK -	Older Tertiary and Cretaceous formations marine and deltaic, *sand and clay*

(Cited from: http://web.wm.edu/geology/virginia/provinces/coastalplain/coastal_plain_strat.html)

QUALITY ASSURANCE

Extensive quality assurance (QA) activities ensure that Jefferson Lab's environmental monitoring program continually performs in accordance with the principles of the QA Program and the requirements of DOE Order 458.1. The QA Program includes:

- Qualification of the laboratories that provide analytical services.
- Verification of certification to perform analytical work.
- Review of performance test results.
- Assessment of the adequacy of each subcontractor's internal quality control (QC) practices, recordkeeping, chain of custody, etc.

In addition to the internal QA performed by the Lab's Radiation Control Department, independent assessments are performed by the lab's Quality Assurance & Continuous Improvement (QA/CI) Department, the DOE Site Office, other regulators such as the EPA and DEQ, and oversight groups within DOE. No QA concerns regarding environmental sampling protocols or results were noted in 2011.

An independent laboratory (Universal Laboratories) collected most of 2011's VPDES and HRSD permit-required water samples. Other samples that involve radiochemicals, including some required by the HRSD permit, are collected by the ESH&Q Division and analyzed in Jefferson Lab's radiological analysis lab. Eberline Services performed all subcontracted radiological analyses. Audits of Universal Lab's collection procedures were performed, and the field efforts were found to be in accordance with protocol.

Samples collected by external analytical laboratories are analyzed for radiological (and non-radiological) attributes using standard EPA-approved analytical procedures. Both external facilities and Jefferson Lab have a continuing program of analytical laboratory QC. Participation in inter-laboratory crosschecks, analysis of various blanks, and replicate sampling and analysis verify data quality. ESH&Q Division staff and other responsible Jefferson Lab personnel review all analytical data for the 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.

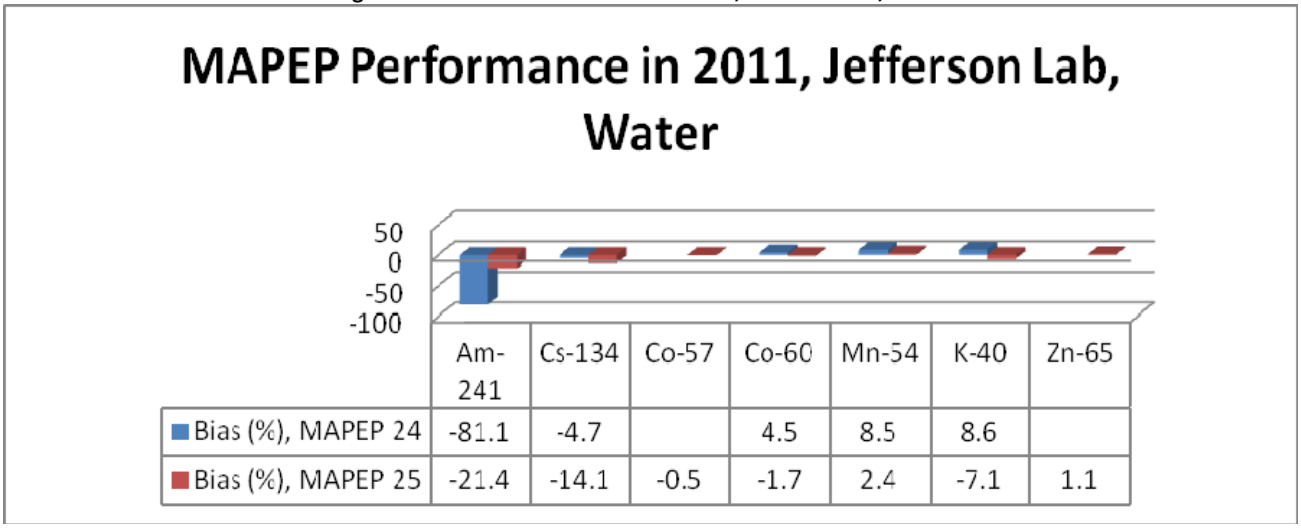
On-going precision and accuracy are monitored by analysis of the following with each batch of samples taken under Permit VA0089320: laboratory standards, duplicate determinations, matrix spikes, and matrix spike duplicates. These data are used to calculate the relative standard deviation on all applicable parameters. The quality of the data is then evaluated and compared to

regulatory limits to determine acceptability. Satisfactory results from the vendors enable Jefferson Lab to validate compliance with the QA requirements in the permit.

Jefferson Lab and Eberline participated in the Mixed Analyte Performance Evaluation Program (MAPEP) conducted by DOE's Radiological and Environmental Services Laboratory, which is available to all DOE subcontractors. This program tests the quality of environmental radiological and non-radiological measurements and provides DOE with complex-wide comparability of measurement performance.

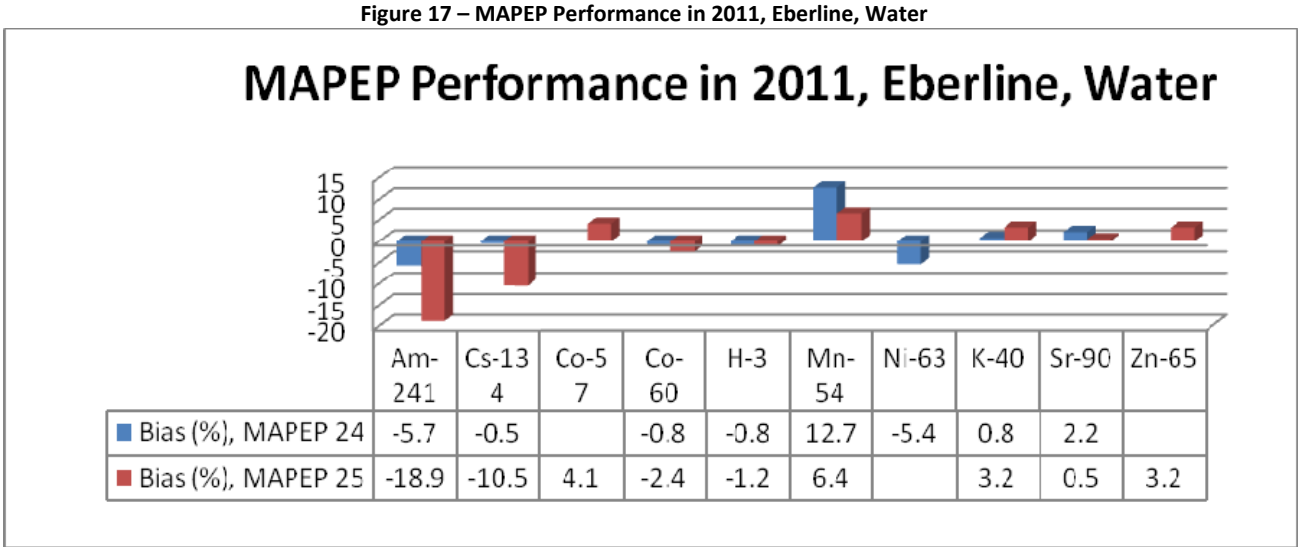
Figure 16 through 19 represent the results of Jefferson Lab's and Eberline's participation in water and soil analysis comparisons in 2011. Measured values within 20% of the established, or reference, value are considered acceptable. Deviation of >20% but <30% are acceptable with a warning.

Figure 16 – MAPEP Performance in 2011, Jefferson Lab, Water



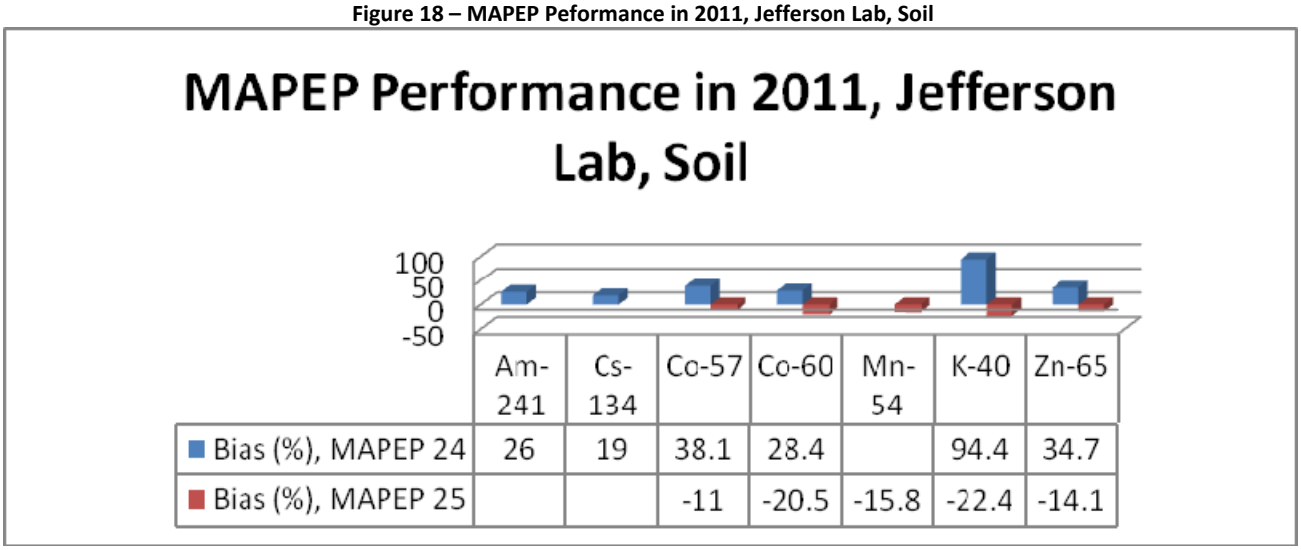
	Am-241	Cs-134	Co-57	Co-60	Mn-54	K-40	Zn-65
Bias (%), MAPEP 24	-81.1	-4.7		4.5	8.5	8.6	
Bias (%), MAPEP 25	-21.4	-14.1	-0.5	-1.7	2.4	-7.1	1.1

Figure 17 – MAPEP Performance in 2011, Eberline, Water



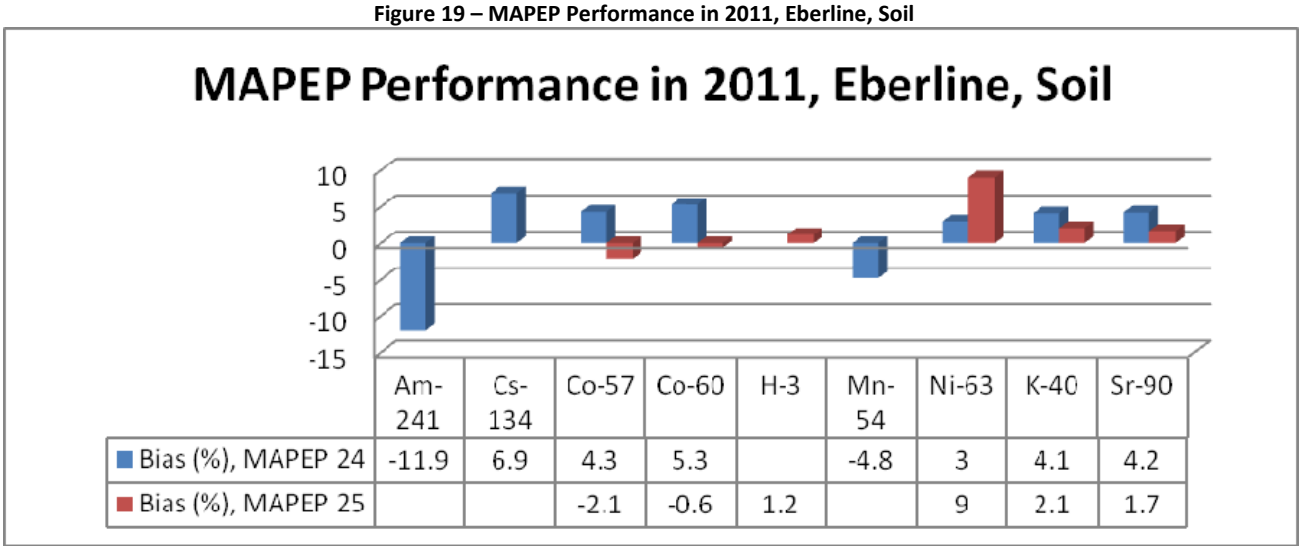
	Am-241	Cs-134	Co-57	Co-60	H-3	Mn-54	Ni-63	K-40	Sr-90	Zn-65
Bias (%), MAPEP 24	-5.7	-0.5		-0.8	-0.8	12.7	-5.4	0.8	2.2	
Bias (%), MAPEP 25	-18.9	-10.5	4.1	-2.4	-1.2	6.4		3.2	0.5	3.2

Figure 18 – MAPEP Peformance in 2011, Jefferson Lab, Soil



	Am-241	Cs-134	Co-57	Co-60	Mn-54	K-40	Zn-65
Bias (%), MAPEP 24	26	19	38.1	28.4		94.4	34.7
Bias (%), MAPEP 25			-11	-20.5	-15.8	-22.4	-14.1

Figure 19 – MAPEP Performance in 2011, Eberline, Soil



	Am-241	Cs-134	Co-57	Co-60	H-3	Mn-54	Ni-63	K-40	Sr-90
Bias (%), MAPEP 24	-11.9	6.9	4.3	5.3		-4.8	3	4.1	4.2
Bias (%), MAPEP 25			-2.1	-0.6	1.2		9	2.1	1.7

ACRONYM LIST

ALARA	As Low As Reasonably Achievable
CASA	Center for Advanced Studies of Accelerators
CEBAF	Continuous Electron Beam Accelerator Facility
CFC	chlorofluorocarbon
DEQ	Department of Environmental Quality (Virginia)
DOE	U.S. Department of Energy
EA	Environmental Assessment
EMS	Environmental Management System
EPA	Environmental Protection Agency
EISA	Energy Independence and Security Act
EPCRA	Emergency Planning and Community Right-to-Know Act of 1986
ES&H	Environment, Safety and Health
FEL	Free Electron Laser
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FONSI	Finding of No Significant Impact
FY	Fiscal Year
GeV	Billion (Giga)-electron Volts
GHG	Greenhouse gas
HPSB	High Performance and Sustainable Building
HRSD	Hampton Roads Sanitation District
ISM	Integrated Safety Management
Jefferson Lab	Thomas Jefferson National Accelerator Facility's
JSA	Jefferson Science Associates, LLC
kW	Kilowatt
LID/GI	Low Impact Development/Green Infrastructure
LLW	Low Level Radioactive Waste
MAPEP	Mixed Analyte Performance Evaluation Program
MEI	maximally exposed individual
mrem	millirem
MS4	Municipal Separate Storm Sewer Systems
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
ODS	Ozone-Depleting Substance
P2	Pollution Prevention
PUE	Power Utilization Effectiveness
QA	Quality Assurance
QC	Quality Control
RBM	Radiation Boundary Monitor
RCRA	Resource Conservation and Recovery Act
SPCC	Spill Prevention, Control, and Countermeasure
SRF	Superconducting Radiofrequency
TEDF	Technology and Engineering Development Facility
VPDES	Virginia Pollutant Discharge Elimination System

FIGURES