2012 SITE ENVIRONMENTAL REPORT

Jefferson Lab
Sustainability Matters

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EXECUTIVE SUMMARY

This Annual Site Environmental Report documents the U.S. Department of Energy's (DOE) Thomas Jefferson National Accelerator Facility's (Jefferson Lab) active environmental protection program and its performance in 2012. This report presents results from environmental activities and the monitoring programs that are within the scope of Jefferson Lab's Environmental Management System (EMS) and provides the compliance status of environmental requirements. This report provides the DOE and the public with information regarding the impact of radioactive and non-radioactive pollutants, if any, resulting from Jefferson Lab operations.

Jefferson Science Associates, LLC (JSA) has managed and operated Jefferson Lab since 2006 as a joint venture between Southeastern Universities Research Association, Inc. and Computer Sciences Corporation (CSC). In July 2013, PAE Company purchased CSC, becoming the named partner in the joint venture.

The mission of Jefferson Lab 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 pass 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 for precise measurements.

In 2012, work continued on a planned upgrade to the CEBAF which, when completed in 2015, will double the beam's energy from 6 Giga-electron Volts (GeV) to 12 GeV. This upgrade includes improvements to experimental apparatus in the three existing experimental halls, and building a fourth hall to serve as another research tool. In 2012, Jefferson Lab completed construction of the fourth hall and began preparing the CEBAF to serve all the experimental halls; the cryogenics system; and all other related systems for operations at 12 GeV.

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, tuned to a precise wavelength or color. The FEL is the most powerful tunable laser in the world. It 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 FEL also operates an ultraviolet FEL that lases in the spectral region down to 363 nm with 100W average power levels. The FEL 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 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 (EMS)

Jefferson Lab's EMS is established and maintained to meet International Organization for Standardization 14001 guidelines and DOE Order requirements. Its principles continually improve the practices of environmental stewardship. The EMS is integrated into the ISM System.

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 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 (EA). 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. Site-specific NEPA Categorical Exclusions cover routine activities and special projects.

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

In 2012, there were no unplanned radiological or non-radiological releases to the public due to accelerator operations. 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 dose from all pathways to the maximally exposed individual (MEI) from Jefferson Lab operations in 2012 was 0.248 millirem (mrem). The MEI dose was predominantly from direct radiation.

Environmental Performance Measures

Jefferson Lab measures its environmental performance in several ways. In 2012, the DOE gave JSA a B+ for its ability to “Sustain Excellence and Enhance Effectiveness of Integrated Safety, Health, and Environmental Protection.” Additionally, Jefferson Lab reports annually to the Office of the Federal Environmental Executive and tracks numerous internal performance metrics – all of which indicated success in 2012.

Inspection

Jefferson Lab’s inspection programs demonstrate its commitment to protect the environment, public health and safety. To ensure operations and activities are performed effectively staff and external agencies, including the DOE Site Office, State of Virginia, and the local sanitation district, conduct inspections. This report provides these inspection results, including detailed comments on Jefferson Lab’s record of compliance with applicable laws and regulations.

General Compliance

Jefferson Lab’s ES&H Manual facilitates integration of general environmental compliance initiatives into site operations. This report presents Jefferson Lab’s environmental compliance activity performance and radiation-related issues, particularly those dealing with water resources and public health. No significant compliance issues arose in 2012.

Awards and Recognitions

In 2012, Hampton Roads Sanitation District (HRSD) recognized Jefferson Lab with a 2011 HRSD Platinum Award for perfect permit compliance for five consecutive years (2006-2011).

The DOE presented Jefferson Lab two awards in 2012 – the Sustainability Award and Bronze GreenBuy Award for excellence in sustainable acquisition.

The U.S. Green Building Council also honored Jefferson Lab’s Technology and Engineering Development (TED) Building with its Leadership in Energy and Environmental Design (LEED) Gold Rating in recognition of its environmentally friendly, sustainable design.

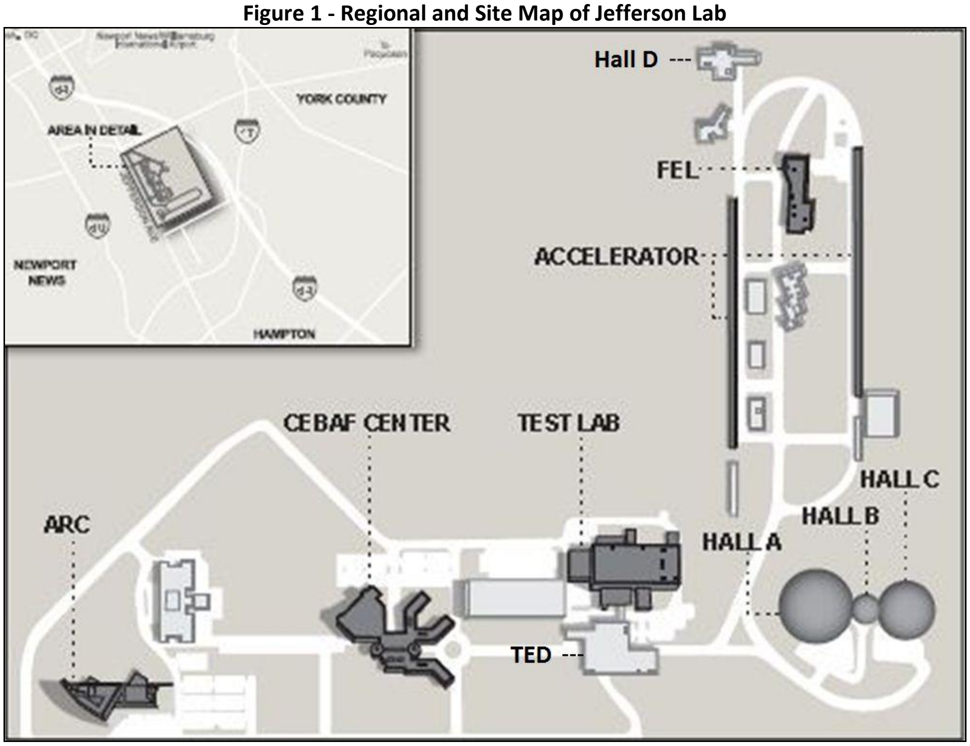

The main entrance to the 74,600-square-foot TED Building. It was designed to LEED gold certification criteria.

INTRODUCTION

SITE LOCATION

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

Figure 1 - Regional and Site Map of Jefferson Lab



Site History

Prior to the construction of Jefferson Lab, there were several users of this general area of Newport News. The U.S. Department of Defense (DOD) acquired most of the Oyster Point area, including the land presently used by Jefferson Lab. The U.S. Air Force later acquired the land and installed a Boeing and Michigan Aerospace Research Center (BOMARC) missile site on a portion of the property. After closure of the BOMARC missile base, the DOD started disposing of the property and conveyed some land to the Commonwealth of Virginia, the NASA, and others. Ownership of the NASA property, including 100 acres of undeveloped land, was conveyed to the DOE in 1987. An additional 52 acres of land was also transferred to the DOE from other sources. The total DOE-owned parcel, upon which Jefferson Lab is built, is 169 acres.

General Environmental Setting

The most comprehensive reviews of the site's environmental setting are the four EAs completed under the NEPA. Each evaluated the potential impact of the site (or of proposed changes to the site) on cultural resources, air quality, water quality, noise, wetlands, endangered and threatened species, and a host of other subjects.

A 1987 EA 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 for the 12GeV upgrade project, also yielded FONSIs. As a result, proposed projects have been completed with the assurance that no harm would be caused to the environment and without the need for Environmental Impact Statements.

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: "… 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.]

The mission 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 environment, safety, health and quality (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, C, and D)

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.
- Hall C contains two moderate resolution spectrometers. One is capable of high momentum particle detection; the other is optimized for the detection of short-lived reaction products.
- Hall D will support studies of photon induced reactions using a solenoidal based detector with high acceptance for charged particles and photons.

Institute for Superconducting Radio Frequency (SRF) Science and Technology

Jefferson Lab's primary research and development facility 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 results generated through the work performed at Jefferson Lab. A secondary goal for the organization is to archive information generated by Jefferson Laboratory's Accelerator Division activities and make it 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, tuned to a precise wavelength or color. The FEL is the most powerful tunable laser in the world. It 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 Oct. 30, 2006, an important wavelength for both the optimal transmission of laser light through the atmosphere and for materials processing. The FEL also operates an ultraviolet FEL which lases in the spectral region down to 363 nm with 100W average power levels. The FEL holds the world's record in generating terahertz wavelengths.

RELEVANT DEMOGRAPHIC INFORMATION

Jefferson Lab is a world-class research institution. It attracts resident and visiting physicists and other scientists from around the world. Approximately 825 full-time physicists, engineers, technicians, and support staff work at Jefferson Lab and more than 1,385 academic and industrial researchers, from across the United States and approximately 29 countries and 120 institutions, participate in scientific collaborations.

Each year, research conducted at Jefferson Lab produces more than one-third of all Nuclear Physics PhDs awarded in the United States. FY2012 research at Jefferson Lab also produced twelve patents.

COMPLIANCE SUMMARY

The following sections summarize Jefferson Lab's 2012 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 waste, and medical wastes. In 2012, Jefferson Lab conducted waste management activities in accordance with 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 hazardous material quantities so local entities can plan and provide adequate chemical emergency response services.

Jefferson Lab meets applicable reporting requirements, such as toxic chemical usage and environmental releases, as required. See Figure 2 - Status of EPCRA Reporting in 2012.

Figure 2 - Status of EPCRA Reporting in 2012

STATUS OF EPCRA REPORTING IN 2012		
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, the environment, and conservation of valuable material and energy resources. As a "Small Quantity Generator," Jefferson Lab adheres to RCRA's principles by generating less than 1000 kilograms (kg) of regulated waste per month (but more than 100 kg). In 2012, approximately 4,218 kg of routine RCRA hazardous waste was generated. Jefferson Lab also does not store, treat, transport, nor dispose of RCRA-regulated waste on site. All RCRA wastes are disposed through licensed waste-handling transport or disposal facilities.

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.

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, subcontractors who have completed the certification program administered by the Virginia Commonwealth perform the application of herbicides and pesticides at Jefferson Lab.

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; no industrial-strength herbicides or pesticides be stored or disposed of on Jefferson Lab property; and only small amounts are allowed to be mixed on site.

National Environmental Policy Act (NEPA)

NEPA requires that projects with potentially significant environmental impacts be evaluated and alternative actions explored. Jefferson Lab uses EAs and Category Exclusions to evaluate impacts. No NEPA evaluations were required in 2012.

Other Wastes

Other wastes generated at Jefferson Lab include general solid, radioactive, and medical. The vast majority of this waste is general solid waste (approximately 1,500 tons in 2012). It consisted of routine office trash and construction debris. Jefferson Lab has an extensive recycling program that segregates paper, metal, aluminum cans, etc. This program resulted in the recycling of over 1,300 tons of material in 2012. Jefferson Lab also recycled close to 100% of its used oil and computer equipment.

Radioactive waste management is done in accordance with DOE Order and Manual 435.1-1, Radioactive Waste Management. In 2012, approximately 39,260 pounds (25 yd^3) of low-level radioactive waste was transferred for off-site disposal. Jefferson Lab utilized an intermodal transport container to enable the disposal of large pieces of construction debris resulting from work in the experimental halls.

Jefferson Lab's on-site clinic only generated a minor amount of medical waste in 2012. Its disposal was in accordance with all applicable regulations.

RADIATION PROTECTION

All Jefferson Lab activities in 2012 were in full compliance with applicable limits for radiation protection. See Section - Environmental Radiological Protection Program and Dose Assessment.

AIR QUALITY AND PROTECTION

Jefferson Lab has no processes that require air permitting. Routine internal calculations are conducted to confirm this status. All emissions remained below reportable thresholds in 2012. Newport News has been in attainment with all Environmental Protection Agency (EPA) and state designated pollutant limits since 2008.

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, and comply with Section 608 of the Clean Air Act's Refrigerant Recycling Rule, Jefferson Lab utilizes EPA certified subcontractors and staff to perform all work involving ODS-containing refrigeration and air conditioning equipment on site. There is one ODS recovery machine on-site. The one remaining chlorofluorocarbon based chiller receives preventive and corrective maintenance by a qualified mechanical subcontractor to ensure optimal performance with minimal loss.

Greenhouse Gas (GHG) Emissions

During 2012, Jefferson Lab and DOE continued to assess GHG emissions. Efforts to understand these various emissions allowed for the development of ways to minimize them. See "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. Controls, such as shielding and other measures, maintain groundwater quality during operations. Processed wastewater, discharged to the surface, is done in accordance with Jefferson Lab's Virginia Pollutant Discharge Elimination System (VPDES) Permit No. 0089320. Discharged wastewater flows to permit-authorized outfalls included in Jefferson Lab's environmental monitoring program. All stormwater discharges are managed through both structural and non-structural Best Management Practices

(BMP). Operational control measures include proper storage and minimizing the use of products that could pollute ground and surface water.

Jefferson Lab held five active water permits in 2012 (See Figure 3 - Jefferson Lab's Active Water Permits 2012). Regulatory limits were not exceeded and all water quality programs were effective.

Figure 3 - Jefferson Lab's Active Water Permits 2012

PERMIT TYPE	# OF OUTFALLS	PARAMETER	# OF PERMIT EXCEEDANCES	# OF SAMPLES TAKEN	# OF COMPLIANT SAMPLES	PERCENT COMPLIANCE
Industrial Wastewater Discharge to Surface (VPDES)	2*	Radionuclides Inorganic Chemicals Organic Chemicals pH Flow Temperature	0	5	5	100
Groundwater Quality (VPDES)	15 wells	Radionuclides Inorganic chemicals pH	0	21	21	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 (HRSD)	2	Radionuclides Inorganic Chemicals Organic Chemicals pH Flow	0	12	12	100
Groundwater Withdrawal	1	Volume	0	12	12	100

*Jefferson Lab's VPDES permit includes two outfalls and the collection and reporting of radionuclide monitoring data from 15 groundwater monitoring wells located throughout the site.

**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 BMPs 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 BMPs 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 TED Building 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.

The TED Building is in conformance with EISA Section 438. It was designed utilizing low impact development/green infrastructure (LID/GI) techniques to the "maximum extent technically feasible."

Future Strategies for EISA Section 438 Conformance

For future development or redevelopment projects of >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 to the Maximum Extent Technically Feasible (METF)). This is accomplished through review of project design criteria to assure the following strategies have been considered:

- Apply 'runoff reduction' as the 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

The purpose of DOE Order 436.1 is to "….Provide requirements and responsibilities for managing sustainability within the DOE to 1) ensure the [DOE] carries out its missions in a sustainable manner that addresses national energy security and global environmental challenges, and advances sustainable, efficient and reliable energy for the future, 2) institute wholesale cultural change to factor sustainability and GHG reductions into all DOE corporate management decisions, and 3) ensure DOE achieves the sustainability goals established in its Strategic Sustainability Performance Plan pursuant to applicable laws, regulations and Executive Orders, related performance scorecards, and sustainability initiatives."

Jefferson Lab satisfies this order's requirements through the implementation of its EMS (see Section - Environmental Management System below) and its Site Sustainability Plan, summarized in Figure 4 - Jefferson Lab's Sustainability Goal Performance.

In 2012, Jefferson Lab issued its Site Sustainability Plan. This plan addresses each specific goal in the DOE O 436.1, assesses performance status, and lays out planned actions and schedules for meeting them. Figure 4 - Jefferson Lab's Sustainability Goal Performance summarizes major 2012 activities associated with the plan.

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 (High/Medium/Low)**
Goal #1 28% GHG Reduction by FY '20 from a FY '08 baseline				
Scope 1: GHG from Vehicle Emissions FY '08 2,996 MTCO2e FY '12 3,063 MTCO2e 0.9% decrease versus FY '08			**Scope 2: GHG from Electricity FY '08 64,708 MTCO2e FY '12 64,044 MTCO2e 0.9% decrease versus FY '08**	
1.1	Reduce energy intensity by 30% by FY '15	Energy intensity reduced 26.4% to date versus FY '03 baseline	Existing building Energy Conservation Measures identified to reduce Energy Intensity Unit and lower British Thermal Units / square feet new construction projects on line prior to FY '15	Low

JEFFERSON LAB'S SUSTAINABILITY GOAL PERFORMANCE

Goal#	DOE Goal	Performance Status	Planned Actions & Contributions	Risk of Non-Attainment (High/Medium/Low)
1.2	7.5% of annual electricity consumption from renewable sources by FY '13 and thereafter (5% FY '10 – '12)	Purchased Renewable Energy Credit certificates in FY '12 equal to 6.8% of total Megawatt hour electric consumption versus 5% goal	Purchase Renewable Energy Credits in FY '13 and beyond equal to 7.5% of total electric consumption and evaluate on-site renewable energy generation	Low
1.3	Sulfur Hexafluoride Reduction	Sulfur Hexafluoride capture program implemented, capturing approximately 900,000 MTC02e since installed in 1999	Continue established Sulfur Hexafluoride capture best practices	Low
1.4	Individual buildings metering for 90% of electricity (by October 1, 2012); for 90% of steam, natural gas, and chilled water (recommended) (by October 1, 2015)	Completed installation of Advanced Metering System for all individual building level and processes for electric, natural gas, and water	Additional metering of new construction and renovation projects planned in FY '12	Low
1.5	Cool roofs, unless uneconomical, for roof replacements unless project already has DOE Critical Decision-2 approval. New roofs must have thermal resistance rating of at least 30	Approximately 52% (295,000 square feet) of total applicable site roof area (568,000 square feet) comply with cool roof requirements to date	Additional 114,601 square feet of cool roof upgrade scheduled in FY '13. All new roofs / replacements will comply as completed	Low
1.6	Training	Completed Certified Energy Auditor training and certification in FY '12. Attended multiple Federal Emergency Management Program and industry sponsored web training sessions	Continue active participation in Federal Emergency Management Program sponsored training and Association of Energy Engineers, U.S. Green Building Council, and The American Society of Heating, Refrigerating and Air Conditioning Engineers energy / sustainability programs	Low
1.7	Net Zero energy in new or major renovation facilities	Current new construction and or major renovation projects not cost effective to achieve net zero energy	Comply with Executive Order 13514 requiring buildings entering the design process in 2020 be designed to achieve net zero energy by 2030	High

JEFFERSON LAB'S SUSTAINABILITY GOAL PERFORMANCE				
Goal#	**DOE Goal**	**Performance Status**	**Planned Actions & Contributions**	**Risk of Non-Attainment (High/Medium/Low)**
1.8	Evaluate 25% of 75% of Facility Energy Use over 4-Year Cycle	Completed 100% energy audits: 4 year cycle ending June 2012	100% of covered facilities scheduled to audit in new 4 year cycle	Low
1.9	13% Scope 3 GHG reduction by FY '20	Scope 3 GHG = +7% increase versus FY '08 primarily from staff commuting	Implement a combined telework, alternative work schedule and carpool program in first half of FY '13	Medium
Goal #2 High Performance and Sustainable Building (HPSB), Energy Savings Performance Contracts, Initiative, Regional and Local Planning				
2.1a	15% of existing buildings greater than 5,000 gross square feet are compliant with Guiding Principles (GPs) for HPSB by 2015	Achieved initial HPSB GP compliant facility in FY '12. New LEED Gold certified building	Existing building renovations, due for completion prior to 2015 end are designed to achieve 15% HPSB GP compliance	Low
2.1b	All new construction, major renovations, and alterations of buildings greater than 5,000 gross square feet must comply with GPs	Major renovation project designed to LEED Gold criteria due for completion, U.S. Green Building Council certification and compliance with HPSB GPs prior to 2015 end	Design all new construction and major renovation projects to comply with HPSB GP Guidance	Low
2.2	Energy Savings Performance Contract Initiative	Utility Energy Services Contract (UESC) program and projects under development to comply with President's performance contracting initiative	Complete contract negotiation with local utility and implement initial task order in FY '13	Low
Goal #3 Fleet Management				
3.1	10% annual increase in fleet alternative fuel consumption by FY '15 relative to a FY '05 baseline	Fleet annual alternative fuel consumption increased to 2,612 Global Environment Governance in FY '12, approximately 384% above the FY '05 baseline, exceeding the 10% annual goal	Continue to utilize alternative fuel as the primary source for site vehicles and equipment	Low

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Goal#	**DOE Goal**	**Performance Status**	**Planned Actions & Contributions**	**Risk of Non-Attainment (High/Medium/Low)**
3.2	2% annual reduction in fleet petroleum consumption by FY '20 relative to a FY '05 baseline	Fleet annual petroleum consumption decreased to 3,029 gallons in FY '12, approximately 30% below the FY '05 baseline, exceeding the 2% annual reduction goal	Continue to increase alternative fuels and reduce fleet petroleum consumption	Low
3.3	100% of light duty vehicle purchases must consist of alternative fuel vehicles by FY '15 and thereafter (75% FY '00 – '15)	Light Duty Fleet = 11 Vehicles Light Duty alternative fuel vehicles = 11 vehicles 100% of Light Duty Fleet alternative fuel vehicle.	Jefferson Lab has achieved the FY '15 of 100% Light Duty alternative fuel vehicles goal	Low
3.4	Reduce fleet inventory by 35% by FY '13 relative to a FY '05 baseline	Fleet reduction through FY '12 = 16% (FY '05 baseline / 30 vehicles, FY '12 Inventory / 25 vehicles)	Jefferson lab will achieve the 35% reduction goal following completion of the 12 Gev expansion project	Low
Goal #4 Water Use Efficiency and Management				
4.1	26% water intensity reduction by FY '20 from a FY '07 baseline	Water intensity (Gallons / Gross Square Foot) decreased by approximately 19% in FY '12 versus the FY '07 baseline. FY '07 (63.8 Gallons / Gross Square Foot) versus FY '12 (51.2 Gallons / Gross Square Foot)	Water consumption, and subsequent water intensity, is estimated to increase significantly due to 12 Gev upgrade requirements. Multiple water reuse and source strategies are under evaluation	Medium
4.2	20% water consumption reduction of industrial, landscaping, and agricultural (ILA) water by FY '20 from a FY '10 baseline	Not applicable, non-potable water sources are not used		Low

JEFFERSON LAB'S SUSTAINABILITY GOAL PERFORMANCE				
Goal#	**DOE Goal**	**Performance Status**	**Planned Actions & Contributions**	**Risk of Non-Attainment (High/Medium/Low)**
Goal #5 Pollution Prevention and Waste Reduction				
5.1	Divert at least 50% of non-hazardous solid waste, excluding construction and demolition debris, by FY '15	Annual non-hazardous solid waste diverted from landfill / recycled = 96.4%	Continue current best practices that exceed the 50% diversion goal	Low
5.2	Divert at least 50% of construction and demolition materials and debris by FY '15	Annual construction materials diverted from landfill / recycled = 85.1%.	Continue current best practices that exceed the 50% diversion goal	Low
Goal #6 Sustainable Acquisition				
6.1	Procurements meet sustainability requirements and include sustainable acquisition clause (95% each year)	Federal Acquisition Regulation clauses regarding sustainability included in all appropriate acquisition contracts	Continue current best practices that achieve 95% goal. Implement measurement procedures in FY '13 to assure annual 95% compliance	Low
Goal #7 Electronic Stewardship and Data Centers				
7.1	All data centers are metered to measure a monthly Power Utilization Effectiveness (PUE) (100% by FY '15)	Primary data center is metered to measure electrical consumption	Expand metering system to include additional measurement of data center Heating Ventilation Air Conditioning system	Low
7.2	Maximum annual weighted average PUE of 1.4 by FY '15	Current calculated weighted average PUE value for two data centers =2.29	Developing data center strategies to reduce cooling energy and improve PUE. Planning UESC program to fund data center efficiency projects	Medium
7.3	Electronic Stewardship - 100% of eligible personal computers, laptops, and monitors with power management actively implemented and in use by FY '12	Power management system actively manages 100% of personal computers and monitor hibernation mode	Continue current practices that achieve the power management goal	Low

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

As discussed earlier in the report, Jefferson Lab continues to implement a project to make significant upgrades to the accelerator, experimental halls and mission support infrastructure. The planning of these activities consistently incorporated waste minimization / pollution prevention evaluations. Opportunities were identified and implemented across the lab, notably including:

- Recycling 80,025 pounds of lead scrap and associated packing materials into shielding bricks for Hall C.
- Recapturing for beneficial reuse 14,000 pounds of helium that would otherwise have been vented to the atmosphere.

Earlier this year, Jefferson Lab Materials Management staff prepared 80,025 pounds of lead scrap for shipment to a lead smelting and processing company. The lab has received back 55,751 pounds of lead in the form of 2,069 lead bricks that will be used for shielding purposes for physics experiments.

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

Purchase requests for hazardous materials are approved by Jefferson Lab's ESH&Q staff to ensure that the most environmentally preferable products are acquired and used.

Environmentally Preferable Purchasing

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

Jefferson Lab received a Bronze GreenBuy Award, achieving excellence in Sustainable Acquisition and exceeding its achievements from the prior year's award. In Fiscal Year (FY) 2012, twenty-seven DOE sites participated in this program. Jefferson Lab was one of only nine that earned recognition for exemplary sustainable acquisition achievements.

Electronic Stewardship

Jefferson Lab utilizes the EPA's Electronic Product Environmental Assessment Tool (see Section – Environmental Performance Measures) 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

Recycling has become standard practice for Jefferson Lab. Recycling containers are standard features in every office, conference, and break room. Jefferson Lab staff, users, and subcontractors also utilize lab-wide office product recycling centers that collect: aluminum cans, small batteries, cardboard, printer cartridges, paper wastes, telephone books, and plastic and glass bottles. In 2012, with construction debris, scrap metal, and automatic data processing equipment included, approximately 1,300 tons of material was recycled.

OTHER ENVIRONMENTAL STATUTES

Oil Pollution Control

Jefferson Lab has a current Spill Prevention, Control, and Countermeasure (SPCC) Plan, which outlines a program by which inspections are conducted and appropriate actions in response to spills from large oil-containing storage tanks and [and other oil containing] equipment on-site are taken. Oil inventory comprises numerous oil-filled electrical transformers, ranging in volume from two gallons to approximately 5,000 gallons, and emergency generators (including one holding 5,000 gallons). Jefferson Lab's estimated volume of oil is approximately 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 in 2012.

UNPLANNED RELEASES

On December 19, 2012, Jefferson Lab responded to the release of approximately 300 gallons of an unidentified substance with a white, cloudy/milky appearance into a receiving storm channel located adjacent to an ongoing construction project. Further investigation lead to the discovery of a construction subcontractor dumping several buckets of gypsum material associated with drywall installation. To mitigate the release and prevent the material from migrating away from its original location a vacuum truck was called onsite. Four other 'near-miss' events occurred during 2012, but Jefferson Lab was able to respond and contain the releases prior to any materials leaving its original vicinity. These events included three small hydraulic fluid spills, and a small diesel fuel spill.

SUMMARY OF PERMITS

Jefferson Lab held five active environmental permits in 2012:

Figure 5 - Environmental Permits in 2012

ENVIRONMENTAL PERMITS IN 2012	
Permit Number	**Permit Type**
GW0047200	Groundwater withdrawal
VAR10-10-104486	Construction Stormwater
VA0089320	Industrial Wastewater to Surface – Groundwater Quality
VAR040079	Stormwater discharge
HRSD 0117	Industrial Wastewater 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.

Self-assessments, inspections, and work observations measure program effectiveness.

ENVIRONMENTAL MANAGEMENT SYSTEM

Jefferson Lab's EMS is designed 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 about improvement, a cross-cutting team of lab scientists, engineers, and other professionals are assembled, at least annually, to discuss how we can do better. This group reviews the previous year's EMS performance, discusses changes to lab operations, how these would affect 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).

In 2012, an independent, certified auditor completed an extensive EMS records review, conducted interviews, and made a site visit. The audit results identified no significant weaknesses and two areas for improvement. Actions in response to the opportunities for improvement were completed.

Figure 6 - 2012 EMS Objectives and Target Summary below summarizes the Objectives and Targets for 2012.

Figure 6 - 2012 EMS Objectives and Target Summary

2012 OBJECTIVES AND TARGETS SUMMARY		
EMS Objective	**Annual Targets**	**Status**
OBJECTIVE 1 MAKE MORE EFFICIENT USE OF ELECTRICITY AND WATER	Purchase renewable energy credits = 5% of total electrical energy consumption.	Completed
	Replace Counting House, Machine Control Center and Test Lab roofs with cool-roof technology.	Completed
	Investigate strategies to reduce potable water usage through the use of impaired BOMARC plume water.	Completed
OBJECTIVE 2 IMPROVE JEFFERSON LAB'S WASTE AND EMISSIONS MANAGEMENT PRACTICES	Implement a waste segregation and disposal program for long shut down activities.	Completed
	Distribute additional recycling containers throughout site and provide good labeling and instructions.	Completed
	Conduct an inventory of gases used in site chiller equipment so that operational control evaluations can be conducted.	Not completed, will continue in 2013
OBJECTIVE 3 REDUCE THE IMPACT OF PETROLEUM PRODUCT USAGE	Develop a proposal to reduce staff commuting mileage.	Completed
	Design and implement an illicit discharge detection and prevention inspection program that includes petroleum use/storage areas.	Completed
	Investigate the availability of local Computer Science Corporation video conference capabilities to reduce travel GHG emissions.	Completed
OBJECTIVE 4 CONTRIBUTE TO REGIONAL AND DOE-WIDE INITIATIVES SUPPORTING JEFFERSON LAB'S ENVIRONMENTAL AND SUSTAINABILITY STRATEGIES	Support Hampton Roads Planning District Commission activities to develop more sustainable commuting options for Lab workers.	Completed
	Support activities of the Hampton Roads Partnership and the Hampton Roads Military and Federal Facilities Alliance to explore technical and financial strategies for sustainable energy sources.	Completed

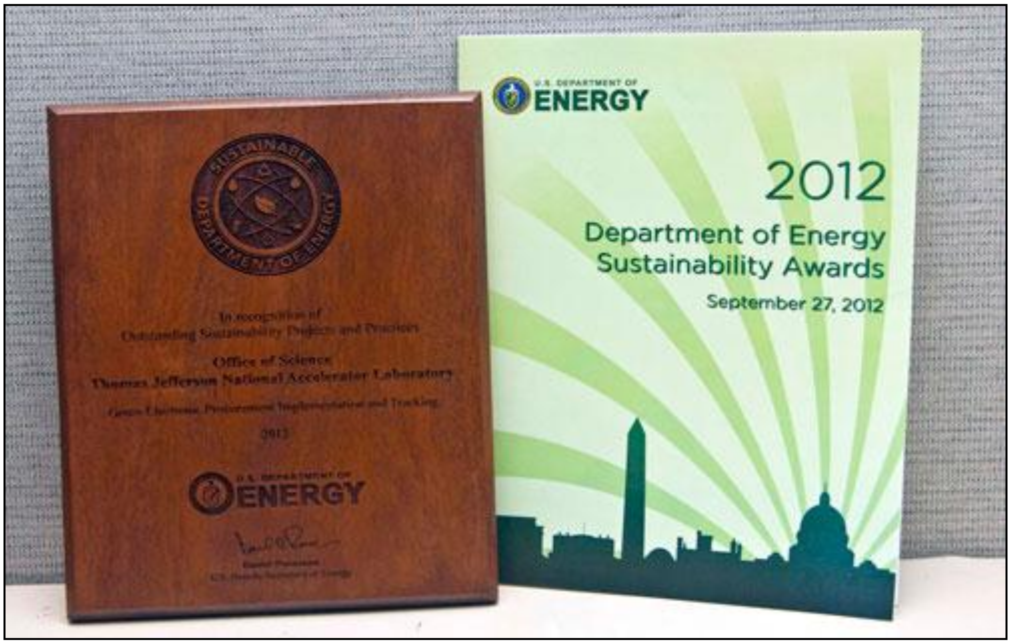
ENVIRONMENTAL PERFORMANCE MEASUREMENT

In May 2012, Jefferson Lab was recognized by the HRSD for its environmental stewardship. The lab was among the nine businesses, industries, and agencies earning a 2011 HRSD Platinum Award for perfect permit compliance for five consecutive years (2006-2011). HRSD recognizes award recipients for their exemplary wastewater pretreatment excellence and for their outstanding pollution prevention measures. An open letter from HRSD reads, in part: "Congratulations … for exemplary permit compliance and outstanding pollution prevention

measures. These businesses pretreat their industrial wastewater before discharging it to HRSD's system. Their efforts help protect our waterways and other natural resources." This recognition is a reflection of Jefferson Lab's execution of its EMS.

HRSD recognized Jefferson Lab with a 2011 Platinum Award for perfect permit compliance for five consecutive years (2007-2011).

Jefferson Lab received a 2012 Sustainability Award, recognizing its outstanding sustainability accomplishments, from the DOE. Jefferson Lab received the award in recognition of its Green Electronic Procurement Implementation and Tracking program. The DOE Sustainability Performance Office Director, Jennifer MacDonald, wrote, "…This project exemplifies the innovation and commitment to sustainability the awards program is designed to recognize. ….Congratulations on your outstanding achievements!" The award was for the development of a computer system configuration referred to as the "bundle program." This program streamlines the ordering and approval process for new computers, saving employees time and reducing waste. The bundling program has enhanced efficiency for the Laboratory's Computer Center in several areas. Bundling limits the variety of computers purchased, so the Computer Center more effectively manages software installations and upgrades. This reduces vulnerability and security threats to the laboratory's network-based systems.



Jefferson Lab received a [2012 Sustainability Award](#) from the Department of Energy for its Green Electronic Procurement Implementation and Tracking program. The award was one of 21 team and individual awards presented at the second annual DOE Sustainability Awards event

In conjunction with presenting the 2012 Sustainability Awards, the Department of Energy also presented Jefferson Lab with a 2012 Bronze GreenBuy Award for excellence in sustainable acquisition. The lab achieved the leadership goal for at least three products in three different categories.

The TED Building, which opened in May 2012, earned a LEED Gold Rating from the U.S. Green Building Council in early December 2012. A variety of recycled materials were used in the construction of the building; its sustainable features include a heating and cooling system that draws 80 percent of its capacity from 178 strategically located geothermal wells; a solar hot water system is utilized; a reclamation water system for use in its toilets; and a "cool" roof that is highly reflective and well insulated.

The TED Building at Jefferson Lab, which opened in May 2012, earned a LEED Gold Rating from the U.S. Green Building Council in early December.

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

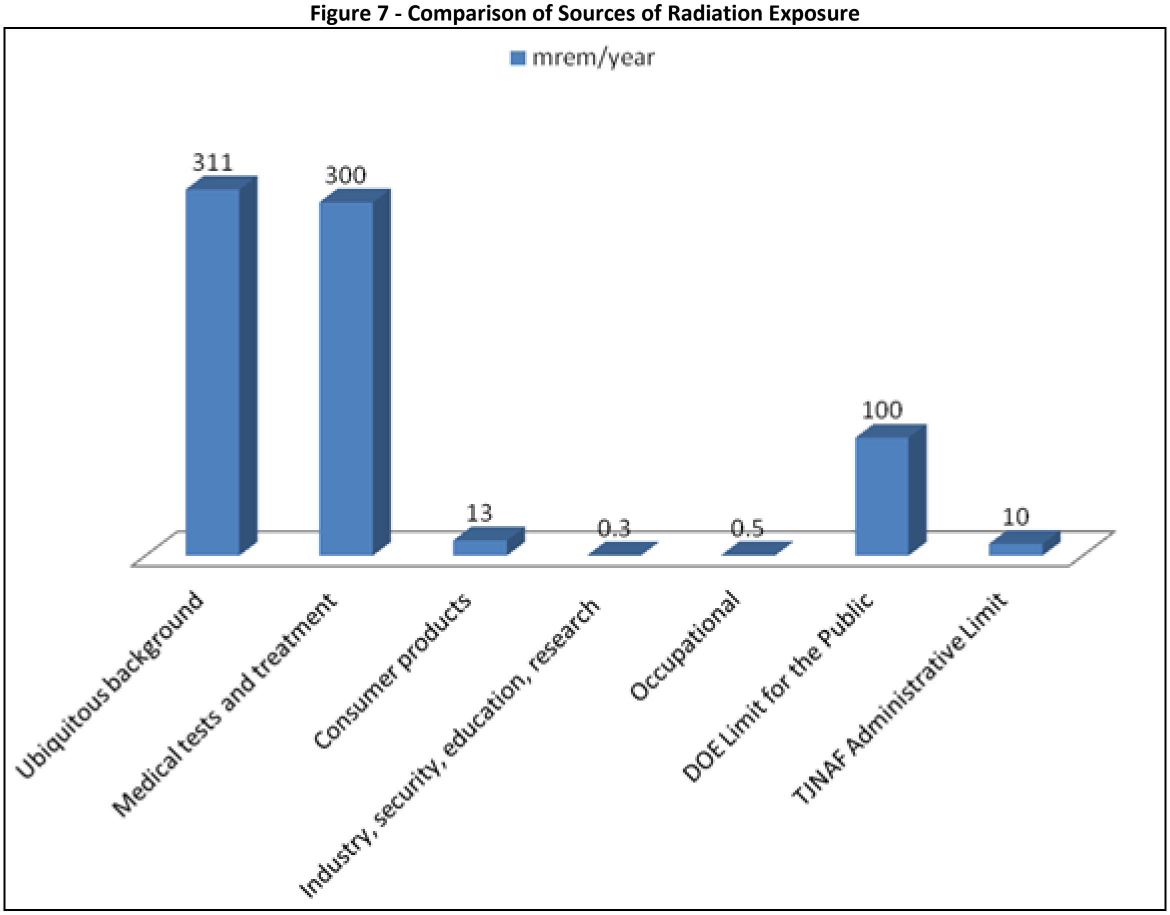
People are exposed to natural sources of radioactivity constantly:

- Cosmic radiation from extraterrestrial sources;
- Terrestrial radiation from naturally-occurring elements in the earth's crust; and
- 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 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. Four site boundary monitoring stations also collected direct radiation data in 2012. 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 adheres to the DOE release limits for surface contamination, and follows DOE guidance for ensuring that materials being released contain no detectable induced radioactivity.

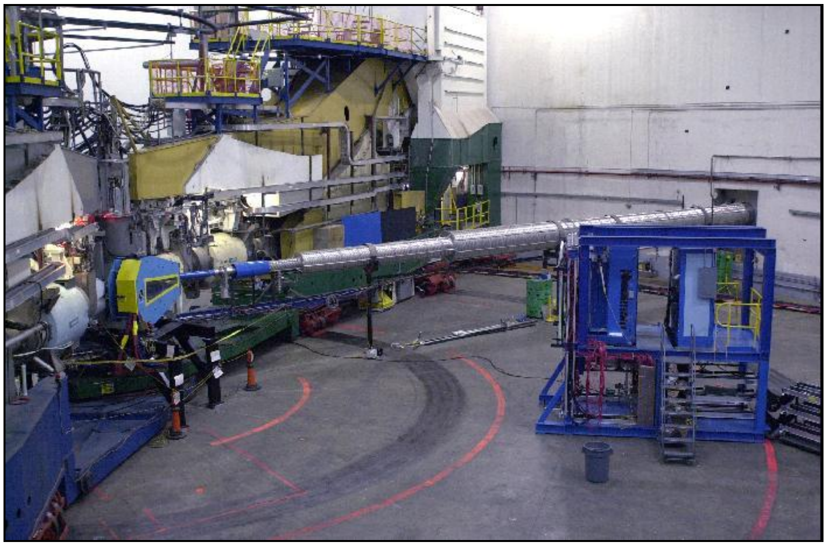
Controls are in place to minimize exposure from both direct and induced radiation to lab personnel, the environment, and the public. Access to the accelerator site and to areas containing radioactive material is strictly limited. Fencing, safety interlocks, signs, training, and other engineered and administrative 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 and VPDES Permit No. 0089320. These wastewaters can include:

- CEBAF accelerator enclosure and experimental hall floor drainage[1]
- Beam dump and target cooling water
- Environmental samples, once analyzed
- Groundwater extracted from beneath Halls A, B, and C

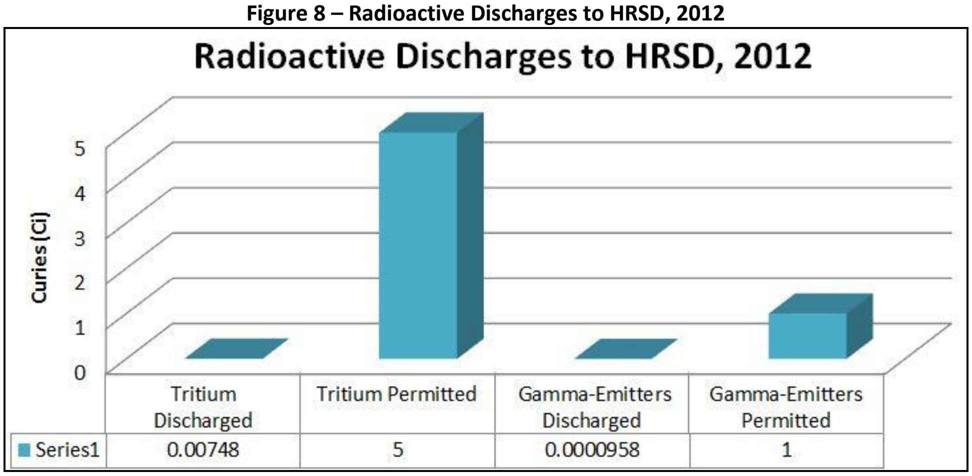
[1] The floor drain system is routed to a common sump. The system accumulates water from A/C condensate drains, spills and leaks from cooling water systems, cleaning activities, and minor in-leakage from surface/ground water.



Hall A Beam Line to Beam Dump toward Right

The potential radiological constituents of Jefferson Lab's wastewater discharge to HRSD in 2012 totaled 7.48E-03 Ci of tritium (versus a limit of 5 Ci) and 9.58E-05 Ci of total gamma-emitters (limit = 1 Ci). These potential releases are overestimates, as they use both measured levels of activity and Minimum Detectable Activity values (e.g., detection limits) where activity cannot be measured.

Figure 8 – Radioactive Discharges to HRSD, 2012



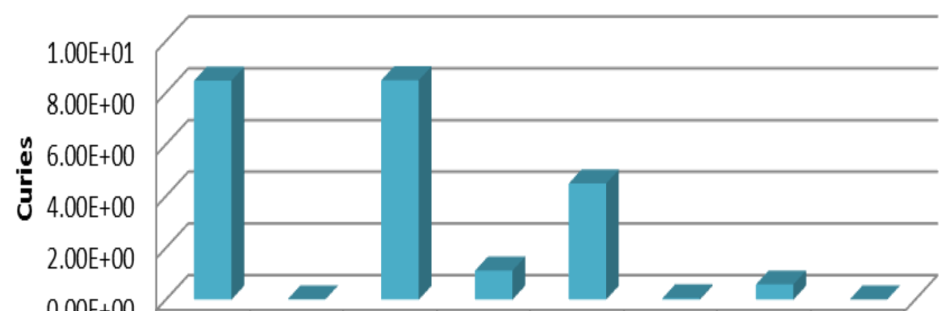
DOE regulates wastewater effluents under DOE Order 458.1. The Order requires wastewater treatment to reduce radioactivity content at specified concentration thresholds, in keeping with the ALARA principle. Average discharge concentrations in 2012 remained a small fraction of the best available technology treatment threshold.

Jefferson Lab
Sustainability Matters

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 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, 2012 below for a summary of estimated atmospheric releases from Jefferson Lab in 2012.

Figure 9 – Atmospheric Discharges of Radionuclides, 2012



	N-13	H-3	Be-7	C-11	O-15	Cl-38	Cl-39	Ar-41
Total (Ci)	8.47E+00	1.50E-02	8.49E+00	1.12E+00	4.49E+00	4.82E-02	5.88E-01	2.19E-03

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 Jefferson Lab's operational emissions remain several orders of magnitude lower than the EPA's 10 mrem/year dose limit for a member of the general public. Jefferson Lab continued to take measurements to verify the very low calculated release rate. The calculated 2012 dose to the MEI among members of the public was 0.0194 mrem/year due to airborne releases. The location of the MEI was 300 meters due south of the accelerator, in the Oyster Point office park. This MEI dose represents a very conservative estimate, as the population in the office park would be expected to occupy their location for only 40 hours/week. CAP-88 does not distinguish between commercial or residential (up to 24 hour/day) presence.

Direct Radiation Monitoring

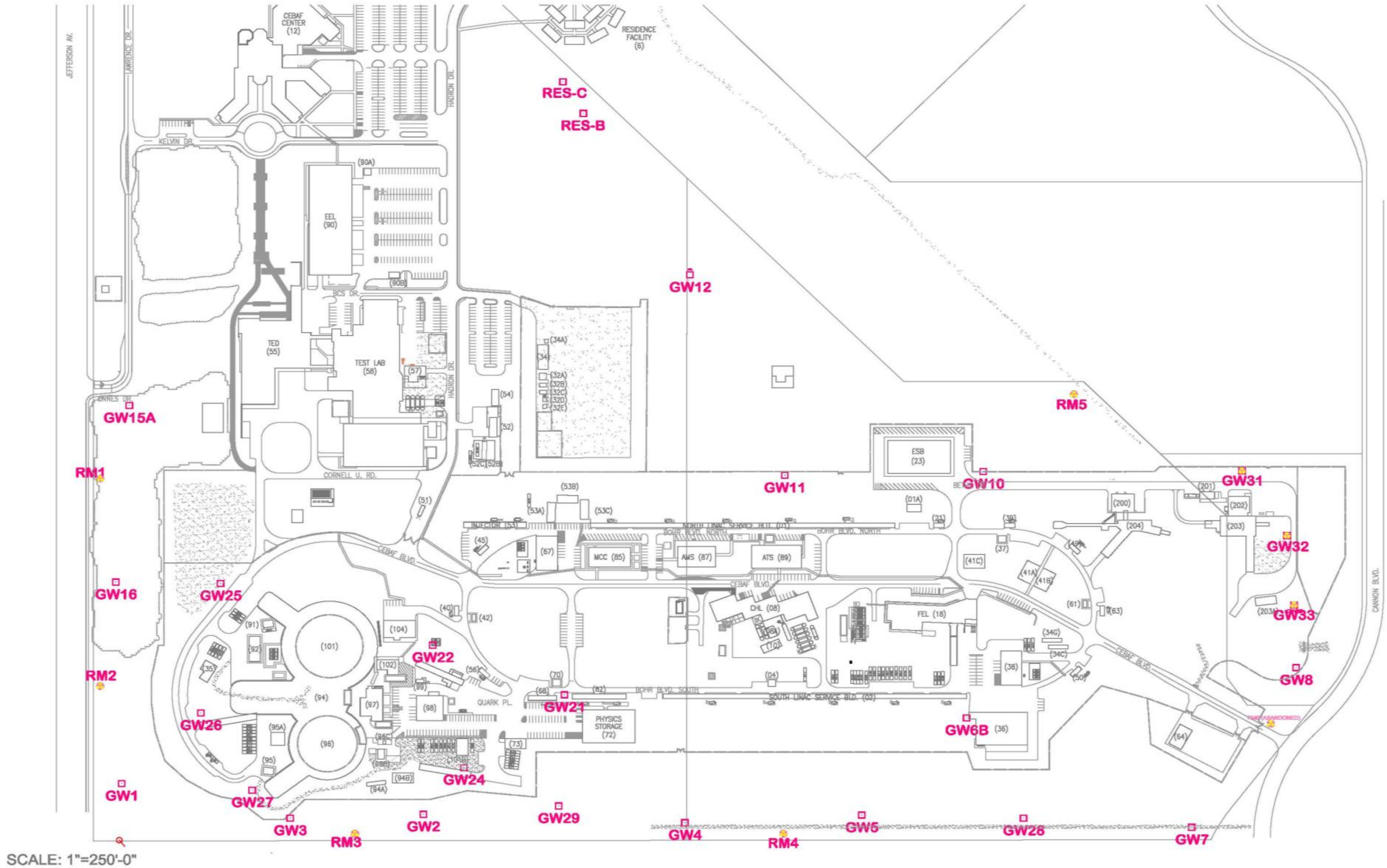
Figure 10 – Direct Radiation Measured at Site Boundary, 2012 displays the radiation doses in mrem at the detector that saw the largest dose from accelerator and experimental hall operations in 2012 (Radiation Boundary Monitor (RM)-3). This dose represents prompt, or direct, radiation exposure that would 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 Measured at Site Boundary, 2012

DIRECT RADIATION DOSE AT SITE BOUNDARY, 2012			
Period	**Neutron (mrem)**	**Photon (mrem)**	**Total (mrem)**
Jan-June (RM-3)	3.46	0.87	4.33
July-Dec	-	-	-
TOTAL	3.46	0.87	4.33 (0.0433 mSv)

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 for estimates of potential doses to the public.

Figure 11 – Environmental Monitoring Locations



Jefferson Lab
Sustainability Matters

Groundwater Monitoring

The underground CEBAF and associated experimental end stations lie 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 VPDES Permit No. 0089320, Jefferson Lab monitors groundwater that is pumped from around the experimental halls and is discharged through Outfall 002 to the surface. The vast majority of the surface water leaving the site flows to the Big Bethel Reservoir via Brick Kiln Creek; a smaller amount goes to the lower James River.

Thirteen of the site's 34 wells (See Figure 11 – Environmental Monitoring Locations) are routinely monitored for radioactivity, using EPA or other approved sampling and analysis protocols. Wells are designated as either A-ring, B-ring, C-ring, or up-gradient. A-ring wells, located closest to the accelerator, are most likely to show effects of soil and groundwater activation. B-ring wells are located further from potential sources of activation. Both A-ring and B-ring wells are sampled semi-annually. C-ring wells, positioned to represent conditions near the property boundaries, are sampled annually, along with the up-gradient well.

Groundwater samples are analyzed for: ^{3}H (tritium), ^{7}Be (beryllium), ^{54}Mn (manganese), and ^{22}Na (sodium). The VPDES permit specifies limits for radioactivity in the wells based on their location with respect to the accelerators. No accelerator-related radionuclides were detected in the groundwater in 2012.

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

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. The maximum possible dose to the public is based on a reasonable worst-case exposure scenario for direct radiation. This reasonably conservative scenario involves exposure at the boundary, at 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 conservatively assume that the individual is exposed at this rate for the entire two hours per day:

> *2 hr/day x 250 days/year = 500 hr/year; 500 hr/8760 hr = yields an "occupancy factor" of 0.057. Direct exposure of 4.33 mrem/year x 0.057 = 0.247 mrem.*

This hypothetical case represents a reasonably conservative scenario for the MEI for this source. Combining the dose from this source with the dose to the MEI from NESHAP-regulated air emissions, the maximum postulated dose from all pathways to a member of the public from Jefferson Lab operations in 2012 is 0.248 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. Dose beyond the site's boundary is so low it cannot be reliably measured.

Figure 12 - Jefferson Lab Radiological Dose Summary for 2012

JEFFERSON LAB RADIOLOGICAL DOSE SUMMARY FOR 2012				
Pathway	**Potential Dose, mrem**	**% of 100 mrem/year DOE Limit**	**Estimated Population Dose, person-rem**	**Population within 80 km**
Air*	0.0194	0.0194		1,743,270
Water	~0	~0	~0	
Release of materials	<1	<1	<1	
Direct radiation **(MEI)	0.247	0.247		-
Total, all pathways	0.267 (0.00267 mSv)	0.267	1.88*	1,743,270
*From 2012 atmospheric modeling results for National Emission Standards for Hazardous Air Pollutants reporting. **Calculated from Boundary Radiation Monitors, with conservative exposure scenario applied (see text). mSv = milliSievert				

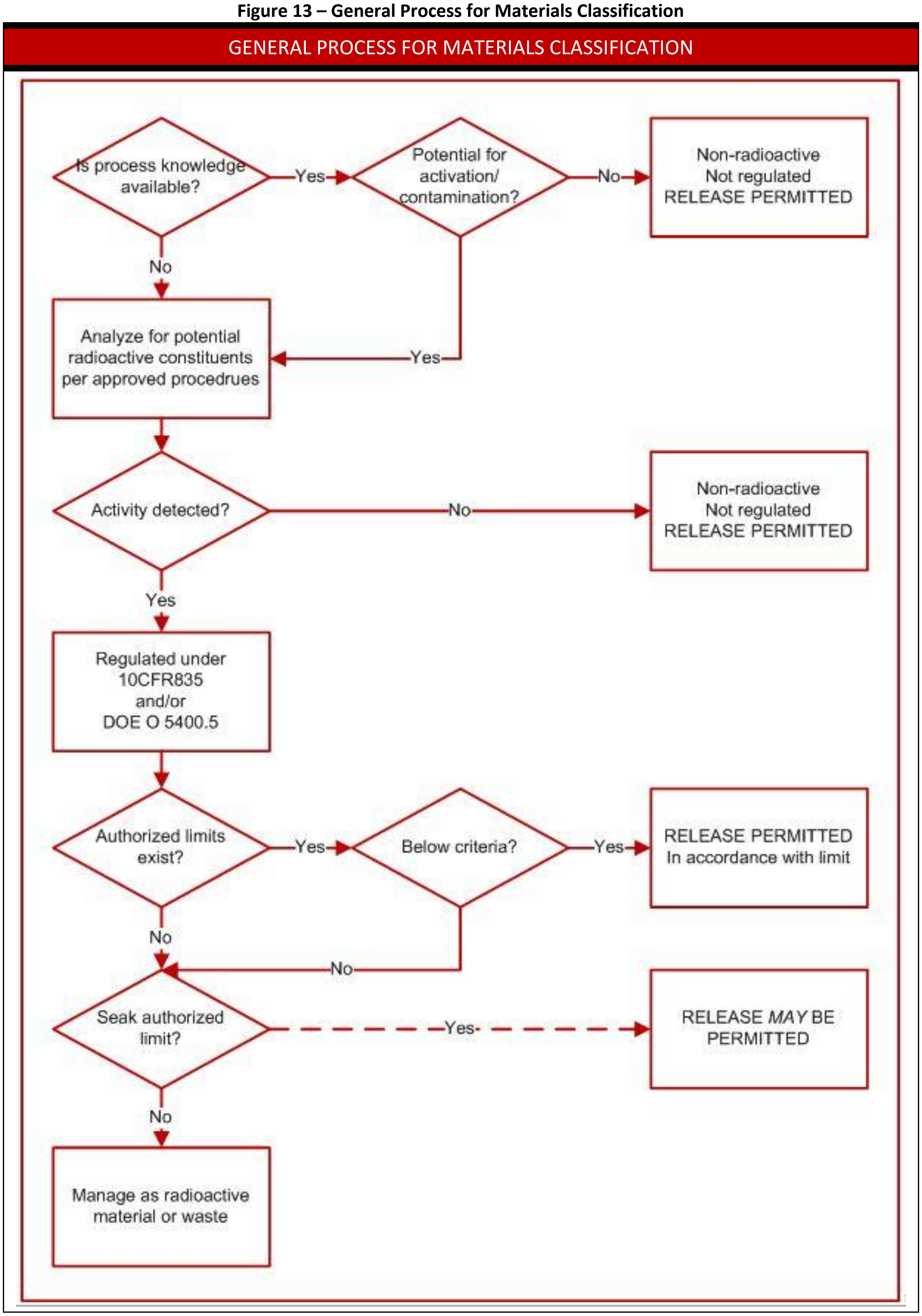
Dose Via Unrestricted Release of Materials and Equipment

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. The program involves literally hundreds of radiological surveys annually.

Release limits for surface contamination given in DOE Order 5400.5 Radiation Protection of the Public and the Environment 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 2012, the estimated volume of materials released through the process described above was about 16.6 tons of solid waste and about 115 tons of scrap metals for 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/year 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 Jefferson 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 2012 review found no deficiencies in Jefferson Lab's program for clearance of material.

Jefferson Lab sought no Authorized Limits for the release of material containing residual radiation in 2012. All materials that exhibit radiation above background levels were managed as Radioactive Material, saved for beneficial reuse, or disposed. The only radioactive waste Jefferson Lab generated was Low-Level Radioactive Wastes (LLW). There were no higher level wastes or any that would be categorized as special nuclear materials. A total of 39,260 pounds (25 cubic yards) of low-level radioactive waste was transferred for off-site disposal in 2012. Used protective equipment, contaminated materials from throughout the Lab, and waste oil are typical LLWs. Additionally, a large amount of concrete and other debris from hall reconfiguration was disposed.

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)

Dose to Local Biota

Jefferson Lab can only estimate absorbed dose to local biota (aquatic or terrestrial). The DOE has provided guidance on evaluating dose that may be received by biota. DOE-Standard-1153-2002 provides screening values 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, all criteria are met if doses do not exceed 0.1 rad/day.

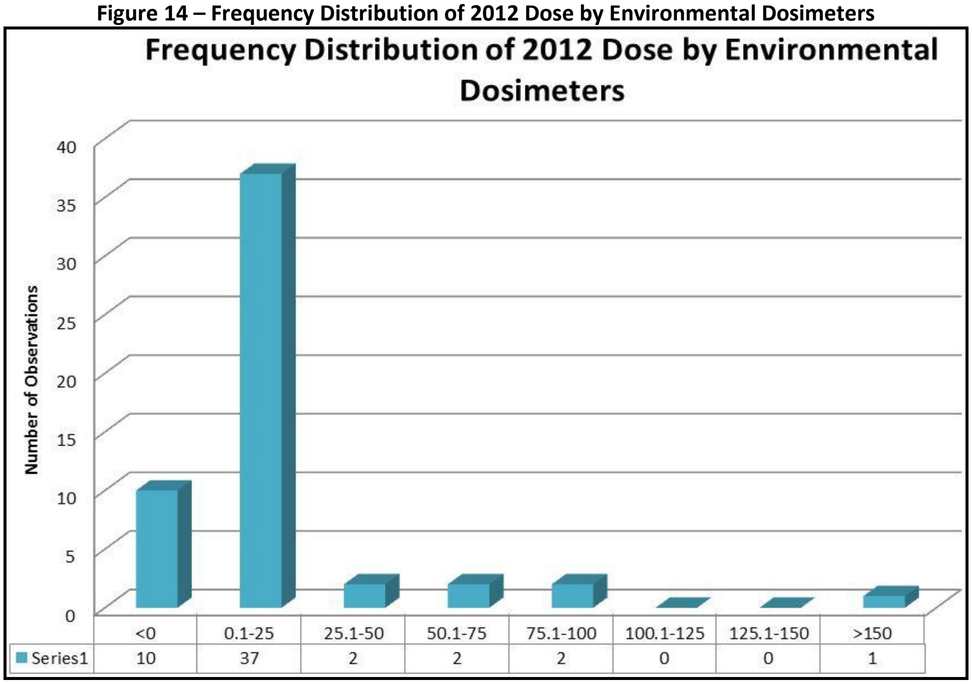
The best indicators of dose to biota are the passive dosimeters placed at various locations around the property. These are the same types of dosimeters used to monitor worker exposure.

Earthen domes over Halls A, B, and C

During 2012, 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.

Figure 14 – Frequency Distribution of 2012 Dose by Environmental Dosimeters shows the frequency distribution of annual (2012) doses from the network of dosimeters. The mean of the values is 14 mrem/year, and the median is 5.8 mrem/year. The maximum recorded dose was 210 mrem/year, measured outside the beam dump cooling water building serving Hall C. Dividing this value by 365 days yields a daily dose of 0.575 mrem/day, or approximately 0.000575 rad/day, far below the most stringent criteria.

Figure 14 – Frequency Distribution of 2012 Dose by Environmental Dosimeters



UNPLANNED RADIOLOGICAL RELEASES

Jefferson Lab had no unplanned radiological releases in 2012.

Figure 15 – Typical Cross Section of Boring at Jefferson Lab Site, compiled from several on-site boring logs, depicts a typical cross section. The CEBAF tunnel and experimental end stations are underground in the Yorktown Formation. Activation of the groundwater and soil are 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.

Figure 15 – Typical Cross Section of Boring at Jefferson Lab Site

Depth, ft.	*Description*
0	Loose to stiff, gray, sandy CLAY
5	Loose, orange-brown clayey 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
37	Very stiff, very sandy SILT with shell fragments
40	Boring Terminated

The monitoring of VPDES-permitted wells for groundwater quality continued in 2012, and provided much of the basis for the Groundwater Protection Program. Through a combination of engineered

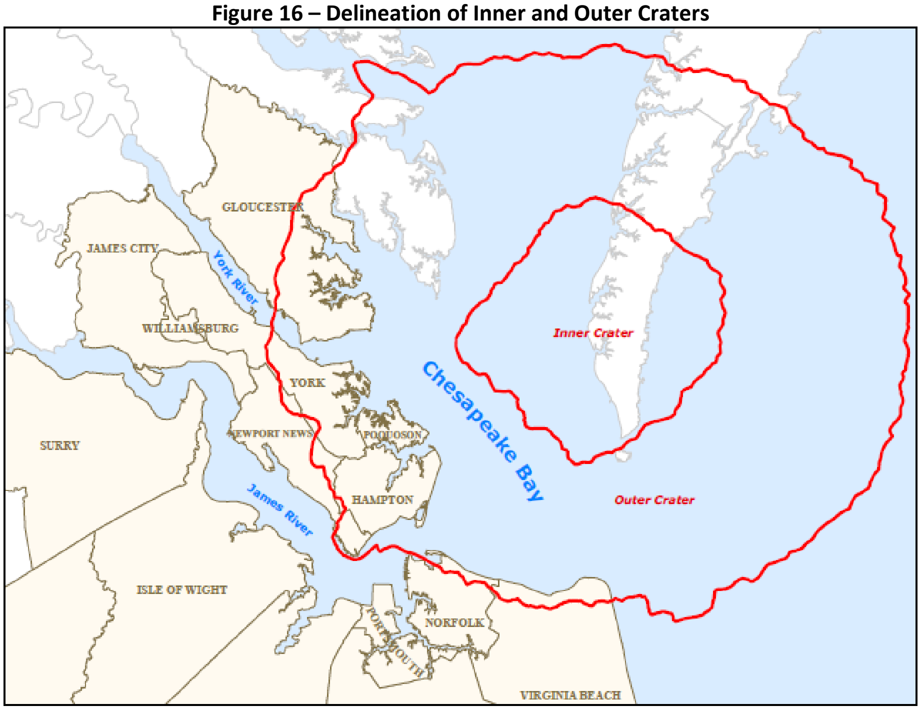
controls (e.g. shielding) designed into the CEBAF and FEL facilities, and adherence to operational limits, no measurable soil or groundwater activation was produced on or offsite.

Many other programs at Jefferson Lab contribute to groundwater protection; spill prevention and control, pollution prevention and waste minimization, materials storage, and waste management are a few.

Relatively recent information places Jefferson Lab in a unique geologic position. Approximately 35 million years ago, a giant bolide[2] blasted a huge crater into the continental shelf. A bolide of this magnitude creates a complex crater with inner and outer rims.

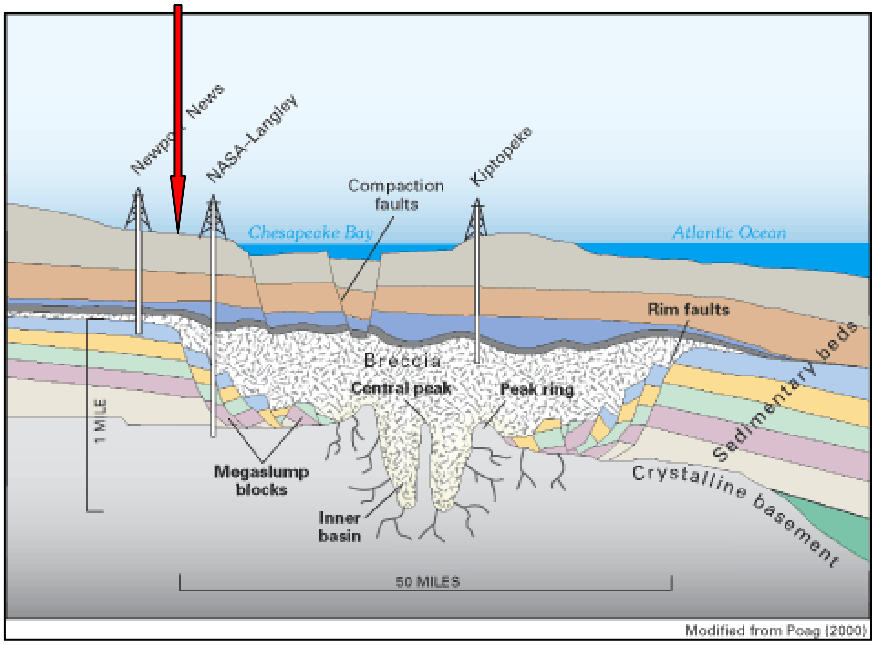
As Figure 16 – Delineation of Inner and Outer Craters indicates, the outer rim of the crater lies across Newport News. The inner and outer rims have complex, characteristic stratigraphic features, as shown in Figure 17 - Location of Jefferson Lab Relative to the Outer Rim of the Chesapeake Bay Bolide Crater.

Figure 16 – Delineation of Inner and Outer Craters



[2] There is no consensus on the definition of a bolide. It is used here to mean an extraterrestrial body in the 1-10-km size range, which impacts the earth at velocities of literally faster than a speeding bullet (20-70 km/sec = Mach 75), explodes upon impact, and creates a large crater. "*Bolide*" is a generic term, used to imply that we do not know the precise nature of the impacting body . . . whether it is a rocky or metallic asteroid, or an icy comet, for example.

Figure 17 - Location of Jefferson Lab Relative to the Outer Rim of the Chesapeake Bay Bolide Crater



The red arrow, denoted in Figure 17 - Location of Jefferson Lab Relative to the Outer Rim of the Chesapeake Bay Bolide Crater, indicates the location of Jefferson Lab relative to the Chesapeake Bay bolide crater. Site geology could be more complex than once thought. Notably, in this area, the Yorktown-Eastover aquifer is greatly diminished. Extensive studies of the groundwater characteristics within the outer rim show that even deeper aquifers were affected by the bolide, which evaporated water more than a mile deep. That water was replaced by saline water, which remains present to this day in the Potomac aquifer and other, deeper groundwater sources.

Jefferson Lab activities to date have involved only the Yorktown-Eastover aquifer; that aquifer is the focus of our Groundwater Protection Program. The Yorktown-Eastover aquifer is represented in the above figure by the blue layer between the orange-tan (Yorktown) and dark gray (Eastover) formations.

QUALITY ASSURANCE (QA)

Extensive 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 Jefferson Lab's Radiation Control Department, independent assessments are performed by the Quality Assurance & Continuous Improvement Department, the DOE Site Office, regulatory agencies such as the EPA and Virginia Department of Environmental Quality, and oversight groups within DOE. No QA concerns regarding environmental sampling protocols or results were noted in 2012.

An independent laboratory (James R. Reed & Associates) collected most of 2012'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 Reed's collection procedures were performed, and the field efforts were found to be in accordance with protocol.

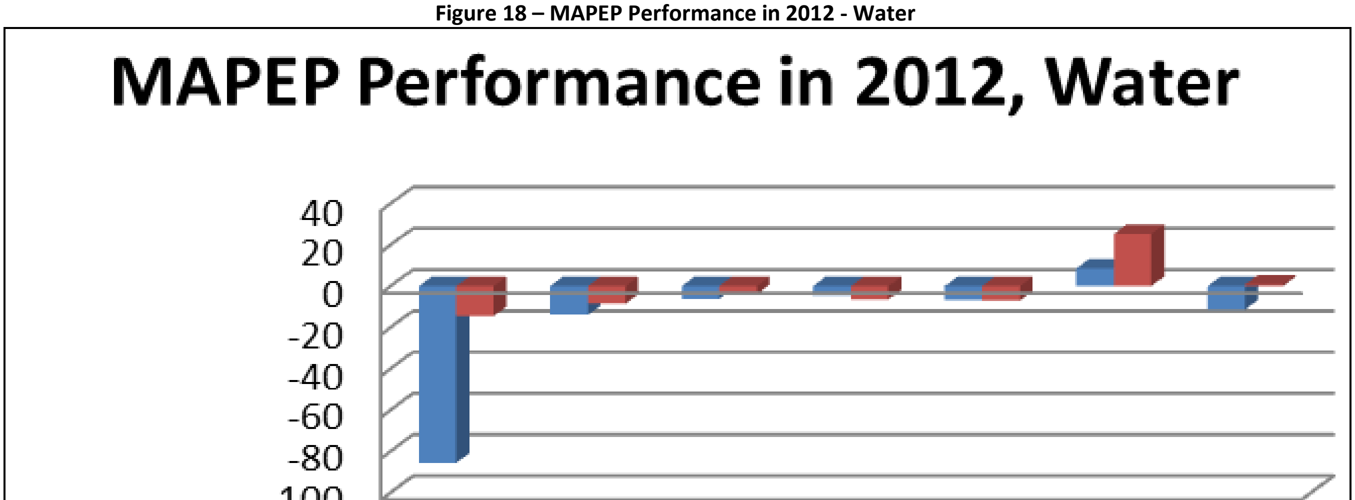
Samples collected by external analytical laboratories are analyzed for radiological (and non-radiological) attributes using standard EPA-approved analytical procedures. Both external facilities and Jefferson Lab have a continuing program of analytical laboratory QC. Participation in inter-laboratory 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 Analytic 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.

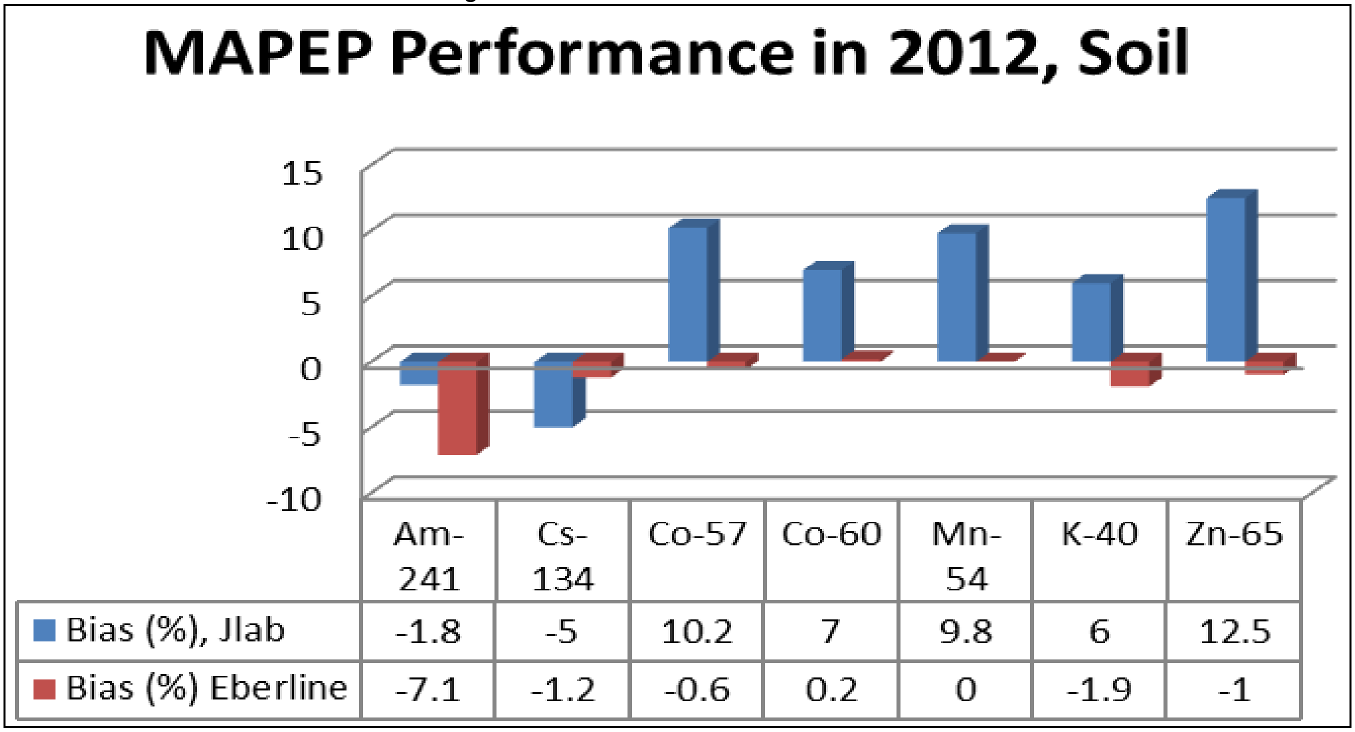
Figure 18 – MAPEP Performance in 2012 - Water and Figure 19 – MAPEP Performance in 2012 - Soil represent the results of Jefferson Lab's and Eberline's participation in water and soil analysis comparisons in 2012. Measured values are acceptable if they are within 20% of the established, or reference, value. Deviation of >20% but <30% indicate acceptable with a warning.

Figure 18 – MAPEP Performance in 2012 - Water



	Am-241	Cs-134	Co-57	Co-60	Mn-54	K-40	Zn-65
Bias (%), Jlab	-85.5	-13.9	-6.1	-4.4	-6.6	8.6	-11.2
Bias (%) Eberline	-14.4	-8.4	-3.9	-6.4	-6.9	25.4	0.8

Figure 19 – MAPEP Performance in 2012 - Soil



ACRONYM LIST

	Definition
ALARA	As Low As Reasonably Achievable
BMP	Best Management Practices
BOMARC	Boeing and Michigan Aerospace Research Center
CASA	Center for Advanced Studies of Accelerators
CEBAF	Continuous Electron Beam Accelerator Facility
CSC	Computer Sciences Corporation
DOD	Department of Defense
DOE	United State 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
ESH&Q	Environment, Safety, Health and Quality
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
GP	Guiding Principles
HPSB	High Performance and Sustainable Building
HRSD	Hampton Roads Sanitation District
ISM	Integrated Safety Management
Jefferson Lab	Thomas Jefferson National Accelerator Facility
JSA	Jefferson Science Associates, LLC
kg	Kilogram
kW	Kilowatt
LEED	Leadership in Energy and Environmental Design
LID/GI	Low Impact Development/Green Infrastructure
LLW	Low Level Radioactive Waste
MAPEP	Mixed Analytic Performance Evaluation Program

	Definition
MEI	maximally exposed individual
METF	Maximum Extent Technically Feasible
mrem	millirem
MS4	Municipal Separate Storm Sewer Systems
NASA	National Aeronautics and Space Administration
NEPA	National Environmental Policy Act
ODS	Ozone-Depleting Substance
PUE	Power Utilization Effectiveness
QA	Quality Assurance
QC	Quality Control
RES	Residence Facility Well
RM	Radiation Boundary Monitor
RCRA	Resource Conservation and Recovery Act
SPCC	Spill Prevention, Control, and Countermeasure
SRF	Superconducting Radiofrequency
TED	Technology and Engineering Development
UESC	Utility Energy Service Contract
VPDES	Virginia Pollutant Discharge Elimination System

FIGURES