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NUCLEAR ENERGY INNOVATION AND CAPABILITIES ACT OF 2017

JUNE 21, 2017.—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. 97]

[Including cost estimate of the Congressional Budget Office]

The Committee on Energy and Natural Resources, to which was referred the bill (S. 97) to enable civilian research and development of advanced nuclear energy technologies by private and public institutions, to expand theoretical and practical knowledge of nuclear physics, chemistry, and materials science, 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. 97 is to enable civilian research and development of advanced nuclear energy technologies by private and public institutions, to expand theoretical and practical knowledge of nuclear physics, chemistry, and materials science.

BACKGROUND AND NEED

Civil nuclear power today relies on light-water reactor technology that was originally developed in the 1950s for use in U.S. Navy submarines. Although there was ample experience in designing, constructing, and operating these light-water reactors, by the 1960s scientists were exploring advanced non-light-water reactor designs that have potential advantages over light-water reactors in proliferation resistance, thermal efficiency, reliability, fuel utilization, nuclear waste yields, inherent safety features, and non-commercial applications. Between 1951 and 1974, the U.S. Atomic Energy

Commission (AEC) experimented on light-water and advanced non-light-water nuclear reactors, taking over 52 different reactors from paper concept to demonstration at the AEC's National Reactor Testing Station, which is now the Idaho National Laboratory.

Due to the economic challenges that face large light-water reactors, there has been a renewed interest in advanced non-light-water reactors from the commercial sector. Venture capital has flowed into 60 companies in North America working on developing advanced reactors of various sizes that are non-light-water fission reactors or fusion reactors.

The Department of Energy (DOE) has unique authorities under the Atomic Energy Act. The DOE is responsible for maintaining nuclear research capabilities, knowledge, and a skilled workforce through support of nuclear research and development activities. Additionally, DOE has the authority to site and regulate research reactors without having to obtain a license from the Nuclear Regulatory Commission (NRC), if the reactor is constructed and operated "under contract with and for the account of the" Department of Energy (42 U.S.C. 2140(b)).

S. 97 seeks to capitalize on these authorities to promote public-private partnerships to research, develop, demonstrate, and deploy advance reactor concepts. S.97 would establish the National Reactor Innovation Center (NRIC) to facilitate the siting of advanced reactor research demonstration facilities through partnerships between DOE and private industry.

LEGISLATIVE HISTORY

Senators Crapo, Booker, Hatch, Murkowski, Risch, and Whitehouse introduced S. 97 on January 11, 2017.

On January 11, 2017, Representative Weber and 14 cosponsors introduced a similar measure, H.R. 431, in the House of Representatives.

On January 20, 2017, Representative Lamar Smith and 15 cosponsors introduced a similar bill, 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.

In the 114th Congress, Senators Crapo, Booker, Hatch, Risch, and Whitehouse introduced a similar bill, S. 2461, on January 21, 2016.

The measure was included in Amendment No. 3021, which the Senate agreed to on January 28, 2016, as an amendment to S. 2012, the Energy Policy Modernization Act of 2016, which the Senate passed, as amended, on April 20, 2016.

Representative Weber and 20 cosponsors introduced a similar bill, H.R. 4084, in the House of Representatives on November 19, 2015. On February 29, 2016, the House passed H.R. 4084 by a voice vote.

The Committee on Energy and Natural Resources met in an open business session on March 30, 2017, and ordered S. 97 favorably reported.

COMMITTEE RECOMMENDATION

The Senate Committee on Energy and Natural Resources, in open business session on March 30, 2017, by majority voice vote of a quorum present, recommends that the Senate pass S. 97.

SECTION-BY-SECTION ANALYSIS

Section 1. Short title

Section 1 sets forth a short title.

Section 2. Nuclear energy innovation capabilities

Section 2(a) amends section 951 of the Energy Policy Act of 2005 (EPAcT, 42 U.S.C. 16271) to refocus 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) defines relevant terms.

Subsection (b) deletes the Nuclear Power 2010 program authorization from Section 952(c) of EPAcT (42 U.S.C. 16272(c)) 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 EPAcT (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 EPAcT (42 U.S.C. 16274(d)(4)) and inserts "that emphasize."

Subsection (e) amends section 955 of EPAcT (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) regarding versatile neutron source. 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. The Secretary is further directed to submit a detailed plan to Congress to establish the user facility that would provide fast neutron irradiation capabilities, have the capacity for upgrades, 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. The plan must include a goal for the completion of construction and the commencement of operations 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 957 of the EPAcT (42 U.S.C. 16277).

Subsection (g) amends section 957 of EPAcT (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 EAct (42 U.S.C. 16271 et seq.) to add a new section 958, to authorize the NRIC. The program is broadly authorized to support research, development, demonstration, and deployment of a broad range of advanced reactor concepts, components, 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 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 EAct (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) directs the Secretary to submit a report to the relevant committees of Congress on innovative fusion energy systems, including the identification of necessary budgetary requirements, within 180 days of the Act's enactment.

Subsection (k) makes conforming changes to the table of contents of Subtitle E of Title IX of EAct (42 U.S.C. 16271).

Section 3. Advanced Nuclear Energy Licensing Cost-Share Grant Program

Section 3 establishes the Advanced Nuclear Energy Cost-Share Grant Program to provide, subject to appropriations, competitive cost-share grants to applicants for the purpose of funding a portion of the NRC fees for pre-application and application review activities.

Subsection (d) requires the Secretary to determine the cost-share amount of each grant.

Subsection (f) authorizes such sums as are necessary to carry out the program.

COST AND BUDGETARY CONSIDERATIONS

The following estimate of the costs of this measure has been provided by the Congressional Budget Office:

S. 97 would amend the objectives of Department of Energy (DOE) programs related to the research, development, demonstration, and commercial application of advanced nuclear technologies.

Based on an analysis of information from DOE and the NRC, CBO estimates that implementing the bill would cost \$340 million over the 2018–2022 period, assuming appropriation of the necessary amounts.

In addition, enacting the bill could affect direct spending by the Tennessee Valley Authority (TVA) to the extent that that agency might participate in activities authorized under the bill. CBO estimates, however, that any such changes in that agency’s net outlays would be negligible. Because S. 97 could affect direct spending, pay-as-you-go procedures apply. Enacting the bill would not affect or revenues.

CBO estimates that enacting S. 97 would not increase net direct spending or on-budget deficits in any of the four consecutive 10-year periods beginning in 2028.

S. 97 contains no intergovernmental or private-sector mandates as defined in the Unfunded Mandates Reform Act (UMRA) and would impose no costs on state, local, or tribal governments.

Estimated cost to the Federal Government: The estimated budgetary effect of S.97 is shown in the following table. The costs of this legislation fall within budget function 270 (energy).

	By fiscal year, in millions of dollars—						
	2017	2018	2019	2020	2021	2022	2017–2022
INCREASES IN SPENDING SUBJECT TO APPROPRIATION							
Estimated Authorization Level	0	87	88	90	92	93	450
Estimated Outlays	0	26	53	80	90	91	340

Basis of estimate: For this estimate, CBO assumes that S. 97 will be enacted near the start of fiscal year 2018 and that the estimated amounts will be appropriated each year. Estimated outlays are based on historical spending patterns for the affected activities.

S. 97 would authorize DOE to support the research and development of advanced reactor technologies and to provide grants to nonfederal developers of such technologies; those grants would cover a portion of the fees charged by the Nuclear Regulatory Commission (NRC) for certain costs related to licensing such technologies. In carrying out those activities, S. 97 would require DOE to collaborate with the national laboratories, other federal agencies, universities, and private firms. The bill would direct DOE to determine the need for a new test reactor to support research and development of advanced reactor systems and, if needed, direct the agency to construct such a facility by 2025. Finally S. 97 would authorize the agency to expand capabilities in the area of high-performance computation modeling and simulation techniques.

Under current law, DOE is already pursuing a variety of activities to expedite the development and commercial deployment of advanced nuclear technologies. Based on an analysis of information from the agency about the anticipated costs of those activities, CBO estimates that implementing the new activities under S. 97 would require appropriations totaling \$450 million over the 2018–2022 period. That estimate is in line with the total amount of funding provided by the Congress for a previous six-year effort, now largely completed, to support the development, certification, and licensing of small modular reactors (another type of advanced nuclear technology). Assuming appropriation of the estimated amounts, CBO

estimates that outlays would total \$340 million over the 2018–2022 period and \$110 million after 2022.

This estimate does not include any costs related to constructing either a test reactor or an advanced nuclear reactor, which CBO estimates would total billions of dollars. In general, CBO expects that any federal spending related to such projects would be limited to a portion of the construction costs. Private firms would likely bear a significant portion of the construction costs and any spending by DOE for such a project would be subject to appropriation. Based on information from DOE, NRC, and the nuclear industry about anticipated timeframes for developing underlying technologies and licensing advanced reactors, CBO expects that any spending to construct such facilities would be negligible over the 2018–2022 period covered by this estimate. Furthermore, based on an analysis of information from DOE, including reports issued by committees that advise the agency on issues related to nuclear energy, CBO expects the agency is unlikely to build a federally owned test reactor under current law.

Pay-As-You-Go considerations: CBO estimates that enacting S. 97 could affect direct spending by TVA, which owns nuclear assets and frequently participates in industry-led efforts to develop nuclear technologies. By law, TVA sells electricity at prices sufficient to recover any costs over the useful life of the investment or program. Based on an analysis of information from TVA, CBO expects that any spending for the advanced nuclear technology projects over 2018–2027 period would primarily be for research and development activities, which are treated as operating expenses and recovered quickly in TVA’s rates. Thus, CBO estimates that the net effect on TVA’s direct spending would be negligible over that period.

Increase in long-term direct spending and deficits: CBO estimates that enacting S. 97 would not increase net direct spending or on-budget deficits in any of the four consecutive 10-year periods beginning in 2028.

Intergovernmental and private-sector impact: S. 97 contains no intergovernmental or private-sector mandates as defined in UMRA and would impose no costs on state, local, or tribal governments.

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 S. 97.

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 the enactment of S. 97, as ordered reported.

CONGRESSIONALLY DIRECTED SPENDING

S. 97, 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 were not requested by the Committee on Energy and Natural Resources in 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 original 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):

THE ENERGY POLICY ACT OF 2005

Public Law 109–58

* * * * *

SEC. 1. SHORT TITLE; TABLE OF CONTENTS.

(a) **SHORT TITLE.**—This Act may be cited as the “Energy Policy Act of 2005”.

(b) **TABLE OF CONTENTS.**—The table of contents for this Act is as follows:

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TITLE IX—RESEARCH AND DEVELOPMENT

* * * * *

Subtitle E—Nuclear Energy

* * * * *

Sec. 957 **[Alternatives to industrial radioactive sources.]** *High-performance computation and supportive research.*

958. *Enabling nuclear energy innovation.*

959. *Budget plan.*

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Subtitle VI—Nuclear Matters

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Subtitle C—Next Generation Nuclear Plant Project**SEC. 641. PROJECT ESTABLISHMENT.**

(a) **ESTABLISHMENT.**—The Secretary shall establish a project to be known as the “Next Generation Nuclear Plant Project” (referred to in this subtitle as the “Project”).

(b) CONTENT.—The Project shall consist of the research, development, design, construction, and operation of a prototype plant, including a nuclear reactor that—

(1) is based on research and development activities supported by the Generation IV Nuclear Energy Systems Initiative under [section 942(d)] *section 952(c)*; and

(2) shall be used—

(A) to generate electricity;

(B) to produce hydrogen; or

(C) both to generate electricity and to produce hydrogen.

* * * * *

Subtitle E—Nuclear Energy

[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.

(b) **ANNUAL REVIEW.**—The program shall be subject to annual review by the Nuclear Energy Research Advisory Committee of the Department or other independent entity, as appropriate.

(c) **INTERNATIONAL COOPERATION.**—In carrying out the program, the Secretary is encouraged to seek opportunities to enhance the progress of the program through international cooperation.

(d) **REPORTS.**—The Secretary shall submit, as part of the annual budget submission of the Department, a report on the activities of the program.

SEC. 954. UNIVERSITY NUCLEAR SCIENCE AND ENGINEERING SUPPORT.

(a) **IN GENERAL.**—The Secretary shall conduct a program to invest in human resources and infrastructure in the nuclear sciences and related fields, including health physics, nuclear engineering, and radiochemistry, consistent with missions of the Department related to civilian nuclear research, development, demonstration, and commercial application.

(b) **REQUIREMENTS.**—In carrying out the program under this section, the Secretary shall—

(1) conduct a graduate and undergraduate fellowship program to attract new and talented students, which may include fellowships for students to spend time at National Laboratories in the areas of nuclear science, engineering, and health physics with a member of the National Laboratory staff acting as a mentor;

(2) conduct a junior faculty research initiation grant program to assist universities in recruiting and retaining new faculty in the nuclear sciences and engineering by awarding grants to junior faculty for research on issues related to nuclear energy engineering and science;

(3) support fundamental nuclear sciences, engineering, and health physics research through a nuclear engineering education and research program;

(4) encourage collaborative nuclear research among industry, National Laboratories, and universities; and

(5) support communication and outreach related to nuclear science, engineering, and health physics.

(c) UNIVERSITY NATIONAL LABORATORY INTERACTIONS.—The Secretary shall conduct—

(1) a fellowship program for professors at universities to spend sabbaticals at National Laboratories in the areas of nuclear science and technology; and

(2) a visiting scientist program in which National Laboratory staff can spend time in academic nuclear science and engineering departments.

(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.

(e) OPERATIONS AND MAINTENANCE.—Funding for a project provided under this section may be used for a portion of the operating and maintenance costs of a research reactor at a university used in the project.

(f) DEFINITION.—In this section, the term “junior faculty” means a faculty member who was awarded a doctorate less than 10 years before receipt of an award from the grant program described in subsection (b)(2).

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 Department, 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 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 de-*

fined 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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