2018-20 Executive Progress Report

Commonwealth of Virginia
Secretary of Education

Southeastern Universities Research Association Doing Business for Jefferson Science Associates, LLC

At A Glance

As a national and international nuclear physics research facility, Jefferson Lab provides unique research capabilities at the forefront of nuclear physics and in particle accelerator technology, provides research opportunities for Virginia faculty and students, and explores and develops core technologies and new initiatives for the economic benefit of the Commonwealth of Virginia.

Staffing 0 Salaried Employees, 0 Contracted Employees, 0 Authorized, and 0 Wage Employees.

Financials Budget FY 2019, $1.78 million, 100.00% from the General Fund.

Trends Legend ↑ Increase, ↓ Decrease, → Steady

Key Perf Areas → % VA users to total users

Productivity → ratio fed/private funds to state funds

Legend ↑ Improving, ↓ Worsening, → Maintaining

For more information on administrative key, and productivity measures, go to www.vaperforms.virginia.gov

Background and History

Agency Background Statement

Jefferson Lab (JLab) is a Department of Energy (DOE) Office of Science facility for conducting nuclear physics research, and is managed by Jefferson Science Associates (JSA), LLC. Construction of the Continuous Electron Beam Accelerator Facility (CEBAF) started in 1987 and the first experiment began in 1995. JLab leads the world in exploring the complex dynamics by which quarks (elementary particles of matter), interacting via gluons (the strong force between quarks), form the stable and solid massive matter of everyday experience. The Lab conducts experiments (183 full and 25 partial completed to-date) using a unique facility that has recently been upgraded to double its accelerator's energy and to add a new experimental hall. The facility serves approximately 1,600 active users from 275 institutions in 36 countries. JLab is a world leader in the technology of superconducting radio frequency (SRF) and energy recovering linacs (linear accelerators).

Emerging areas of technology will be identified and developed. Most recent is the future potential ~$1.5 billion Electron Ion Collider (EIC) at Jefferson Lab. An EIC has been recommended for future construction by the Nuclear Science Advisory Committee and endorsed in July 2018 by the National Academy of Sciences. Commonwealth support for an EIC has enabled preliminary research and development. Additional support from the Commonwealth will provide seed funds to establish a center for nuclear femtography, which would position JLab and its partnering Virginia universities as the leading international center for this emerging revolutionary field.

Major Products and Services

To provide world-class unique facilities for research in nuclear physics -- products include: experiments, Ph.D.s, papers in refereed journals, invited talks and scientific and technical prizes or awards.

To provide research support and development of industry-university partnerships in emerging fields to explore and develop applications for lab-developed technologies that could provide economic benefit to the Commonwealth -- products are collaborations, partnerships, proposals, research papers and publications, patents, new business spin-offs, and licenses.

Customers

Customer Summary

JSA/Jefferson Lab has two specific categories of customers served by activities funded by the Commonwealth:

- Nuclear physics researchers in hadronic (particles of quarks and gluons) physics
- Nuclear physics faculty and students in the Commonwealth

It is expected that the number of customers in these categories (Nuclear Physics users and Virginia nuclear physics users and faculty) will be stable or increase modestly as Jefferson Lab continues to deliver its forefront experimental program. JLab is fully operational after the recent successful commissioning of its 12 GeV CEBAF upgrade of the facility. The upgrade, doubling the energy of the accelerator, has enhanced the capabilities experimental program and will allow researchers access to new, discovery- caliber science.

Customer Table

Predefined Group	User Defined Group	Number Served Annually	Potential Number of Annual Customers	Projected Customer Trend
Higher Education Institutions	Commonwealth nuclear physics students and faculty	286	286	Stable
Higher Education Institutions	Nuclear physics users	1,597	1,597	Stable

Finance and Performance Management

Finance

Financial Summary

The FY2019 initial general fund (GF) appropriation of $1,775,439 represents base funding of $1,275,439 and supports faculty and staff positions and industry-led research that will promote economic development opportunities in the Commonwealth, plus an additional $500,000 in one-time seed funding to establish a center for nuclear femtography (CNF) in partnership with the Commonwealth's research universities. Through multidisciplinary collaboration with Virginia universities, CNF will enable new insights in understanding the subatomic world through the development of novel methods for imaging the structure of atomic nuclei. The knowledge and technology developed through the CNF have the potential for future technological developments associated with structure at a much smaller distance scale than current nanotechnology. The center would also support Jefferson Lab's (JLab's) case as the site to establish a future electron ion collider (EIC). JLab plans to dedicate a portion of its base funds to a newly established EIC Center to support graduate and postdoctoral fellowships. The FY2020 Initial GF Appropriation of $1,275,439 represents base funding that supports faculty positions and industry-led research that will promote economic development opportunities in the Commonwealth.

In addition to these funds, JLab received $1,400,000 (GF) FY2017 and $1,000,000 (GF) in FY2018 for continued preliminary research and development for an EIC, which has been recommended as the next major facility construction by the Nuclear Science Advisory Committee in its 2015 Long Range Plan for Nuclear Science and was endorsed in the National Academy of Science's June 2018 report. Two laboratories, including JLab, are developing concepts for this facility and site characterization to prepare for the construction project phase and selection process for the US Department of Energy. Completing these studies would advance JLab's position as a potential site for this facility; thereby allowing Virginia to extend and expand its world leadership in this area of nuclear physics. These funds were made available through the Commonwealth's Development Opportunity Fund (Item 106.A.1, Chapter 836).

Fund Sources

Fund Code	Fund Name	FY 2019	FY 2020
01000	General Fund	$1,775,439	$1,275,439

Revenue Summary

Jefferson Laboratory is not a revenue generating entity.

Performance

Performance Highlights

Jefferson Science Associates (JSA)/Jefferson Lab (JLab) measures its progress and performance via a performance-based management and operating contract with the United States Department of Energy (U.S. DOE). For activities funded by the Commonwealth of Virginia, it also reports progress towards metrics to the Virginia Performs database. These activities are:

1. Support for new research directions and technology development, including emerging technologies with economic development potential. Support for these research activities provides an opportunity for Virginia research universities to participate in research at an international level, and may lead to important developments in science, defense, security, health and manufacturing with economic impact.
2. The Governor's Distinguished Continuous Electron Beam Accelerator Facility (CEBAF) Professorships and Governor's CEBAF Scientist (GCS) programs, funded by the Commonwealth, provide opportunities for JLab leaders to hold faculty positions at Virginia universities.
3. Funding support that allows JSA to attract and retain top scientific and technological leaders to JLab.
4. Leveraging support for the ~$1.5 billion potential federal investment in an Electron Ion Collider at JLab.

JSA/JLab has shown excellent scientific and technological productivity in its basic research and technology transfer missions. It has approximately 1,600 active users from the international scientific community, including 176 on approved experiments led by scientists at Virginia research universities.

Selected Measures

Measure ID	Measure	Alternative Name	Estimated Trend
93611004.001.001	Percentage of participation by Virginia university faculty and students in research at Jefferson Lab	% VA users to total users	Maintaining
93611004.002.002	Ratio of federal/private matching funds to state-provided funds for the support of basic and applied research.	ratio fed/private funds to state funds	Maintaining

Key Risk Factors

The primary impediment to the accomplishment of goals is the availability of adequate federal funding to operate JLab. Pressure on the discretionary portion of the federal budget will continue to impact JLab and could delay or obstruct progress toward goals and initiatives.

Agency Statistics

Statistics Summary

It is expected that the total number of publications will increase as completed experiments undergo analysis and new experiments start producing results. The total number of Ph.D.s awarded is also projected to increase as future experiments provide opportunities for university faculty and students to participate and produce theses based on JLab research.

Commonwealth support of Jefferson Lab's research activities and technology development provides important benefits including emerging technologies with economic development potential and opportunities for Virginia research universities to participate in research at an international level. This research may lead to important developments in science, defense, security, health and manufacturing with economic impact. Additionally, The Governor's Distinguished Continuous Electron Beam Facility (CEBAF) Professorships, Scientists and Fellows program provides salary support that allows JSA and Jefferson Lab to attract and retain top scientific and technological talent in the Commonwealth.

Jefferson Lab has approximately 1,600 active users from the international scientific community, including 176 on approved experiments led by scientists at Virginia's research universities. Nearly one-third of all nuclear science Ph.D.s awarded in the United States is based on Jefferson Lab's science. Six hundred eight Ph.D.s (203 from Virginia institutions) have been awarded to date, with 199 more in progress (73 from Virginia institutions). Jefferson Lab research has been cited in more than 180,000 times in scientific literature, including some top cited papers in the field. The Jefferson Lab Free Electron Laser was awarded a 2005 R&D 100 Award as one of the 100 top technology advances in the United States. Work at Jefferson Lab has resulted in 167 patents and two spin-off companies: 1), Dilon Technologies, now producing breast imagers for use in centers around the world, and was featured on the ABC Evening News on October 23, 2006, and 2) BNNT (Boron Nitride Nanotubes), LLC. Ninety-four faculty positions in nuclear science and JLab related technologies have been created at Virginia's research universities.

A 2011 economic impact study noted that Jefferson Lab generates economic benefit of ~$217.6 million in the Hampton Roads area, while creating 1,968 jobs. In the Commonwealth, Jefferson Lab generates $271.1 million in economic output and 2,200 jobs. Nationwide, the Lab generates $679.1million in economic output and 4,422 jobs.

Statistics Table

Description	Value
PhDs produced	608
Publications in Physical Review Letters	426
Publications in other refereed journals	1,461

Management Discussion

General Information About Ongoing Status of Agency

JSA/JLab will continue to be a national and international center for nuclear physics research and with the 12 GeV CEBAF upgrade now complete, will remain at the forefront of the field for the next several decades. JLab expects to sustain or increase its scientific productivity in terms of Ph.D.s produced and in scientific papers and journal articles based on this program expansion. JLab is also well-positioned to compete for another planned U.S. DOE Office of Science project, an Electron Ion Collider, a facility of central importance to the field of Nuclear Physics, as identified by the Nuclear Science Advisory Committee and as endorsed in the 2018 National Academy of Sciences Electron Ion Collider report.

JSA/JLab will continue its participation in research and development (R&D) and technology using the capabilities of the Low Energy Recirculator Facility (LERF), further building on the investments made by the Navy and leveraging Commonwealth funds to develop applications to benefit economic development in Virginia. Future LERF planned activities include a DOE funded initiative to develop medical isotope production in

collaboration with Virginia Commonwealth University (VCU).

JSA/JLab will continue to identify and develop emerging research opportunities that open new avenues for collaboration with university researchers and business/industry partners.

Information Technology

JSA/JLab receives its primary funding from the DOE Office of Science that supports the information technology requirements of the facility.

Southeastern Universities Research Association (SURA) institutions, Old Dominion University (ODU), College of William & Mary (W&M), Virginia Polytechnic and State University (Va. Tech) and University of Virginia (UVA) work collaboratively with JLab to maintain E-LITE and MARIA networking services to provide high-speed connectivity to Virginia research institutions and to the Department of Energy's ESnet. This collaboration leverages the networking expertise at ODU, W&M, Va. Tech., and ESnet to provide a cost-effective, high-speed Internet connection to collaborators around the world in support of the laboratory's scientific mission.

Workforce Development

JSA/JLab faces a specific workforce challenge in recruiting for positions with highly specialized skill sets that are critical to the Lab’s success including Superconducting Radio Frequency (SRF) scientists and engineers, cryogenic systems engineers, superconducting magnet engineers, electrical and mechanical R&D engineers.

Physical Plant

JLab is located on a 169 acre DOE-owned federal complex within Newport News and includes 69 buildings.

Adjacent to the federal complex is a five acre parcel owned by the Commonwealth containing the Virginia Associated Research Campus which provides additional office and shop space at a de minimus cost to the Lab. Also adjacent to the federal complex is an 11 acre parcel owned by Newport News that contains the Applied Research Center which provides additional office and lab space. SURA owns 37 acres adjacent to the JLab site where it operates a 42-room Residence Facility providing temporary housing for Lab users, researchers, and guests.

JSA/JLab receives its primary funding from the U.S. DOE Office of Science that supports the infrastructure and maintenance requirements of the facility.