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HOUSE OF REPRESENTATIVES
REPORT
115–555

ACCELERATING AMERICAN LEADERSHIP IN SCIENCE ACT OF 2017

FEBRUARY 13, 2018.—Committed to the Committee of the Whole House on the State of the Union and ordered to be printed

Mr. SMITH of Texas, from the Committee on Science, Space, and Technology, submitted the following

R E P O R T

[To accompany H.R. 4377]

[Including cost estimate of the Congressional Budget Office]

The Committee on Science, Space, and Technology, to whom was referred the bill (H.R. 4377) to direct the Secretary of Energy to carry out an upgrade to research equipment and construct research user facilities, and for other purposes, having considered the same, report favorably thereon without amendment and recommend that the bill do pass.

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PURPOSE AND SUMMARY

The purpose of H.R. 4377, the "Accelerating American Leadership in Science Act of 2017," is to provide for technological innovation through the prioritization of upgrades and additions of key user facilities at Department of Energy (DOE) national labs from the existing Federal investment in basic research and fundamental scientific discovery by the DOE Office of Science.

The bill authorizes an upgrade to the Advanced Photon Source (APS–U) at Argonne National Laboratory, a proton power upgrade and a second target station upgrade to the Spallation Neutron Source (SNS–PPU and SNS–STS) at Oak Ridge National Laboratory (ORNL), and the construction of the Long Baseline Neutrino Facility (LBNF) at Fermi National Accelerator Laboratory (Fermilab).

BACKGROUND AND NEED FOR LEGISLATION

DOE is the leading Federal sponsor of research in the physical sciences, and operates world-class, open-access user facilities around the country at the DOE national laboratories. These facilities include the supercomputers, x-ray light sources, photon sources, and neutron sources necessary to conduct ground-breaking basic research, and host approximately 30,000 researchers annually from around the world.

The Committee recognizes that these best-in-the-world science facilities uniquely enable research conducted through the DOE Office of Science and other Federal sponsors of basic research and facilitate revolutionary discoveries about the atomic structure, properties, and dynamics of materials. The next transformative breakthroughs in innovative energy technologies will likely arise from a strong foundation in basic research, particularly in the study of and development of unique materials, for which the facilities authorized in this bill provide critical capabilities.

This legislation relies on the assessments of the Department and the scientific community, primarily through the long-range planning function of the DOE Office of Science Basic Energy Sciences Advisory Committee (BESAC) and the High Energy Physics Advisory Panel (HEPAP). Both advisory committees, chartered under the Federal Advisory Committee Act (FACA) and comprised of representatives from universities, national laboratories, and industries involved in relevant areas of research, provide official technical advice to the Department and other Federal agencies on the national program priorities for basic energy sciences and high-energy science research.

Based on the recommendations provided in the most recent reports issued from each advisory committee, H.R. 4377 authorizes the completion of upgrades and construction of scientific user facilities necessary to undertake the next generation of transformative research in these areas. Under this legislation, the Secretary of Energy is directed to provide for an upgrade to the APS at Argonne National Laboratory in IL, as well as a proton power upgrade and the construction of a second target station for the SNS at ORNL under the Basic Energy Sciences (BES) program within the DOE Office of Science. The Secretary is also directed to construct the

LBNF underground sites at Fermilab in Batavia, IL, and the Sanford Underground Research Facility (SURF) in Lead, SD, under the High Energy Physics (HEP) program within the DOE Office of Science.

The APS is one of the most advanced synchrotron radiation research facilities in the world. The APS produces ultra-bright, high-energy, storage ring-generated x-ray beams which enable scientists to study the structure and behavior of physical and biological materials. This research enables innovation in many fields, including materials synthesis and pharmaceutical development. The APS–U will increase the brightness of the APS hard x-ray beams, which allows more x-rays to be focused onto a smaller area and provides more detailed data for researchers in less time. Hard x-rays, like those produced at the APS, are optimal for determining the atomic structure of materials and penetrating into condensed phase media.

The SNS is a one-of-a-kind neutron scattering research facility that provides the most intense pulsed neutron beams in the world for scientific research and industrial development. This source of brighter and more intense neutrons enables unprecedented research opportunities, allowing scientists to make sensitive measurements in complex sample environments, with higher resolution and speed than any existing neutron facility.

The SNS–PPU will update the SNS accelerator complex, doubling the power of its proton beam and greatly increasing the flux (the neutron density (n) multiplied by neutron velocity (v)) on SNS's existing First Target Station neutron beamlines. This will correspondingly increase the capacity and capability of these neutron beamlines to power important experiments and analyses.

The SNS–PPU will also provide power for the SNS–STS. In order to maintain its leadership in the field of neutron science, the SNS requires a second target station to provide opportunity to a growing research community. The STS will double the number of beamlines at SNS, significantly expanding the number of instrument stations and opportunities for cutting-edge neutron scattering research at this facility. Combined, the PPU and the STS will allow SNS to reach its full potential and provide for world-leading neutron science here in the U.S.

The Department's longstanding support and prioritization of both the APS upgrade and the two upgrades to the SNS are documented in a publication of the Office of Science titled, "Facilities for the Future of Science: A Twenty-Year Outlook," published November 2003, and its publication of "Four Years Later: An Interim Report on Facilities for the Future of Science: A Twenty-Year Outlook," published August 2007. In June, 2016, the BESAC released a report titled, "Report on Facility Upgrades," which identified the APS–U, SNS–PPU, and SNS–STS as three of the five priority upgrade projects within BES. In this report, the BESAC determined that these projects are absolutely central to U.S. contributions to world-leading science.

The HEP program is tasked with conducting the theoretical and experimental particle physics and accelerator science and technology in order to discover the most elementary constituents of matter and energy, the basic nature of space and time, and interactions between the two. The LBNF project is a critical component to pursuing these long-term research goals.

The LBNF is an internationally coordinated project, designed to build the world's highest intensity neutrino beam and a suite of cryogenic near detectors at Fermilab. This facility will be used to run the Deep Underground Neutrino Experiment (DUNE), which will measure the neutrino beamline generated at LBNF on cutting-edge, far detectors located 800 miles away at the SURF in South Dakota.

Longstanding support for construction of this world-leading neutrino facility is documented in the HEPAP report titled, "US Particle Physics: Scientific Opportunities, A Strategic Plan for the Next Ten Years, Report of the Particle Physics Project Prioritization Panel," published May 2008, and in its publication titled, "Major High Energy Physics Facilities 2014–2024, Input to the prioritization of proposed scientific user facilities for the Office of Science," published March 2013. In May 2014, HEPAP named the execution of the LBNF at Fermilab as "the highest priority large project in its timeframe," in its publication titled, "Building for Discovery: Strategic Plan for U.S. Particle Physics in the Global Context, Report of the Particle Physics Prioritization Panel."

Further, this legislation requires that, to the maximum extent practicable, the Secretary of Energy shall ensure that the start of full operations of the APS–U and the SNS–PPU occurs before December 31, 2025, the start of full operations of the LBNF occurs before December 31, 2026, and the start of full operations of the SNS–STS occurs before December 31, 2030.

LEGISLATIVE HISTORY

On November 18, 2015, the Energy Subcommittee held a hearing titled, "Recommendations of the Commission to Review the Effectiveness of the National Energy Laboratories." Witnesses were: Mr. TJ Glauthier, Co-Chair, Commission to Review the Effectiveness of the National Energy Laboratories; Dr. Jared L. Cohon, Co-Chair, Commission to Review the Effectiveness of the National Energy Laboratories; Dr. Peter Littlewood, Director, Argonne National Laboratory.

On March 22, 2016, the Committee held a hearing titled, "An Overview of the Budget Proposal for the Department of Energy for Fiscal Year 2017." The witness was The Honorable Ernest Moniz, Secretary of Energy, U.S. Department of Energy.

On June 15, 2016, the Energy Subcommittee held a hearing titled, "Innovation in Solar Fuels, Electricity Storage, and Advanced Materials." Witnesses were: Dr. Nate Lewis, Professor, California Institute of Technology; Dr. Daniel Scherson, Professor, Case Western Reserve University; Dr. Collin Broholm, Professor, Johns Hopkins University; Dr. Daniel Hallinan Jr., Assistant Professor, Florida A&M University—Florida State University College of Engineering.

On June 28, 2017, the Energy Subcommittee and the Research and Technology Subcommittee held a hearing titled, "Material Science: Building the Future." Witnesses were: Dr. Matthew Tirrell, Deputy Laboratory Director for Science and Chief Research Officer, Argonne National Laboratory; Dr. Laurie Locascio, Acting Associate Director for Laboratory Programs and Director, Material Measurement Laboratory, National Institute of Standards and Technology; Dr. Adam Schwartz, Director, Ames Laboratory; Dr.

Fred Higgs, John and Ann Doerr Professor of Mechanical Engineering, Rice University.

On July 19, 2017, the Committee held a hearing titled, "Energy Innovation: Letting Technology Lead." Witnesses were: Dr. Jacob DeWitte, President and CEO, Oklo; Dr. Gaurav N. Sant, Associate Professor and Henry Samueli Fellow, Department of Civil and Environmental Engineering, Henry Samueli School of Engineering and Applied Science, University of California, Los Angeles; Dr. Venky Narayanamurti, Benjamin Peirce Research Professor of Technology and Public Policy, John A. Paulson School of Engineering and Applied Science, Harvard University; Mr. Kiran Kumaraswamy, Market Development Director, AES Energy Storage.

On November 13, 2017, Rep. Randy Hultgren introduced H.R. 4377, which was referred solely to the Committee.

On November 15, 2017, the Committee approved and ordered reported H.R. 4377 by voice vote.

COMMITTEE VIEWS

Advanced Photon Source upgrade

H.R. 4377 authorizes a six-year upgrade to the APS as described in the publication approved by the BESAC on June 9, 2016, titled, "Report on Facility Upgrades." This includes the development of a multi-bend achromat lattice to produce a high flux of coherent x-rays within the hard x-ray energy region and a suite of beamlines optimized for this source. The Committee concurs with the assessment of the Department and the most recent BESAC report that the completion of this upgrade is essential to maintaining world-leading science here in the United States.

The APS upgrade authorized in this legislation will harness new advances in storage ring technologies to increase the brightness of the APS beamline. These improved capabilities will yield a vast increase in imaging output, allowing researchers to observe materials under real conditions at extremely small scales. In order to ensure the on-schedule, on-budget construction of this project, the Committee included a timeline and sufficient annual authorizations in this legislation requiring the Department to complete the APS upgrade by the close of 2025.

Long-Baseline Neutrino Facility

Finally, H.R. 4377 authorizes construction of the LBNF to facilitate the international DUNE and enable a program in neutrino physics to measure the fundamental properties of neutrinos, explore physics beyond the Standard Model, and better clarify the nature of matter and anti-matter. The Committee concurs with the assessment of the Department and the most recent HEPAP report that the completion of this project is the highest priority large project within HEP and is essential to maintaining world-leading science here in the United States.

The construction of the LBNF and subsequent experiments will increase the fundamental knowledge of neutrinos and their properties—providing valuable insight into cosmic phenomena and theoretical particle physics. With initial construction of LBNF just beginning in 2017, the Committee believes that an authorization of

specific annual funding for all remaining construction and necessary instrumentation is required to ensure this vital project is completed on time and on budget by the close of 2026.

Upon completion, LBNF will be the first internationally-funded science facility hosted in the United States. The Committee supports the Department's continuing efforts to solicit international contributions for the construction of the project, and recognizes the importance of funds already committed to the project, including the September 2017 commitment of $88 million from the UK Minister of State for Universities, Science, Research and Innovation.

Recommendations for, and coordination of, Federal high energy physics underground science and neutrino research was authorized in the American Innovation and Competitiveness Act, signed into law January 6th, 2017, as P.L. 114–329.

Spallation Neutron Source Proton Power Upgrade and Second Target Station

H.R. 4377 authorizes two upgrades to the SNS as described in the publication approved by the BESAC on June 9, 2016, titled, "Report on Facility Upgrades." The Committee concurs with the assessment of the Department and the most recent BESAC report that the completion of these upgrades are essential to maintaining world-leading science here in the United States.

Currently, the SNS is the most powerful pulsed neutron user facility in the world. However, the Committee finds that without the upgrades authorized in this legislation, this leading facility will be surpassed by the European Spallation Source, which is currently under construction in Sweden and is expected to provide approximately an order of magnitude higher neutron flux than the SNS by 2024. Upon completion, the SNS–PPU and SNS–STS will ensure that the SNS remains the leading site for research in soft matter, biology, and polymer science that is facilitated by neutron experiments.

The June 2016 BESAC report also concluded that ORNL must resolve "significant scientific/engineering challenges" in order to ensure that the planned upgrades would effectively increase the repetition rate and average brightness at the SNS, and that more engagement with the neutron science user community was required to ensure the development of a compelling and robust set of "first experiments" for the upgraded SNS before initiating construction. However, following discussions with Department officials and ORNL leadership, the Committee finds that ORNL has provided the necessary responses to the Department in order to proceed with the construction of this project.

In order to ensure the on-schedule, on-budget construction of these projects, the Committee included timelines and sufficient annual authorizations in this legislation requiring the Department to complete the SNS–PPU by the close of 2025 and the SNS–STS by the close of 2030.

SECTION-BY-SECTION

Sec. 1. Short title

Accelerating American Leadership in Science Act of 2017.

Sec. 2. Advanced Photon Source Upgrade

This section authorizes the APS–U over six years. This upgrade will ensure that DOE can maintain APS's status as a world class x-ray facility and allow scientists to study the structure and behavior of materials at extremely small scales.

Sec. 3. Long Baseline Neutrino Facility for Deep Underground Neutrino Experiment

This section authorizes the construction of the LBNF over nine years. This facility will be used to conduct DUNE, which will enable fundamental research of neutrinos and their properties.

Sec. 4. Spallation Neutron Source proton power upgrade

This section authorizes a proton power upgrade to the SNS over seven years. This upgrade will provide higher resolution and speed than any existing neutron facility.

Sec. 5. Spallation Neutron Source second target station

This section authorizes a second target station upgrade to the SNS over eleven years. This upgrade will double the number of beamlines at SNS, significantly expanding opportunities for cutting-edge neutron scattering research at this facility.

EXPLANATION OF AMENDMENTS

There were no amendments to this bill.

COMMITTEE CONSIDERATION

On November 15, 2017, the Committee met in open session and ordered reported favorably the bill, H.R. 4377, by voice vote, a quorum being present.

APPLICATION OF LAW TO THE LEGISLATIVE BRANCH

Section 102(b)(3) of Public Law 104–1 requires a description of the application of this bill to the legislative branch where the bill relates to the terms and conditions of employment or access to public services and accommodations. This bill provides for technological innovation through the prioritization of Federal investment in basic research and fundamental scientific discovery through the upgrade of key user facilities at DOE. As such, this bill does not relate to employment or access to public services and accommodations.

STATEMENT OF OVERSIGHT FINDINGS AND RECOMMENDATIONS OF THE COMMITTEE

In compliance with clause 3(c)(1) of rule XIII and clause (2)(b)(1) of rule X of the Rules of the House of Representatives, the Committee's oversight findings and recommendations are reflected in the descriptive portions of this report.

STATEMENT OF GENERAL PERFORMANCE GOALS AND OBJECTIVES

H.R. 4377 provides for technological innovation through the prioritization of Federal investment in basic research and funda-

mental scientific discovery through the upgrade of key user facilities at DOE.

DUPLICATION OF FEDERAL PROGRAMS

No provision of H.R. 4377 establishes or reauthorizes a program of the Federal Government known to be duplicative of another Federal program, a program that was included in any report from the Government Accountability Office to Congress pursuant to section 21 of Public Law 111–139, or a program related to a program identified in the most recent Catalog of Federal Domestic Assistance.

DISCLOSURE OF DIRECTED RULE MAKINGS

The Committee estimates that enacting H.R. 4377 does not direct the completion of any specific rule makings within the meaning of 5 U.S.C. 551.

FEDERAL ADVISORY COMMITTEE ACT

The Committee finds that the legislation does not establish or authorize the establishment of an advisory committee within the definition of 5 U.S.C. App., Section 5(b).

UNFUNDED MANDATE STATEMENT

Section 423 of the Congressional Budget and Impoundment Control Act (as amended by Section 101(a)(2) of the Unfunded Mandate Reform Act, P.L. 104–4) requires a statement as to whether the provisions of the reported include unfunded mandates. In compliance with this requirement the Committee has received a letter from the Congressional Budget Office included herein.

EARMARK IDENTIFICATION

H.R. 4377 does not include any congressional earmarks, limited tax benefits, or limited tariff benefits as defined in clause 9 of rule XXI.

COMMITTEE ESTIMATE

Clause 3(d)(2) of rule XIII of the Rules of the House of Representatives requires an estimate and a comparison by the Committee of the costs that would be incurred in carrying out H.R. 4377. However, clause 3(d)(3)(B) of that rule provides that this requirement does not apply when the Committee has included in its report a timely submitted cost estimate of the bill prepared by the Director of the Congressional Budget Office under section 402 of the Congressional Budget Act.

BUDGET AUTHORITY AND CONGRESSIONAL BUDGET OFFICE COST ESTIMATE

With respect to the requirements of clause 3(c)(2) of rule XIII of the Rules of the House of Representatives and section 308(a) of the Congressional Budget Act of 1974 and with respect to requirements of clause (3)(c)(3) of rule XIII of the Rules of the House of Representatives and section 402 of the Congressional Budget Act of

1974, the Committee has received the following cost estimate for H.R. 4377 from the Director of Congressional Budget Office:

U.S. CONGRESS,
CONGRESSIONAL BUDGET OFFICE,
Washington, DC, December 18, 2017.

Hon. LAMAR SMITH,
Chairman, Committee on Science, Space, and Technology,
House of Representatives, Washington, DC.

DEAR MR. CHAIRMAN: The Congressional Budget Office has prepared the enclosed cost estimate for H.R. 4377, the Accelerating American Leadership in Science Act of 2017.

If you wish further details on this estimate, we will be pleased to provide them. The CBO staff contact is Janani Shankaran.

Sincerely,

KEITH HALL,
Director.

Enclosure.

H.R. 4377—Accelerating American Leadership in Science Act of 2017

Summary: H.R. 4377 would authorize the appropriation of funds to support construction of and upgrades to research equipment and facilities administered by the Department of Energy's (DOE's) Office of Science. CBO estimates that implementing H.R. 4377 would cost about $1.5 billion over the 2018–2022 period, assuming appropriation of the authorized amounts.

Enacting H.R. 4377 would not affect direct spending or revenues; therefore, pay-as-you-go procedures do not apply.

CBO estimates that enacting H.R. 4377 would not increase net direct spending or on-budget deficits in any of the four consecutive 10-year periods beginning in 2028.

H.R. 4377 contains no intergovernmental or private-sector mandates as defined in the Unfunded Mandates Reform Act (UMRA).

Estimated cost to the Federal Government: The estimated budgetary effect of H.R. 4377 is shown in the following table. The cost of this legislation falls within budget function 250 (general science, space, and technology).

	By fiscal year, in millions of dollars—					
	2018	2019	2020	2021	2022	2018–2022
INCREASES IN SPENDING SUBJECT TO APPROPRIATION						
Advanced Photon Source Upgrade:						
Authorization Level	93	130	152	150	74	599
Estimated Outlays	51	99	137	148	108	543
Long-Baseline Neutrino Facility: [a]						
Authorization Level	45	160	195	195	200	795
Estimated Outlays	25	102	162	190	198	676
Proton Power Upgrade:						
Authorization Level	26	71	34	41	21	192
Estimated Outlays	14	47	44	43	29	176
Second Target Station:						
Authorization Level	5	10	15	25	50	105
Estimated Outlays	3	7	12	20	37	79
Total:						
Authorization Level	169	371	396	411	345	1,691

	By fiscal year, in millions of dollars—					
	2018	2019	2020	2021	2022	2018–2022
Estimated Outlays	93	255	354	400	372	1,474

A Numbers may not add up to totals because of rounding.

[a] H.R. 4377 would authorize the appropriation of $95 million in 2018 for construction of the Long-Baseline Neutrino Facility. On an annualized basis, Public Law 115–90 provided $50 million in 2018 for that project. As a result, CBO estimates that H.R. 4377 would increase the amount authorized to be appropriated in 2018 by $45 million, the difference between the authorized amount and the annualized appropriated amount.

Basis of estimate: DOE's Office of Science supports basic research in the physical sciences and operates a system of national scientific user facilities. The office received an appropriation of $5.4 billion in 2017 and the same amount on an annualized basis for 2018; that amount includes funding for construction of and upgrades to equipment and research facilities. Under current law, no specific sums are authorized to be appropriated to DOE for those purposes after 2018.

H.R. 4377 would authorize appropriations totaling $1.7 billion over the 2018–2022 period for the following specific projects:

- $599 million for upgrades to the Advanced Photon Source;
- $795 million for construction of the Long-Baseline Neutrino Facility;
- $192 million for a proton power upgrade at the Spallation Neutron Source; and
- $105 million for a second target station at the Spallation Neutron Source.

The bill also would authorize the appropriation of $2 billion over the 2023–2028 period for those projects. Of that amount, $1.4 billion would be for the construction of a second target station at the Spallation Neutron Source.

In 2017, DOE spent $37 million for construction of the Long-Baseline Neutrino Facility. According to the agency, the upgrades to the Advanced Photon Source and Spallation Neutron Source are in the design phase. In recent years, the agency received appropriations of $40 million a year for those projects.

Based on historical spending patterns, CBO estimates that if the authorized amounts are appropriated, implementing H.R. 4377 would cost $1.5 billion over the 2018–2022 period and $2.2 billion after 2022.

Pay-As-You-Go considerations: None.

Increase in long-term direct spending and deficits: CBO estimates that enacting H.R. 4377 would not increase net direct spending or on-budget deficits in any of the four consecutive 10-year periods beginning in 2028.

Mandates: H.R. 4377 contains no intergovernmental or private-sector mandates as defined in UMRA.

Estimate prepared by: Federal costs: Janani Shankaran; Mandates: Jon Sperl.

Estimate approved by: H. Samuel Papenfuss, Deputy Assistant Director for Budget Analysis.

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