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SENATE

{ REPORT
115-241

DEPARTMENT OF ENERGY RESEARCH AND INNOVATION ACT

MAY 9, 2018.—Ordered to be printed

Ms. MURKOWSKI, from the Committee on Energy and Natural
Resources, submitted the following

R E P O R T

[To accompany S. 2503]

The Committee on Energy and Natural Resources, to which was referred the bill (S. 2503) to establish Department of Energy policy for science and energy research and development programs, and reform National Laboratory management and technology transfer programs, and for other purposes, having considered the same, reports favorably thereon without amendment and recommends that the bill do pass.

PURPOSE

The purpose of S. 2503 is to establish Department of Energy (DOE) policy for science and energy research and development programs, and to reform National Laboratory management and technology transfer programs, and for other purposes.

BACKGROUND AND NEED

DOE currently operates 17 National Laboratories that are managed by six different offices: the Office of Science; the National Nuclear Security Administration; the Office of Nuclear Energy; the Office of Fossil Energy; the Office of Energy Efficiency and Renewable Energy; and the Office of Environmental Management. The mission of the National Laboratories includes basic science, as well as research, development, and deployment related to energy and national security. In addition, the National Laboratories house scientific instrumentation and facilities that, in many cases, are unique and available to the public.

A number of studies conducted by government agencies and independent third parties have highlighted concerns with the relationship between DOE and the management of National Laboratories, the challenges associated with technology transfer, and research coordination within DOE.

This legislation addresses a number of these challenges and provides additional program direction to DOE.

LEGISLATIVE HISTORY

On March 6, 2018, Senator Lisa Murkowski, with Senator Maria Cantwell as cosponsor, introduced S. 2503, in the Senate.

On January 20, 2017, Representative Lamar Smith and 15 cosponsors introduced similar legislation, H.R. 589, in the House of Representatives. H.R. 589 was passed in the House of Representatives by a voice vote on January 24, 2017. On January 30, 2017, H.R. 589 was read twice in the Senate and referred to the Committee on Energy and Natural Resources.

On June 28, 2017, Senator Lisa Murkowski, with Senator Maria Cantwell as cosponsor, introduced the Energy and Natural Resources Act, S. 1460, which includes the provisions included in H.R. 589. S. 1460 was placed on the Senate Legislative Calendar.

COMMITTEE RECOMMENDATION

The Senate Committee on Energy and Natural Resources, in open business session on March 8, 2018, by a majority voice vote of a quorum present, recommended that the Senate pass S. 2503.

SECTION-BY-SECTION ANALYSIS

Section 1. Short title; table of contents

Section 1 sets forth a short title and table of contents.

Section 2. Definitions

Section 2 provides a list of definitions.

TITLE I—LABORATORY MODERNIZATION AND TECHNOLOGY TRANSFER

Section 101. Short title

Section 101 sets forth a short title for Title I.

Section 102. Inclusion of early stage technology demonstration in authorized technology transfer activities

Section 102 amends section 1001 of the Energy Policy Act of 2005 (42 U.S.C. 16391) to authorize directors of National Laboratories to use technology transfer funds to carry out early stage and pre-commercial technology demonstration activities to remove technology barriers that limit private sector interest, and to demonstrate potential commercial applications of any research and technologies arising from National Laboratory activities.

Section 103. Sense of Congress on accelerating energy innovation

Section 103 expresses the Sense of Congress that: accelerating clean energy innovation will help meet critical national goals; energy options vary by geographic region; a regional approach to promoting innovation has merit; and Congress, the Secretary and en-

ergy industry participants should advance efforts that promote international, domestic, and regional cooperation on R&D of energy innovations.

Section 104. Restoration of laboratory directed research and development program

Section 104(a) requires the Secretary to ensure that laboratory operating contractors do not allocate costs of general and administrative overhead to laboratory directed research and development.

Subsection (b) provides an exception for national security laboratories to which section 3119 of the National Defense Authorization Act for Fiscal Year 2017 (Public Law 114–328) applies.

Section 105. Research grants database

Section 105(a) requires the Secretary to establish and maintain a searchable public database, accessible on the website of the Department, for research and development transactions administered by the Department.

Subsection (b) requires each listing in the database to include specific information.

Subsection (c) requires the Secretary to provide information on relevant literature and patents associated with each project.

Section 106. Technology transfer and transitions assessment

Section 106 requires the Secretary to transmit, within one year of the date of enactment and as often as the Secretary determines to be necessary thereafter, a report to the appropriate committees of Congress that includes recommended changes to the policy of the Department and proposed changes to section 1001 of the Energy Policy Act of 2005 (42 U.S.C. 16391) to improve the ability of the Department to transfer new technologies to the private sector.

Section 107. Agreements for commercializing technology pilot program

Section 107(a) requires the Secretary to carry out the pilot program for National Laboratories to enter into Agreements for Commercializing Technology that was announced December 8, 2011.

Subsection (b) requires each agreement entered into under the pilot program to provide to the contractor of the applicable national laboratory increased authority to negotiate contract terms.

Subsection (c) sets forth eligibility requirements.

Subsection (d) requires an affected director of a National Laboratory to submit specific information to the Secretary with respect to each agreement.

Subsection (e) requires the contractor of the affected National Laboratory to certify that the project is not in direct competition with the private sector and addresses conflicts of interest as required.

Subsection (f) extends the pilot program until September 30, 2019.

Subsection (g) requires reports to the appropriate committees of Congress.

Section 108. Short-term cost-share pilot program

Section 108(a) amends section 988(b) of the Energy Policy Act of 2005 (42 U.S.C. 16352(b)) to include, for a two year period beginning on the day of enactment, an exemption for institutions of higher education and other non-profit institutions.

Subsection (b) requires reports to the appropriate committees of Congress.

TITLE II—DEPARTMENT OF ENERGY RESEARCH COORDINATION

Section 201. Short title

Section 201 sets forth a short title for Title II.

Section 202. Protection of information

Section 202 amends section 5012 of the America Competes Act (42 U.S.C. 16538) to provide additional protection for proprietary information collected by the Advanced Research Projects Agency—Energy (ARPA-E).

Section 203. Crosscutting research and development

Section 203(a) requires the Secretary to identify strategic opportunities for collaborative research, development, demonstration, and commercial application of innovative science and technologies.

Subsection (b) requires the Secretary to seek to leverage existing programs and consolidate and coordinate activities within the Department.

Subsection (c) sets forth additional requirements for the Secretary to follow when identifying crosscutting activities.

Section 204. Strategic research and development

Section 204 amends section 994 of the Energy Policy Act of 2005 (42 U.S.C. 16358) to update the criteria for strategic research and development planning.

Section 205. Strategy for facilities and infrastructure

Section 205 revises the section heading of section 993 of the Energy Policy Act of 2005, requires the Secretary to submit a report detailing the strategy for facilities and infrastructure in 2018, and provides a corresponding clerical amendment in the table of contents of the Energy Policy Act of 2005 reflecting the change in the section heading.

Section 206. Energy Innovation Hubs

Section 206(a) provides definitions.

Subsection (b) requires the Secretary to carry out a program to enhance economic, environmental, and energy security by making grants to consortia for establishing and operating hubs to be known as “Energy Innovation Hubs.”

Subsection (c) sets forth an application process for the Energy Innovation Hub program.

Subsection (d) sets forth the length of time and renewal policies for the Energy Innovation Hub program.

Subsection (e) sets forth requirements for hub operations and activities.

TITLE III—DEPARTMENT OF ENERGY OFFICE OF SCIENCE POLICY

Section 301. Short title

Section 301 sets forth a short title for Title III.

Section 302. Mission of the Office of Science

Section 302 amends section 209 of the Department of Energy Organization Act (42 U.S.C. 7139) to include a mission for the Office of Science.

Section 303. Basic energy sciences

Section 303(a) requires the Secretary to carry out a program (“Energy Frontier Research Centers”) to provide awards on a competitive, merit-reviewed basis, to multi-institutional collaborations to conduct energy research to accelerate scientific breakthroughs.

Subsection (b) requires the Director of the Office of Science to carry out a program for basic science user facilities.

Subsection (c) requires the Director to carry out research and development on advanced accelerator and storage ring technologies.

Subsection (d) amends section 973 of the Energy Policy Act of 2005 (42 U.S.C. 16313) to require the Secretary, leveraging other programs within the Department, to carry out a Solar Fuels Research Initiative to support research into artificial photosynthesis and to replicate natural photosynthesis.

Subsection (e) amends section 975 of the Energy Policy Act of 2005 (43 U.S.C. 16315) to require the Secretary, leveraging other programs within the Department, to carry out an Electricity Storage Research Initiative to support: electricity storage research; multivalent ion materials in electric energy storage; electrochemistry modeling and simulation; and mesoscale electrochemistry.

Section 304. Advanced scientific computing research

Section 304(a)(1) amends section 1 of the Department of Energy High-End Computing Revitalization Act of 2004 (15 U.S.C. 5501 note; Public Law 108–423) to rename the Act and provides for a conforming amendment to section 976(a)(1) of the Energy Policy Act of 2005 (42 U.S.C. 16316(1)) to reflect the name change.

Subsection (a)(2) amends definitions included in the American Super Computing Leadership Act (15 U.S.C. 5541).

Subsection (a)(3) amends the American Super Computing Leadership Act (15 U.S.C. 5542) to require the Secretary to conduct a research program for exascale computing systems at DOE.

Subsection (b) requires the Secretary to conduct a research program for high-performance computing and networking research.

Subsection (c) requires the Director to conduct activities for applied mathematics and software development for high-end computing systems.

Section 305. High-energy physics

Section 305(a) expresses the Sense of Congress related to the high-energy physics program.

Subsection (b) encourages the Director to ensure access of United States researchers to the most advanced accelerator facilities in the world, including the Large Hadron Collider.

Subsection (c) requires the Director to carry out research on the nature of the neutrino.

Subsection (d) requires the Director to carry out research on the nature of dark energy and dark matter.

Section 306. Biological and environmental research

Section 306(a) requires the Director to carry out research and development activities in fundamental, structural, computational, and systems biology.

Subsection (b) provides that the Director shall not approve new climate-science-related initiatives without making a determination that such work is well coordinated with any relevant work carried out by other Federal agencies.

Subsection (c) requires the Director to carry out a research program on low-dose radiation.

Section 307. Fusion energy

Section 307(a) requires the Director to coordinate with the Assistant Secretary for Nuclear Energy to carry out research and development activities related to fusion power systems and an assessment of facilities required for fusion testing.

Subsection (b) requires the Director to support activities to optimize the tokamak approach to fusion energy.

Subsection (c) requires the Director to support inertial fusion energy research and development activities.

Subsection (d) requires the Director to support research and development activities at institutions of higher education, National Laboratories, and private facilities for a portfolio of alternative and enabling fusion energy concepts.

Subsection (e) requires coordination with ARPA-E.

Subsection (f) amends section 33 of the Atomic Energy Act of 1954 (42 U.S.C. 2053) to require fairness in competition for solicitations and international project activities.

Subsection (g) requires the Secretary to submit a report on fusion energy activities.

Section 308. Nuclear physics

Section 308(a) permits the Director of the Office of Science to carry out a program for the development and production of isotopes for research applications.

Subsection (b) renames the Rare Isotope Accelerator.

Section 309. Science laboratories infrastructure program

Section 309(a) requires the Director to carry out a program to improve the safety, efficiency, and mission readiness of infrastructure at laboratories of the Office of Science.

Subsection (b) provides direction on inclusion of projects in the infrastructure program.

TITLE IV—NUCLEAR ENERGY INNOVATION CAPABILITIES

Section 401. Short title

Section 401 sets forth the short title for Title IV.

Section 402. Nuclear energy innovation capabilities

Section 402(a) amends section 951 of the Energy Policy Act of 2005 (42 U.S.C. 16271) with respect to the objectives of DOE's nuclear energy research and development program.

Subsection (a) of the amended section 951 restates the mission and objectives of DOE's civilian nuclear energy research and development work. Subsection (a)(2)(A) directs the Secretary to carry out programs to provide research infrastructure in order to promote scientific progress in nuclear, chemical, and materials science engineering. Subsection (a) also provides direction to DOE in relation to its work with private industry, the National Laboratories, and institutions of higher education, including supporting technology transfer and enabling public-private partnerships.

Subsection (b) deletes from section 952(c) of Energy Policy Act of 2005 (42 U.S.C. 16272(c)) the authorization for the Nuclear Power 2010 program and makes conforming changes.

Subsection (c) strikes the delegation of authority to the Director of the Office of Nuclear Energy, Science and Technology contained in section 953(a) of Energy Policy Act of 2005 (42 U.S.C. 16273(a)).

Subsection (d) deletes the phrase "as part of a taking into consideration effort that emphasizes" in section 954(d)(4) of Energy Policy Act of 2005 (42 U.S.C. 16274(d)(4)) and inserts "that emphasize."

Subsection (e) amends section 955 of Energy Policy Act of 2005 (42 U.S.C. 16275) by removing a requirement for the Secretary to develop a comprehensive plan for the Idaho National Laboratory and replacing it with a new subsection (c). This new provision directs the Secretary to assess the mission need for a versatile reactor-based fast neutron source to be operated as a national user facility. As soon as practicable after determining mission need, the Secretary is directed to submit a detailed plan to Congress to establish the user facility and is required to ensure that the facility provides fast neutron irradiation capabilities and has the capacity for upgrades. The Secretary is required to consider capabilities to support high-temperature testing, and provide flexible facilities to accommodate various types of fuels, materials, and coolants, including pre- and post-irradiation examination capabilities. To the maximum extent practicable, the Secretary shall complete construction and approve the start of operations for the user facility by December 31, 2025.

Subsection (f) strikes the delegation of authority to the Director of the Office of Nuclear Energy, Science and Technology contained in section 956 of the Energy Policy Act of 2005 (42 U.S.C. 16276).

Subsection (g) amends section 957 of Energy Policy Act of 2005 (42 U.S.C. 16277) to require the Secretary to carry out a program to enhance the capabilities of the United States to develop new reactor technologies through high-performance computational modeling and simulation. In carrying out the effort, the Secretary is directed to coordinate with relevant Federal agencies and leverage expertise from the private sector, institutions of higher education, and the National Laboratories.

Subsection (h) amends subtitle E of title IX of Energy Policy Act of 2005 (42 U.S.C. 16271 et seq.) to add a new section 958, authorizing the National Reactor Innovation Center (NRIC). The program is authorized to support research, development, demonstration, and deployment of a broad range of advanced reactor concepts, compo-

nents, technologies, fuels, and materials. The NRIC will allow for the testing and demonstration of reactor concepts to be proposed and funded, in whole or in part, by the private sector, and would leverage the expertise of relevant Federal agencies and the National Laboratories.

Subsections (d) and (e) of the new section 958 authorize the Secretary to enter into memoranda of understanding with the Chairman of the Nuclear Regulatory Commission (NRC) to share technical expertise and to coordinate the research and development activities of the DOE with safety mission of the NRC.

Subsection (f) of the new section 958 requires the Secretary to submit to the relevant committees of Congress a report that addresses the various internal mechanisms and impacts pertaining to NRIC.

Subsection (g) of the new section 958 contains savings clauses to preserve the NRC's existing licensing and regulatory authority over demonstration reactors, and to make it clear that the NRIC's activities are subject to the financial protection and indemnification requirements of the Price-Anderson Act.

Subsection (i) amends subtitle E of title IX of the Energy Policy Act of 2005 (42 U.S.C. 16271 et seq.) to add a new section 959, to require the Secretary to develop, and submit to the relevant committees of Congress, two 10-year budget plans, one constrained and one unconstrained, for the civilian nuclear energy research and development activities of the DOE.

Subsection (j) makes conforming changes to the table of contents of subtitle E of title IX of the Energy Policy Act of 2005 (42 U.S.C. 16271).

COST AND BUDGETARY CONSIDERATIONS

The Congressional Budget Office estimate of the costs of this measure has been requested but was not received at the time the report was filed. When the report is available, the Chairman will request it to be printed in the Congressional Record for the advice of the Senate.

REGULATORY IMPACT EVALUATION

In compliance with paragraph 11(b) of rule XXVI of the Standing Rules of the Senate, the Committee makes the following evaluation of the regulatory impact which would be incurred in carrying out the bill.

The bill is not a regulatory measure in the sense of imposing Government-established standards or significant economic responsibilities on private individuals and businesses.

No personal information would be collected in administering the program. Therefore, there would be no impact on personal privacy.

Little, if any, additional paperwork would result from enactment of the bill, as ordered reported.

CONGRESSIONALLY DIRECTED SPENDING

S. 2503, as reported, does not contain any congressionally directed spending items, limited tax benefits, or limited tariff benefits as defined in rule XLIV of the Standing Rules of the Senate.

EXECUTIVE COMMUNICATIONS

Executive Communications on S. 2503 were not requested by the Committee on Energy and Natural Resources for the 115th Congress.

CHANGES IN EXISTING LAW

In compliance with paragraph 12 of rule XXVI of the Standing Rules of the Senate, changes in existing law made by the bill, as reported, are shown as follows (existing law proposed to be omitted is enclosed in black brackets, new matter is printed in *italic*, existing law in which no change is proposed is shown in roman):

AMERICA COMPETES ACT

Public Law 110–69, as Amended

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SEC. 5012. ADVANCED RESEARCH PROJECTS AGENCY—ENERGY.

(a) DEFINITIONS.—In this section:

(1) ARPA–E.—The term “ARPA–E” means the Advanced Research Projects Agency–Energy established by subsection (b).

(2) DIRECTOR.—The term “Director” means the Director of ARPA–E appointed under subsection (d).

(3) FUND.—The term “Fund” means the Energy Transformation Acceleration Fund established under subsection [(n)(1)] *o(1)*.

* * * * *

(m) EXISTING AUTHORITIES.—The authorities granted by this section are—

(1) in addition to existing authorities granted to the Secretary; and

(2) are not intended to supersede existing authorities.

(n).—*The following types of information collected by ARPA–E from recipients of financial assistance awards shall be considered commercial and financial information obtained from a person and privileged or confidential and not subject to disclosure under section 552(b)(4) of title 5, United States Code—*

(1) *Plans for commercialization of technologies developed under the award, including business plans, technology-to-market plans, market studies, and cost and performance models.*

(2) *Investments provided to an awardee from third parties (such as venture capital firms, hedge funds, and private equity firms), including amounts and the percentage of ownership of the awardee provided in return for the investments.*

(3) *Additional financial support that the awardee—*

(A) plans to or has invested into the technology developed under the award; or

(B) is seeking from third parties.

(4) *Revenue from the licensing or sale of new products or services resulting from research conducted under the award.*
 [(n)] (o) FUNDING.—

(1) FUND.—There is established in the Treasury of the United States a fund, to be known as the “Energy Transformation Acceleration Fund”, which shall be administered by the Director for the purposes of carrying out this section.

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ATOMIC ENERGY ACT

Public Law 87–206, as Amended

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SEC. 33. RESEARCH FOR OTHERS.

In this section, with respect to international research projects, the term “private facilities or laboratories” means facilities or laboratories located in the United States. Where the Commission finds private facilities or laboratories are inadequate to the purpose, it is authorized to conduct for other persons, through its own facilities, such of those activities and studies of the types specified in section 31 as it deems appropriate to the development of atomic energy. To the extent the Commission determines that private facilities or laboratories are inadequate to the purpose, and that the Commission’s facilities, or scientific or technical resources have the potential of lending significant assistance to other persons in the fields of protection of public health and safety, the Commission may also assist other persons in these fields by conducting for such persons, through the Commission’s own facilities, research and development or training activities and studies. The Commission is authorized to determine and make such charges as in its discretion may be desirable for the conduct of the activities and studies referred to in this section.

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DEPARTMENT OF ENERGY ORGANIZATION ACT

Public Law 95–91, as Amended

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OFFICE OF SCIENCE

SEC. 209.

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(c) *MISSION.—The mission of the Office of Science shall be the delivery of scientific discoveries, capabilities, and major scientific tools to transform the understanding of nature and to advance the energy, economic, and national security of the United States.*

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DEPARTMENT OF ENERGY HIGH-END COMPUTING REVITALIZATION ACT

Public Law 108–423

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SECTION 1. SHORT TITLE.

This Act may be cited as the **["Department of Energy High-End Computing Revitalization Act of 2004"]** *American Supercomputing Leadership Act of 2017*.

SEC. 2. DEFINITIONS.

In this Act:

[(1) CENTER.]—The term “Center” means a High-End Software Development Center established under section 3(d).**]**

(1) DEPARTMENT.—*The term “Department” means the Department of Energy.*

(2) EXASCALE COMPUTING.—*The term “exascale computing” means computing through the use of a computing machine that performs near or above 10 to the 18th power operations per second.*

[(2)] (3) HIGH-END COMPUTING SYSTEM.—The term “high-end computing system” means a computing system with performance that substantially exceeds that of systems that are commonly available for advanced scientific and engineering applications.

[(3)] (4) LEADERSHIP SYSTEM.—The term “Leadership System” means a high-end computing system that is among the most advanced in the world in terms of performance in solving scientific and engineering problems.

[(4)] (5) INSTITUTION OF HIGHER EDUCATION.—The term “institution of higher education” has the meaning given the term in section 101(a) of the Higher Education Act of 1965 (20 U.S.C. 1001(a)).

[(5)] (6) SECRETARY.—The term “Secretary” means the Secretary of Energy.

SEC. 3. DEPARTMENT OF ENERGY HIGH-END COMPUTING RESEARCH AND DEVELOPMENT PROGRAM.

(a) IN GENERAL.—The Secretary shall—

(1) carry out a **[program]** *coordinated program across the Department* of research and development (including development of software and hardware) to advance high-end computing systems; and

(2) develop and deploy high-end computing systems for advanced scientific and engineering applications.

(b) PROGRAM.—The program shall—

(1) support both individual investigators and multidisciplinary teams of investigators;

(2) conduct research in multiple architectures**[],** which may include vector, reconfigurable logic, streaming, processor-in-memory, and multithreading architectures**];**

(3) conduct research on software for high-end computing systems, including research on algorithms, programming environments, tools, languages, and operating systems for high-end

computing systems, in collaboration with architecture development efforts;

(4) provide for sustained access by the research community in the United States to high-end computing systems and to Leadership Systems, including provision of technical support for users of such systems;

(5) support technology transfer to the private sector and others in accordance with applicable law; and

(6) ensure that the high-end computing activities of the Department of Energy are coordinated with relevant activities in industry and with other Federal agencies, including the National Science Foundation, the Defense Advanced Research Projects Agency, the National Nuclear Security Administration, the National Security Agency, the National Institutes of Health, the National Aeronautics and Space Administration, the National Oceanic and Atmospheric Administration, the National Institutes of Standards and Technology, and the Environmental Protection Agency.

(c) LEADERSHIP SYSTEMS FACILITIES.—

(1) IN GENERAL.—As part of the program carried out under this Act, the Secretary shall establish and operate 1 or more Leadership Systems facilities to—

(A) conduct advanced scientific and engineering research and development using Leadership Systems; and

(B) develop potential advancements in high-end computing system hardware and software.

(2) ADMINISTRATION.—In carrying out this subsection, the Secretary shall provide to Leadership Systems, on a competitive, merit-reviewed basis, access to researchers in United States industry, institutions of higher education, national laboratories, and other Federal agencies.

[(d) HIGH-END SOFTWARE DEVELOPMENT CENTER.—

[(1) IN GENERAL.—As part of the program carried out under this Act, the Secretary shall establish at least 1 High-End Software Development Center.

[(2) DUTIES.—A Center shall concentrate efforts to develop, test, maintain, and support optimal algorithms, programming environments, tools, languages, and operating systems for high-end computing systems.

[(3) PROPOSALS.—In soliciting proposals for the Center, the Secretary shall encourage staffing arrangements that include both permanent staff and a rotating staff of researchers from other institutions and industry to assist in coordination of research efforts and promote technology transfer to the private sector.

[(4) USE OF EXPERTISE.—The Secretary shall use the expertise of a Center to assess research and development in high-end computing system architecture.

[(5) SELECTION.—The selection of a Center shall be determined by a competitive proposal process administered by the Secretary.]

(d) EXASCALE COMPUTING PROGRAM.—

(1) IN GENERAL.—*The Secretary shall conduct a research program (referred to in this subsection as the ‘Program’) for exascale computing, including the development of two or more*

exascale computing machine architectures, to promote the missions of the Department.

(2) EXECUTION.—

(A) IN GENERAL.—*In carrying out the Program, the Secretary shall—*

(i) establish two or more National Laboratory partnerships with industry partners and institutions of higher education for the research and development of two or more exascale computing architectures across all applicable organizations of the Department;

(ii) conduct mission-related codesign activities in developing the exascale computing architectures under clause (i);

(iii) develop such advancements in hardware and software technology as are required to fully realize the potential of an exascale production system in addressing Department target applications and solving scientific problems involving predictive modeling and simulation and large scale data analytics and management;

(iv) explore the use of exascale computing technologies to advance a broad range of science and engineering; and

(v) provide, as appropriate, on a competitive, merit-reviewed basis, access for researchers in industries in the United States, institutions of higher education, National Laboratories, and other Federal agencies to the exascale computing systems developed pursuant to clause (i).

(B) SELECTION OF PARTNERS.—*The Secretary shall select the partnerships with the computing facilities of the Department under subparagraph (A) through a competitive, peer-review process.*

(3) CODESIGN AND APPLICATION DEVELOPMENT.—

(A) IN GENERAL.—*The Secretary shall—*

(i) carry out the Program through an integration of applications, computer science, applied mathematics, and computer hardware architecture using the partnerships established pursuant to paragraph (2) to ensure that, to the maximum extent practicable, two or more exascale computing machine architectures are capable of solving Department target applications and broader scientific problems, including predictive modeling and simulation and large scale data analytics and management; and

(ii) conduct outreach programs to increase the readiness for the use of such platforms by domestic industries, including manufacturers.

(B) REPORT.—*The Secretary shall submit to Congress a report describing—*

(i) how the integration under subparagraph (A) is furthering application science data and computational workloads across application interests, including national security, material science, physical science, cybersecurity, biological science, the Materials Genome

and BRAIN Initiatives of the President, advanced manufacturing, and the national electric grid; and

(ii) the roles and responsibilities of National Laboratories and industry, including the definition of the roles and responsibilities within the Department to ensure an integrated program across the Department.

(4) **PROJECT REVIEW.**—

(A) **IN GENERAL.**—The exascale architectures developed pursuant to partnerships established pursuant to paragraph (2) shall be reviewed through a project review process.

(B) **REPORT.**—Not later than 90 days after the date of enactment of this subsection, the Secretary shall submit to Congress a report on—

(i) the results of the review conducted under subparagraph (A); and

(ii) the coordination and management of the Program to ensure an integrated research program across the Department.

(5) **ANNUAL REPORTS.**—At the time of the budget submission of the Department for each fiscal year, the Secretary, in consultation with the members of the partnerships established pursuant to paragraph (2), shall submit to Congress a report that describes funding for the Program as a whole by functional element of the Department and critical milestones.

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THE ENERGY POLICY ACT OF 2005

Public Law 109–58

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SECTION 1. SHORT TITLE; TABLE OF CONTENTS.

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Sec. 973 **[Catalysis research program]** *Solar fuels research initiative.*

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Sec. 975. **[Solid state lighting]** *Electricity storage research initiative.*

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Sec. 993. **[Strategy and plan for science and energy facilities and infrastructure]**
Strategy for facilities and infrastructure.

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TITLE IX—RESEARCH AND DEVELOPMENT

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[SEC. 951. NUCLEAR ENERGY.]

[(a) IN GENERAL.]—The Secretary shall conduct programs of civilian nuclear energy research, development, demonstration, and commercial application, including activities described in this subtitle. Programs under this subtitle shall take into consideration the following objectives:

[(1) Enhancing nuclear power's viability as part of the United States energy portfolio.

[(2) Providing the technical means to reduce the likelihood of nuclear proliferation.

[(3) Maintaining a cadre of nuclear scientists and engineers.

[(4) Maintaining National Laboratory and university nuclear programs, including their infrastructure.

[(5) Supporting both individual researchers and multidisciplinary teams of researchers to pioneer new approaches in nuclear energy, science, and technology.

[(6) Developing, planning, constructing, acquiring, and operating special equipment and facilities for the use of researchers.

[(7) Supporting technology transfer and other appropriate activities to assist the nuclear energy industry, and other users of nuclear science and engineering, including activities addressing reliability, availability, productivity, component aging, safety, and security of nuclear power plants.

[(8) Reducing the environmental impact of nuclear energy-related activities.

[(b) AUTHORIZATION OF APPROPRIATIONS FOR CORE PROGRAMS.—There are authorized to be appropriated to the Secretary to carry out nuclear energy research, development, demonstration, and commercial application activities, including activities authorized under this subtitle, other than those described in subsection (c)—

[(1) \$330,000,000 for fiscal year 2007;

[(2) \$355,000,000 for fiscal year 2008; and

[(3) \$495,000,000 for fiscal year 2009.

[(c) NUCLEAR INFRASTRUCTURE AND FACILITIES.—There are authorized to be appropriated to the Secretary to carry out activities under section 955—

[(1) \$135,000,000 for fiscal year 2007;

[(2) \$140,000,000 for fiscal year 2008; and

[(3) \$145,000,000 for fiscal year 2009.

[(d) ALLOCATIONS.—From amounts authorized under subsection (a), the following sums are authorized:

[(1) For activities under section 953—

[(A) \$150,000,000 for fiscal year 2007;

[(B) \$155,000,000 for fiscal year 2008; and

[(C) \$275,000,000 for fiscal year 2009.

[(2) For activities under section 954—

[(A) \$43,600,000 for fiscal year 2007;

[(B) \$50,100,000 for fiscal year 2008; and

[(C) \$56,000,000 for fiscal year 2009.

[(3) For activities under section 957, \$6,000,000 for each of fiscal years 2007 through 2009.

[(e) LIMITATION.—None of the funds authorized under this section may be used to decommission the Fast Flux Test Facility.]

SEC. 951. NUCLEAR ENERGY.

(a) MISSION.—

(1) *IN GENERAL.*—The Secretary shall carry out programs of civilian nuclear research, development, demonstration, and commercial application, including activities under this subtitle.

(2) *CONSIDERATIONS.*—The programs carried out under paragraph (1) shall take into consideration the following objectives:

(A) *Providing research infrastructure to promote scientific progress and enable users from academia, the National Laboratories, and the private sector to make scientific discoveries relevant for nuclear, chemical, and materials science engineering.*

(B) *Maintaining nuclear energy research and development programs at the National Laboratories and institutions of higher education, including infrastructure at the National Laboratories and institutions of higher education.*

(C) *Providing the technical means to reduce the likelihood of nuclear proliferation.*

(D) *Increasing confidence margins for public safety of nuclear energy systems.*

(E) *Reducing the environmental impact of activities relating to nuclear energy.*

(F) *Supporting technology transfer from the National Laboratories to the private sector.*

(G) *Enabling the private sector to partner with the National Laboratories to demonstrate novel reactor concepts for the purpose of resolving technical uncertainty associated with the objectives described in subparagraphs (A) through (F).*

(b) *DEFINITIONS.—In this subtitle:*

(1) *ADVANCED NUCLEAR REACTOR.—The term “advanced nuclear reactor” means—*

(A) *a nuclear fission reactor with significant improvements over the most recent generation of nuclear fission reactors, which may include—*

(i) *inherent safety features;*

(ii) *lower waste yields;*

(iii) *greater fuel utilization;*

(iv) *superior reliability;*

(v) *resistance to proliferation;*

(vi) *increased thermal efficiency; and*

(vii) *the ability to integrate into electric and nonelectric applications; or*

(B) *a nuclear fusion reactor.*

(2) *COMMISSION.—The term “Commission” means the Nuclear Regulatory Commission.*

(3) *FAST NEUTRON.—The term “fast neutron” means a neutron with kinetic energy above 100 kiloelectron volts.*

(4) *NATIONAL LABORATORY.—*

(A) *IN GENERAL.—Except as provided in subparagraph (B), the term “National Laboratory” has the meaning given the term in section 2.*

(B) *LIMITATION.—With respect to the Lawrence Livermore National Laboratory, the Los Alamos National Laboratory, and the Sandia National Laboratories, the term ‘National Laboratory’ means only the civilian activities of the laboratory.*

(5) *NEUTRON FLUX.—The term “neutron flux” means the intensity of neutron radiation measured as a rate of flow of neutrons applied over an area.*

(6) *NEUTRON SOURCE.*—The term “neutron source” means a research machine that provides neutron irradiation services for—

- (A) research on materials sciences and nuclear physics;
- and
- (B) testing of advanced materials, nuclear fuels, and other related components for reactor systems.

SEC. 952. NUCLEAR ENERGY RESEARCH PROGRAMS.

(a) *NUCLEAR ENERGY RESEARCH INITIATIVE.*—The Secretary shall carry out a Nuclear Energy Research Initiative for research and development related to nuclear energy.

(b) *NUCLEAR ENERGY SYSTEMS SUPPORT PROGRAM.*—The Secretary shall carry out a Nuclear Energy Systems Support Program to support research and development activities addressing reliability, availability, productivity, component aging, safety, and security of existing nuclear power plants.

[(c) *NUCLEAR POWER 2010 PROGRAM.*—

[(1) *IN GENERAL.*—The Secretary shall carry out a Nuclear Power 2010 Program, consistent with recommendations of the Nuclear Energy Research Advisory Committee of the Department in the report entitled “A Roadmap to Deploy New Nuclear Power Plants in the United States by 2010” and dated October 2001.

[(2) *ADMINISTRATION.*—The Program shall include—

[(A) use of the expertise and capabilities of industry, institutions of higher education, and National Laboratories in evaluation of advanced nuclear fuel cycles and fuels testing;

[(B) consideration of a variety of reactor designs suitable for both developed and developing nations;

[(C) participation of international collaborators in research, development, and design efforts, as appropriate; and

[(D) encouragement for participation by institutions of higher education and industry.]

[(d)] (c) *GENERATION IV NUCLEAR ENERGY SYSTEMS INITIATIVE.*—(1) *IN GENERAL.*—The Secretary shall carry out a Generation IV Nuclear Energy Systems Initiative to develop an overall technology plan for and to support research and development necessary to make an informed technical decision about the most promising candidates for eventual commercial application.

(2) *ADMINISTRATION.*—In conducting the Initiative, the Secretary shall examine advanced proliferation-resistant and passively safe reactor designs, including designs that—

(A) are economically competitive with other electric power generation plants;

(B) have higher efficiency, lower cost, and improved safety compared to reactors in operation on the date of enactment of this Act;

(C) use fuels that are proliferation resistant and have substantially reduced production of high-level waste per unit of output; and

(D) use improved instrumentation.

[(e)] (d) REACTOR PRODUCTION OF HYDROGEN.—The Secretary shall carry out research to examine designs for high-temperature reactors capable of producing large-scale quantities of hydrogen.

SEC. 953. ADVANCED FUEL CYCLE INITIATIVE.

(a) IN GENERAL.—The Secretary[, acting through the Director of the Office of Nuclear Energy, Science and Technology,] shall conduct an advanced fuel recycling technology research, development, and demonstration program (referred to in this section as the ‘program’) to evaluate proliferation-resistant fuel recycling and transmutation technologies that minimize environmental and public health and safety impacts as an alternative to aqueous reprocessing technologies deployed as of the date of enactment of this Act in support of evaluation of alternative national strategies for spent nuclear fuel and the Generation IV advanced reactor concepts.

SEC. 954. UNIVERSITY NUCLEAR SCIENCE AND ENGINEERING SUPPORT.

* * * * *

(d) STRENGTHENING UNIVERSITY RESEARCH AND TRAINING REACTORS AND ASSOCIATED INFRASTRUCTURE.—In carrying out the program under this section, the Secretary may support—

- (1) converting research reactors from high-enrichment fuels to low-enrichment fuels and upgrading operational instrumentation;
- (2) consortia of universities to broaden access to university research reactors;
- (3) student training programs, in collaboration with the United States nuclear industry, in relicensing and upgrading reactors, including through the provision of technical assistance; and
- (4) reactor improvements [as part of a taking into consideration effort that emphasizes] *that emphasize* research, training, and education, including through the Innovations in Nuclear Infrastructure and Education Program or any similar program.

SEC. 955. DEPARTMENT OF ENERGY CIVILIAN NUCLEAR INFRASTRUCTURE AND FACILITIES.

(a) IN GENERAL.—The Secretary shall operate and maintain infrastructure and facilities to support the nuclear energy research, development, demonstration, and commercial application programs, including radiological facilities management, isotope production, and facilities management.

(b) DUTIES.—In carrying out this section, the Secretary shall—

- (1) develop an inventory of nuclear science and engineering facilities, equipment, expertise, and other assets at all of the National Laboratories;
- (2) develop a prioritized list of nuclear science and engineering plant and equipment improvements needed at each of the National Laboratories;
- (3) consider the available facilities and expertise at all National Laboratories and emphasize investments which complement rather than duplicate capabilities; and
- (4) develop a timeline and a proposed budget for the completion of deferred maintenance on plant and equipment, with the

goal of ensuring that Department programs under this subtitle will be generally recognized to be among the best in the world.

[(c) PLAN.—The Secretary shall develop a comprehensive plan for the facilities at the Idaho National Laboratory, especially taking into account the resources available at other National Laboratories. In developing the plan, the Secretary shall—

[(1) evaluate the facilities planning processes utilized by other physical science and engineering research and development institutions, both in the United States and abroad, that are generally recognized as being among the best in the world, and consider how those processes might be adapted toward developing such facilities plan;

[(2) avoid duplicating, moving, or transferring nuclear science and engineering facilities, equipment, expertise, and other assets that currently exist at other National Laboratories;

[(3) consider the establishment of a national transuranic analytic chemistry laboratory as a user facility at the Idaho National Laboratory;

[(4) include a plan to develop, if feasible, the Advanced Test Reactor and Test Reactor Area into a user facility that is more readily accessible to academic and industrial researchers;

[(5) consider the establishment of a fast neutron source as a user facility;

[(6) consider the establishment of new hot cells and the configuration of hot cells most likely to advance research, development, demonstration, and commercial application in nuclear science and engineering, especially in the context of the condition and availability of these facilities elsewhere in the National Laboratories; and

[(7) include a timeline and a proposed budget for the completion of deferred maintenance on plant and equipment.

[(d) TRANSMITTAL TO CONGRESS.—Not later than 1 year after the date of enactment of this Act, the Secretary shall transmit the plan under subsection (c) to Congress.】

(c) *VERSATILE NEUTRON SOURCE*.—

(1) *MISSION NEED*.—

(A) *IN GENERAL*.—Not later than December 31, 2017, the Secretary shall determine the mission need for a versatile reactor-based fast neutron source, which shall operate as a national user facility.

(B) *CONSULTATIONS REQUIRED*.—In carrying out subparagraph (A), the Secretary shall consult with the private sector, institutions of higher education, the National Laboratories, and relevant Federal agencies to ensure that the user facility described in subparagraph (A) will meet the research needs of the largest practicable majority of prospective users.

(2) *ESTABLISHMENT*.—As soon as practicable after determining the mission need under paragraph (1)(A), the Secretary shall submit to the appropriate committees of Congress a detailed plan for the establishment of the user facility.

(3) *FACILITY REQUIREMENTS*.—

(A) *CAPABILITIES.*—*The Secretary shall ensure that the user facility will provide, at a minimum, the following capabilities:*

(i) *Fast neutron spectrum irradiation capability.*

(ii) *Capacity for upgrades to accommodate new or expanded research needs.*

(B) *CONSIDERATIONS.*—*In carrying out the plan submitted under paragraph (2), the Secretary shall consider the following:*

(i) *Capabilities that support experimental high-temperature testing.*

(ii) *Providing a source of fast neutrons at a neutron flux, higher than that at which current research facilities operate, sufficient to enable research for an optimal base of prospective users.*

(iii) *Maximizing irradiation flexibility and irradiation volume to accommodate as many concurrent users as possible.*

(iv) *Capabilities for irradiation with neutrons of a lower energy spectrum.*

(v) *Multiple loops for fuels and materials testing in different coolants.*

(vi) *Additional pre-irradiation and post-irradiation examination capabilities.*

(vii) *Lifetime operating costs and lifecycle costs.*

(4) *DEADLINE FOR ESTABLISHMENT.*—*The Secretary shall, to the maximum extent practicable, complete construction of, and approve the start of operations for, the user facility by not later than December 31, 2025.*

(5) *REPORTING.*—*The Secretary shall include in the annual budget request of the Department an explanation for any delay in the progress of the Department in completing the user facility by the deadline described in paragraph (4).*

(6) *COORDINATION.*—*The Secretary shall leverage the best practices for management, construction, and operation of national user facilities from the Office of Science.*

SEC. 956. SECURITY OF NUCLEAR FACILITIES.

The Secretary **[**, acting through the Director of the Office of Nuclear Energy, Science and Technology,**]** shall conduct a research and development program on cost-effective technologies for increasing—

- (1) the safety of nuclear facilities from natural phenomena; and
- (2) the security of nuclear facilities from deliberate attacks.

[SEC. 957. ALTERNATIVES TO INDUSTRIAL RADIOACTIVE SOURCES.]

[(a) SURVEY.—

[(1) IN GENERAL.—Not later than August 1, 2006, the Secretary shall submit to Congress the results of a survey of industrial applications of large radioactive sources.

[(2) ADMINISTRATION.—The survey shall—

[(A) consider well-logging sources as one class of industrial sources;

[(B) include information on current domestic and international Department, Department of Defense, State De-

partment, and commercial programs to manage and dispose of radioactive sources; and

[(C) analyze available disposal options for currently deployed or future sources and, if deficiencies are noted for either deployed or future sources, recommend legislative options that Congress may consider to remedy identified deficiencies.

[(b) PLAN.—

[(1) IN GENERAL.—In conjunction with the survey conducted under subsection (a), the Secretary shall establish a research and development program to develop alternatives to sources described in subsection (a) that reduce safety, environmental, or proliferation risks to either workers using the sources or the public.

[(2) ACCELERATORS.—Miniaturized particle accelerators for well-logging or other industrial applications and portable accelerators for production of short-lived radioactive materials at an industrial site shall be considered as part of the research and development efforts.

[(3) REPORT.—Not later than August 1, 2006, the Secretary shall submit to Congress a report describing the details of the program plan.]

SEC. 957. HIGH-PERFORMANCE COMPUTATION AND SUPPORTIVE RESEARCH.

(a) *MODELING AND SIMULATION.*—*The Secretary shall carry out a program to enhance the capabilities of the United States to develop new reactor technologies through high-performance computation modeling and simulation techniques.*

(b) *COORDINATION.*—*In carrying out the program under subsection (a), the Secretary shall coordinate with relevant Federal agencies as described by the National Strategic Computing Initiative established by Executive Order No. 13702 (80 Fed. Reg. 46177 (July 29, 2015)), while taking into account the following objectives:*

(1) *Using expertise from the private sector, institutions of higher education, and the National Laboratories to develop computational software and capabilities that prospective users may access to accelerate research and development of advanced nuclear reactor systems and reactor systems for space exploration.*

(2) *Developing computational tools to simulate and predict nuclear phenomena that may be validated through physical experimentation.*

(3) *Increasing the utility of the research infrastructure of the Department by coordinating with the Advanced Scientific Computing Research program within the Office of Science.*

(4) *Leveraging experience from the Energy Innovation Hub for Modeling and Simulation.*

(5) *Ensuring that new experimental and computational tools are accessible to relevant research communities, including private sector entities engaged in nuclear energy technology development.*

(c) *SUPPORTIVE RESEARCH ACTIVITIES.*—*The Secretary shall consider support for additional research activities to maximize the utility of the research facilities of the Department, including physical processes—*

- (1) to simulate degradation of materials and behavior of fuel forms; and
- (2) for validation of computational tools.

SEC. 958. ENABLING NUCLEAR ENERGY INNOVATION.

(a) **NATIONAL REACTOR INNOVATION CENTER.**—There is authorized a program to enable the testing and demonstration of reactor concepts to be proposed and funded, in whole or in part, by the private sector.

(b) **TECHNICAL EXPERTISE.**—In carrying out the program under subsection (a), the Secretary shall leverage the technical expertise of relevant Federal agencies and the National Laboratories in order to minimize the time required to enable construction and operation of privately funded experimental reactors at National Laboratories or other Department-owned sites.

(c) **OBJECTIVES.**—The reactors described in subsection (b) shall operate to meet the following objectives:

- (1) Enabling physical validation of advanced nuclear reactor concepts.
- (2) Resolving technical uncertainty and increasing practical knowledge relevant to safety, resilience, security, and functionality of advanced nuclear reactor concepts.
- (3) General research and development to improve nascent technologies.

(d) **SHARING TECHNICAL EXPERTISE.**—In carrying out the program under subsection (a), the Secretary may enter into a memorandum of understanding with the Chairman of the Commission in order to share technical expertise and knowledge through—

- (1) enabling the testing and demonstration of advanced nuclear reactor concepts to be proposed and funded, in whole or in part, by the private sector;
- (2) operating a database to store and share data and knowledge relevant to nuclear science and engineering between Federal agencies and the private sector;
- (3) developing and testing electric and nonelectric integration and energy conversion systems relevant to advanced nuclear reactors;
- (4) leveraging expertise from the Commission with respect to safety analysis; and
- (5) enabling technical staff of the Commission to actively observe and learn about technologies developed under the program.

(e) **AGENCY COORDINATION.**—The Chairman of the Commission and the Secretary shall enter into a memorandum of understanding regarding the following:

(1) Ensuring that—

(A) the Department has sufficient technical expertise to support the timely research, development, demonstration, and commercial application by the civilian nuclear industry of safe and innovative advanced nuclear reactor technology; and

(B) the Commission has sufficient technical expertise to support the evaluation of applications for licenses, permits, and design certifications and other requests for regulatory approval for advanced nuclear reactors.

(2) *The use of computers and software codes to calculate the behavior and performance of advanced nuclear reactors based on mathematical models of the physical behavior of advanced nuclear reactors.*

(3) *Ensuring that—*

(A) *the Department maintains and develops the facilities necessary to enable the timely research, development, demonstration, and commercial application by the civilian nuclear industry of safe and innovative reactor technology; and*

(B) *the Commission has access to the facilities described in subparagraph*

(A), *as needed.*

(f) **REPORTING REQUIREMENTS—**

(1) **IN GENERAL.**—*Not later than 180 days after the date of enactment of the Nuclear Energy Innovation Capabilities Act of 2017, the Secretary, in consultation with the National Laboratories, relevant Federal agencies, and other stakeholders, shall submit to the appropriate committees of Congress a report assessing the capabilities of the Department to authorize, host, and oversee privately funded experimental advanced nuclear reactors as described in subsection (b).*

(2) **CONTENTS.**—*The report submitted under paragraph (1) shall address—*

(A) *the safety review and oversight capabilities of the Department, including options to leverage expertise from the Commission and the National Laboratories;*

(B) *options to regulate privately proposed and funded experimental reactors hosted by the Department;*

(C) *potential sites capable of hosting privately funded experimental advanced nuclear reactors;*

(D) *the efficacy of the available contractual mechanisms of the Department to partner with the private sector and Federal agencies, including cooperative research and development agreements, strategic partnership projects, and agreements for commercializing technology;*

(E) *the liability of the Federal Government with respect to the disposal of low-level radioactive waste, spent nuclear fuel, or high-level radioactive waste (as those terms are defined in section 2 of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101));*

(F) *the impact on the aggregate inventory in the United States of low-level radioactive waste, spent nuclear fuel, or high-level radioactive waste (as those terms are defined in section 2 of the Nuclear Waste Policy Act of 1982 (42 U.S.C. 10101));*

(G) *potential cost structures relating to physical security, decommissioning, liability, and other long-term project costs; and*

(H) *other challenges or considerations identified by the Secretary.*

(3) **UPDATES.**—*Once every 2 years, the Secretary shall update relevant provisions of the report submitted under paragraph (1) and submit to the appropriate committees of Congress the update.*

(g) SAVINGS CLAUSES.—

(1) *LICENSING REQUIREMENT.*—Nothing in this section authorizes the Secretary or any person to construct or operate a nuclear reactor for the purpose of demonstrating the suitability for commercial application of the nuclear reactor unless licensed by the Commission in accordance with section 202 of the Energy Reorganization Act of 1974 (42 U.S.C. 15 5842).

(2) *FINANCIAL PROTECTION.*—Any activity carried out under this section that involves the risk of public liability shall be subject to the financial protection or indemnification requirements of section 170 of the Atomic Energy Act of 1954 (42 U.S.C. 21 2210) (commonly known as the “Price-Anderson Act”).

SEC. 959. BUDGET PLAN.

(a) *IN GENERAL.*—Not later than 1 year after the date of enactment of the Nuclear Energy Innovation Capabilities Act of 2017, the Secretary shall submit to the Committee on Energy and Natural Resources of the Senate and the Committee on Science, Space, and Technology of the House of Representatives 2 alternative 10-year budget plans for civilian nuclear energy research and development by the Secretary, as described in subsections (b) through (d).

(b) *BUDGET PLAN ALTERNATIVE 1.*—One of the budget plans submitted under subsection (a) shall assume constant annual funding for 10 years at the appropriated level for the civilian nuclear energy research and development of the Department for fiscal year 2016.

(c) *BUDGET PLAN ALTERNATIVE 2.*—One of the budget plans submitted under subsection (a) shall be an unconstrained budget.

(d) *INCLUSIONS.*—Each alternative budget plan submitted under subsection (a) shall include—

(1) a prioritized list of the programs, projects, and activities of the Department to best support the development of advanced nuclear reactor technologies;

(2) realistic budget requirements for the Department to implement sections 955(c), 957, and 5 958; and

(3) the justification of the Department for continuing or terminating existing civilian nuclear energy research and development programs.

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[SEC. 973. CATALYSIS RESEARCH PROGRAM.]

[(a) *ESTABLISHMENT.*—The Secretary, acting through the Office of Science, shall support a program of research and development in catalysis science consistent with the statutory authorities of the Department related to research and development.

[(b) *COMPONENTS.*—The program shall include efforts to—

[(1) enable catalyst design using combinations of experimental and mechanistic methodologies coupled with computational modeling of catalytic reactions at the molecular level;

[(2) develop techniques for high throughput synthesis, assay, and characterization at nanometer and subnanometer scales in-situ under actual operating conditions;

[(3) synthesize catalysts with specific site architectures;

[(4) conduct research on the use of precious metals for catalysis; and

[(5) translate molecular understanding to the design of catalytic compounds.

[(c) DUTIES OF THE OFFICE OF SCIENCE.—In carrying out the program, the Director of the Office of Science shall—

[(1) support both individual investigators and multidisciplinary teams of investigators to pioneer new approaches in catalytic design;

[(2) develop, plan, construct, acquire, share, or operate special equipment or facilities for the use of investigators in collaboration with national user facilities, such as nanoscience and engineering centers;

[(3) support technology transfer activities to benefit industry and other users of catalysis science and engineering; and

[(4) coordinate research and development activities with industry and other Federal agencies.

[(d) ASSESSMENT.—Not later than 3 years after the date of enactment of this Act, the Secretary shall enter into an arrangement with the National Academy of Sciences to—

[(1) review the catalysis program to measure—

[(A) gains made in the fundamental science of catalysis; and

[(B) progress towards developing new fuels for energy production and material fabrication processes; and

[(2) submit to Congress a report describing the results of the review.]

SEC. 973. SOLAR FUELS RESEARCH INITIATIVE.

(a) **INITIATIVE.**—

(1) **IN GENERAL.**—*The Secretary shall carry out a research initiative, to be known as the “Solar Fuels Research Initiative” (referred to in this section as the “Initiative”) to expand theoretical and fundamental knowledge of photochemistry, electrochemistry, biochemistry, and materials science useful for the practical development of experimental systems to convert solar energy to chemical energy.*

(2) **LEVERAGING.**—*In carrying out programs and activities under the Initiative, the Secretary shall leverage expertise and resources from—*

(A) the Basic Energy Sciences Program and the Biological and Environmental Research Program of the Office of Science; and

(B) the Office of Energy Efficiency and Renewable Energy.

(3) **TEAMS.**—

(A) IN GENERAL.—In carrying out the Initiative, the Secretary shall organize activities among multidisciplinary teams to leverage, to the maximum extent practicable, expertise from the National Laboratories, institutions of higher education, and the private sector.

(B) GOALS.—The multidisciplinary teams described in subparagraph (A) shall pursue aggressive, milestone-driven, basic research goals.

(C) RESOURCES.—The Secretary shall provide sufficient resources to the multidisciplinary teams described in subparagraph (A) to achieve the goals described in subparagraph (B) over a period of time to be determined by the Secretary.

(4) *ADDITIONAL ACTIVITIES.*—*The Secretary may organize additional activities under this subsection through Energy Frontier Research Centers, Energy Innovation Hubs, or other organizational structures.*

(b) *ARTIFICIAL PHOTOSYNTHESIS.*—

(1) *IN GENERAL.*—*The Secretary shall carry out under the Initiative a program to support research needed to bridge scientific barriers to, and discover knowledge relevant to, artificial photosynthetic systems.*

(2) *ACTIVITIES.*—*As part of the program described in paragraph (1)—*

(A) *the Director of the Office of Basic Energy Sciences shall support basic research to pursue distinct lines of scientific inquiry, including—*

(i) *photoinduced production of hydrogen and oxygen from water; and*

(ii) *the sustainable photoinduced reduction of carbon dioxide to fuel products including hydrocarbons, alcohols, carbon monoxide, and natural gas; and*

(B) *the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.*

(3) *STANDARD OF REVIEW.*—*The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.*

(4) *PROHIBITION.*—*No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.*

(c) *BIOCHEMISTRY, REPLICATION OF NATURAL PHOTOSYNTHESIS, AND RELATED PROCESSES.*—

(1) *IN GENERAL.*—*The Secretary shall carry out under the Initiative a program to support research needed to replicate natural photosynthetic processes by use of artificial photosynthetic components and materials.*

(2) *ACTIVITIES.*—*As part of the program described in paragraph (1)—*

(A) *the Director of the Office of Basic Energy Sciences shall support basic research to expand fundamental knowledge to replicate natural synthesis processes, including—*

(i) *the photoinduced reduction of dinitrogen to ammonia;*

(ii) *the absorption of carbon dioxide from ambient air;*

(iii) *molecular-based charge separation and storage;*

(iv) *photoinitiated electron transfer; and*

(v) *catalysis in biological or biomimetic systems;*

(B) *the Associate Director of Biological and Environmental Research shall support systems biology and genomics approaches to understand genetic and physiological pathways connected to photosynthetic mechanisms; and*

(C) *the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, devel-*

opment, and validation of physical concepts developed under the program.

(3) *STANDARD OF REVIEW.*—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

(4) *PROHIBITION.*—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

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[SEC. 975. SOLID STATE LIGHTING.]

[The Secretary shall conduct a program of fundamental research on solid state lighting in support of the Next Generation Lighting Initiative carried out under section 912.]

SEC. 975. ELECTRICITY STORAGE RESEARCH INITIATIVE.

(a) *INITIATIVE.*—

(1) *IN GENERAL.*—The Secretary shall carry out a research initiative, to be known as the “Electricity Storage Research Initiative” (referred to in this section as the “Initiative”)—

(A) to expand theoretical and fundamental knowledge to control, store, and convert—

(i) electrical energy to chemical energy; and

(ii) chemical energy to electrical energy; and

(B) to support scientific inquiry into the practical understanding of chemical and physical processes that occur within systems involving crystalline and amorphous solids, polymers, and organic and aqueous liquids.

(2) *LEVERAGING.*—In carrying out programs and activities under the Initiative, the Secretary shall leverage expertise and resources from—

(A) the Basic Energy Sciences Program, the Advanced Scientific Computing Research Program, and the Biological and Environmental Research Program of the Office of Science; and

(B) the Office of Energy Efficiency and Renewable Energy.

(3) *TEAMS.*—

(A) *IN GENERAL.*—In carrying out the Initiative, the Secretary shall organize activities among multidisciplinary teams to leverage, to the maximum extent practicable, expertise from the National Laboratories, institutions of higher education, and the private sector.

(B) *GOALS.*—The multidisciplinary teams described in subparagraph (A) shall pursue aggressive, milestone-driven, basic research goals.

(C) *RESOURCES.*—The Secretary shall provide sufficient resources to the multidisciplinary teams described in subparagraph (A) to achieve the goals described in subparagraph (B) over a period of time to be determined by the Secretary.

(4) *ADDITIONAL ACTIVITIES.*—The Secretary may organize additional activities under this subsection through Energy Frontier Research Centers, Energy Innovation Hubs, or other organizational structures.

(b) *MULTIVALENT SYSTEMS.*—

(1) *IN GENERAL.*—The Secretary shall carry out under the Initiative a program to support research needed to bridge scientific barriers to, and discover knowledge relevant to, multivalent ion materials in electric energy storage systems.

(2) *ACTIVITIES.*—As part of the program described in paragraph (1)—

(A) the Director of the Office of Basic Energy Sciences shall investigate electrochemical properties and the dynamics of materials, including charge transfer phenomena and mass transport in materials; and

(B) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

(3) *STANDARD OF REVIEW.*—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

(4) *PROHIBITION.*—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

(c) *ELECTROCHEMISTRY MODELING AND SIMULATION.*—

(1) *IN GENERAL.*—The Secretary shall carry out under the Initiative a program to support research to model and simulate organic electrolytes, including the static and dynamic electrochemical behavior and phenomena of organic electrolytes at the molecular and atomic level in monovalent and multivalent systems.

(2) *ACTIVITIES.*—As part of the program described in paragraph (1)—

(A) the Director of the Office of Basic Energy Sciences, in coordination with the Associate Director of Advanced Scientific Computing Research, shall support the development of high performance computational tools through a joint development process to maximize the effectiveness of current and projected high performance computing systems; and

(B) the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.

(3) *STANDARD OF REVIEW.*—The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.

(4) *PROHIBITION.*—No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.

(d) *MESOSCALE ELECTROCHEMISTRY.*—

(1) *IN GENERAL.*—The Secretary shall carry out under the Initiative a program to support research needed to reveal electrochemistry in confined mesoscale spaces, including scientific discoveries relevant to—

(A) bio-electrochemistry and electrochemical energy conversion and storage in confined spaces; and

(B) the dynamics of the phenomena described in subparagraph (A).

(2) *ACTIVITIES.*—As part of the program described in paragraph (1)—

(A) *the Director of the Office of Basic Energy Sciences and the Associate Director of Biological and Environmental Research shall investigate phenomena of mesoscale electrochemical confinement for the purpose of replicating and controlling new electrochemical behavior; and*

(B) *the Assistant Secretary for Energy Efficiency and Renewable Energy shall support translational research, development, and validation of physical concepts developed under the program.*

(3) *STANDARD OF REVIEW.*—*The Secretary shall review activities carried out under the program described in paragraph (1) to determine the achievement of technical milestones.*

(4) *PROHIBITION.*—*No funds allocated to the program described in paragraph (1) may be obligated or expended for commercial application of energy technology.*

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SEC. 981. [RARE ISOTOPE ACCELERATOR.] FACILITY FOR RARE ISOTOPE BEAMS.

(a) *ESTABLISHMENT.*—The Secretary shall construct and operate a [Rare Isotope Accelerator] *Facility for Rare Isotope Beams*. The Secretary shall commence construction no later than September 30, 2008.

(b) *AUTHORIZATION OF APPROPRIATIONS.*—There are authorized to be appropriated to the Secretary such sums as may be necessary to carry out this section. The Secretary shall not spend more than \$1,100,000,000 in Federal funds for all activities associated with the [Rare Isotope Accelerator] *Facility for Rare Isotope Beams*, prior to operation of the Accelerator.

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SEC. 988. COST SHARING.

(a) *APPLICABILITY.*—Notwithstanding any other provision of law, in carrying out a research, development, demonstration, or commercial application program or activity that is initiated after the date of enactment of this section, the Secretary shall require cost-sharing in accordance with this section.

(b) *RESEARCH AND DEVELOPMENT.*—

(1) *IN GENERAL.*—[Except as provided in paragraphs (2) and (3)] *Except as provided in paragraphs (2), (3), and (4) and subsection (f), the Secretary shall require not less than 20 percent of the cost of a research or development activity described in subsection (a) to be provided by a non-Federal source.*

(2) *EXCLUSION.*—Paragraph (1) shall not apply to a research or development activity described in subsection (a) that is of a basic or fundamental nature, as determined by the appropriate officer of the Department.

(3) *REDUCTION.*—The Secretary may reduce or eliminate the requirement of paragraph (1) for a research and development activity of an applied nature if the Secretary determines that the reduction is necessary and appropriate.

(4) *EXEMPTION FOR INSTITUTIONS OF HIGHER EDUCATION AND OTHER NONPROFIT INSTITUTIONS.*—

(A) *IN GENERAL.*—Paragraph (1) shall not apply to a research or development activity performed by an institution of higher education or nonprofit institution (as defined in section 4 of the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3703)).

(B) *TERMINATION DATE.*—The exemption under subparagraph (A) shall apply during the 2-year period beginning on the date of enactment of this paragraph.

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SEC. 993. [STRATEGY AND PLAN FOR SCIENCE AND ENERGY FACILITIES AND INFRASTRUCTURE.] STRATEGY FOR FACILITIES AND INFRASTRUCTURE.

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(b) *REPORT.*—(1) *IN GENERAL.*—The Secretary shall prepare and submit, along with the budget request of the President submitted to Congress for fiscal year **[2008]** 2018, a report describing the strategy developed under subsection (a).

(2) *CONTENTS.*—For each National Laboratory and single-purpose research facility that is primarily used for science and energy research, the report shall contain—

(A) the current priority list of proposed facilities and infrastructure projects, including cost and schedule requirements;

(B) a current 10-year plan that demonstrates the reconfiguration of its facilities and infrastructure to meet its missions and to address its long-term operational costs and return on investment;

(C) the total current budget for all facilities and infrastructure funding; and

(D) the current status of each facility and infrastructure project compared to the original baseline cost, schedule, and scope.

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[SEC. 994. STRATEGIC RESEARCH PORTFOLIO ANALYSIS AND COORDINATION PLAN.]

[(a) IN GENERAL.—The Secretary shall periodically review all of the science and technology activities of the Department in a strategic framework that takes into account both the frontiers of science to which the Department can contribute and the national needs relevant to the Department’s statutory missions.

[(b) COORDINATION ANALYSIS AND PLAN.—As part of the review under subsection (a), the Secretary shall develop a coordination plan to improve coordination and collaboration in research, development, demonstration, and commercial application activities across Department organizational boundaries.

[(c) PLAN CONTENTS.—The plan shall describe—

[(1) cross-cutting scientific and technical issues and research questions that span more than one program or major office of the Department;

[(2) how the applied technology programs of the Department are coordinating their activities, and addressing those questions;

[(3) ways in which the technical interchange within the Department, particularly between the Office of Science and the

applied technology programs, can be enhanced, including ways in which the research agendas of the Office of Science and the applied programs can interact and assist each other;

[(4) a description of how the Secretary will ensure that the Department's overall research agenda include, in addition to fundamental, curiosity-driven research, fundamental research related to topics of concern to the applied programs, and applications in Departmental technology programs of research results generated by fundamental, curiosity-driven research.

[(d) PLAN TRANSMITTAL.—Not later than 12 months after the date of enactment of this Act, and every 4 years thereafter, the Secretary shall transmit to Congress the results of the review under subsection (a) and the coordination plan under subsection (b).]

SEC. 994. STRATEGIC RESEARCH PORTFOLIO ANALYSIS AND COORDINATION PLAN.

(a) *IN GENERAL.*—The Secretary shall periodically review all of the science and technology activities of the Department in a strategic framework that takes into account—

(1) the frontiers of science to which the Department can contribute;

(2) the national needs relevant to the statutory missions of the Department; and

(3) global energy dynamics.

(b) *COORDINATION ANALYSIS AND PLAN.*—

(1) *IN GENERAL.*—As part of the review under subsection (a), the Secretary shall develop a plan to improve coordination and collaboration in research, development, demonstration, and commercial application activities across organizational boundaries of the Department.

(2) *PLAN CONTENTS.*—The plan developed under paragraph (1) shall describe—

(A) crosscutting scientific and technical issues and research questions that span more than one program or major office of the Department;

(B) ways in which the applied technology programs of the Department are coordinating activities and addressing the questions referred to in subparagraph (A);

(C) ways in which the technical interchange within the Department, particularly between the Office of Science and the applied technology programs, could be enhanced, including ways in which the research agendas of the Office of Science and the applied programs could better interact and assist each other;

(D) ways in which the Secretary would ensure that the overall research agenda of the Department includes, in addition to fundamental, curiosity-driven research, fundamental research related to topics of concern to the applied programs, and applications in Departmental technology programs of research results generated by fundamental, curiosity-driven research;

(E) critical assessments of any ongoing programs that have experienced subpar performance or cost overruns of 10 percent or more over 1 or more years;

(F) any activities that may be more effectively left to the States, industry, nongovernmental organizations, institutions of higher education, or other stakeholders; and

(G) detailed evaluations and proposals for innovation hubs, institutes, and research centers of the Department, including—

(i) an affirmation that the hubs, institutes, and research centers will—

(I) advance the mission of the Department; and

(II) prioritize research, development, and demonstration; and

(ii) an affirmation that any hubs, institutes, or research centers that are established or renewed within the Office of Science are consistent with the mission of the Office of Science described in subsection (c) of section 209 of the Department of Energy Organization Act (42 U.S.C. 7139).

(c) *SUBMISSION TO CONGRESS.*—Every 4 years, the Secretary shall submit to Congress—

(1) the results of the review under subsection (a); and

(2) the coordination plan under subsection (b).

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SEC. 1001. IMPROVED TECHNOLOGY TRANSFER OF ENERGY TECHNOLOGIES.

(a) **TECHNOLOGY TRANSFER COORDINATOR.**—The Secretary shall appoint a Technology Transfer Coordinator to be the principal advisor to the Secretary on all matters relating to technology transfer and commercialization.

(b) **QUALIFICATIONS.**—The Coordinator shall be an individual who, by reason of professional background and experience, is specially qualified to advise the Secretary on matters pertaining to technology transfer at the Department.

(c) **DUTIES OF THE COORDINATOR.**—The Coordinator shall oversee—

(1) the activities of the Technology Transfer Working Group established under subsection (d);

(2) the expenditure of funds allocated for technology transfer within the Department;

(3) the activities of each technology partnership ombudsman appointed under section 11 of the Technology Transfer Commercialization Act of 2000 (42 U.S.C. 7261c); and

(4) efforts to engage private sector entities, including venture capital companies.

(d) **TECHNOLOGY TRANSFER WORKING GROUP.**—The Secretary shall establish a Technology Transfer Working Group, which shall consist of representatives of the National Laboratories and single-purpose research facilities, to—

(1) coordinate technology transfer activities occurring at National Laboratories and single-purpose research facilities;

(2) exchange information about technology transfer practices, including alternative approaches to resolution of disputes involving intellectual property rights and other technology transfer matters; and

(3) develop and disseminate to the public and prospective technology partners information about opportunities and procedures for technology transfer with the Department, including opportunities and procedures related to alternative approaches to resolution of disputes involving intellectual property rights and other technology transfer matters.

(e) **TECHNOLOGY COMMERCIALIZATION FUND.**—The Secretary shall establish an Energy Technology Commercialization Fund, using 0.9 percent of the amount made available to the Department for applied energy research, development, demonstration, and commercial application for each fiscal year, to be used to provide matching funds with private partners to promote promising energy technologies for commercial purposes.

(f) **TECHNOLOGY TRANSFER RESPONSIBILITY.**—Nothing in this section affects the technology transfer responsibilities of Federal employees under the Stevenson-Wydler Technology Innovation Act of 1980 (15 U.S.C. 3701 et seq.).

(g) *EARLY STAGE TECHNOLOGY DEMONSTRATION.*—*The Secretary shall permit the directors of the National Laboratories to use funds authorized to support technology transfer within the Department to carry out early stage and precommercial technology demonstration activities to remove technology barriers that limit private sector interest and demonstrate potential commercial applications of any research and technologies arising from National Laboratory activities.*

[(g)] (h) **PLANNING AND REPORTING.**—

(1) **IN GENERAL.**—Not later than 180 days after the date of enactment of this Act, the Secretary shall submit to Congress a technology transfer execution plan.

(2) **UPDATES.**—Each year after the submission of the plan under paragraph (1), the Secretary shall submit to Congress an updated execution plan and reports that describe progress toward meeting goals set forth in the execution plan and the funds expended under subsection (e).