

114TH CONGRESS  
2D SESSION

# S. 2461

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.

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## IN THE SENATE OF THE UNITED STATES

JANUARY 21, 2016

Mr. CRAPO (for himself, Mr. WHITEHOUSE, Mr. RISCH, Mr. BOOKER, and Mr. HATCH) introduced the following bill; which was read twice and referred to the Committee on Energy and Natural Resources

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## A BILL

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.

1 *Be it enacted by the Senate and House of Representa-*  
2 *tives of the United States of America in Congress assembled,*

3 **SECTION 1. SHORT TITLE.**

4 This Act may be cited as the “Nuclear Energy Inno-  
5 vation Capabilities Act”.

6 **SEC. 2. DEFINITIONS.**

7 In this Act:

1           (1) ADVANCED FISSION REACTOR.—The term  
2           “advanced fission reactor” means a nuclear fission  
3           reactor with significant improvements over the most  
4           recent generation of nuclear reactors, including im-  
5           provements such as—

6                   (A) inherent safety features;

7                   (B) lower waste yields;

8                   (C) greater fuel utilization;

9                   (D) superior reliability;

10                  (E) resistance to proliferation;

11                  (F) increased thermal efficiency; and

12                  (G) ability to integrate into electric and  
13           nonelectric applications.

14           (2) DEPARTMENT.—The term “Department”  
15           means the Department of Energy.

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

19           (4) NATIONAL LABORATORY.—

20                   (A) IN GENERAL.—Except as provided in  
21           subparagraph (B), the term “National Labora-  
22           tory” has the meaning given the term in section  
23           2 of the Energy Policy Act of 2005 (42 U.S.C.  
24           15801).

1 (B) LIMITATION.—With respect to the  
2 Lawrence Livermore National Laboratory, the  
3 Los Alamos National Laboratory, and the  
4 Sandia National Laboratories, the term “Na-  
5 tional Laboratory” means only the civilian ac-  
6 tivities of the laboratory.

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

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

13 (A) research on materials sciences and nu-  
14 clear physics; and

15 (B) testing of advanced materials, nuclear  
16 fuels, and other related components for reactor  
17 systems.

18 (7) SECRETARY.—The term “Secretary” means  
19 the Secretary of Energy.

20 **SEC. 3. MISSION.**

21 Section 951 of the Energy Policy Act of 2005 (42  
22 U.S.C. 16271) is amended by striking subsection (a) and  
23 inserting the following:

24 “(a) IN GENERAL.—The Secretary shall conduct pro-  
25 grams of civilian nuclear research, development, dem-

1 onstration, and commercial application, including activi-  
2 ties described in this subtitle, that take into consideration  
3 the following objectives:

4 “(1) Providing research infrastructure—

5 “(A) to promote scientific progress; and

6 “(B) to enable users from academia, the  
7 National Laboratories, and the private sector to  
8 make scientific discoveries relevant for nuclear,  
9 chemical, and materials science engineering.

10 “(2) Maintaining nuclear energy research and  
11 development programs at the National Laboratories  
12 and institutions of higher education, including pro-  
13 grams of infrastructure of National Laboratories  
14 and institutions of higher education.

15 “(3) Providing the technical means to reduce  
16 the likelihood of nuclear weapons proliferation.

17 “(4) Ensuring public safety.

18 “(5) Reducing the environmental impact of nu-  
19 clear energy-related activities.

20 “(6) Supporting technology transfer from the  
21 National Laboratories to the private sector.

22 “(7) Enabling the private sector to partner with  
23 the National Laboratories to demonstrate novel reac-  
24 tor concepts for the purpose of resolving technical

1       uncertainty associated with the objectives described  
2       in this subsection.”.

3 **SEC. 4. SENSE OF CONGRESS.**

4       It is the sense of Congress that—

5           (1) nuclear energy, through fission or fusion,  
6       represents the highest energy density of any known  
7       attainable source and yields low air emissions;

8           (2) nuclear energy is of national importance to  
9       scientific progress, national security, electricity gen-  
10      eration, heat generation for industrial applications,  
11      and space exploration; and

12          (3) considering the inherent complexity and  
13      regulatory burden associated with nuclear energy,  
14      the Department should focus civilian nuclear re-  
15      search and development activities of the Department  
16      on programs that enable the private sector, National  
17      Laboratories, and institutions of higher education to  
18      carry out experiments to promote scientific progress  
19      and enhance practical knowledge of nuclear engi-  
20      neering.

21 **SEC. 5. HIGH-PERFORMANCE COMPUTATION AND SUP-**  
22 **PORTIVE RESEARCH.**

23      (a) MODELING AND SIMULATION PROGRAM.—

24           (1) IN GENERAL.—The Secretary shall carry  
25      out a program to enhance the capabilities of the

1 United States to develop new reactor technologies  
2 and related systems technologies through high-per-  
3 formance computation modeling and simulation tech-  
4 niques (referred to in this subsection as the “pro-  
5 gram”).

6 (2) COORDINATION REQUIRED.—In carrying  
7 out the program, the Secretary shall coordinate with  
8 relevant Federal agencies through the National Stra-  
9 tegic Computing Initiative established by Executive  
10 Order 13702 (80 Fed. Reg. 46177) (July 29, 2015).

11 (3) OBJECTIVES.—In carrying out the program,  
12 the Secretary shall take into consideration the fol-  
13 lowing objectives:

14 (A) Using expertise from the private sec-  
15 tor, institutions of higher education, and Na-  
16 tional Laboratories to develop computational  
17 software and capabilities that prospective users  
18 may access to accelerate research and develop-  
19 ment of advanced fission reactor systems, nu-  
20 clear fusion systems, and reactor systems for  
21 space exploration.

22 (B) Developing computational tools to sim-  
23 ulate and predict nuclear phenomena that may  
24 be validated through physical experimentation.

1 (C) Increasing the utility of the research  
2 infrastructure of the Department by coordi-  
3 nating with the Advanced Scientific Computing  
4 Research program of the Office of Science.

5 (D) Leveraging experience from the En-  
6 ergy Innovation Hub for Modeling and Simula-  
7 tion.

8 (E) Ensuring that new experimental and  
9 computational tools are accessible to relevant  
10 research communities, including private compa-  
11 nies engaged in nuclear energy technology de-  
12 velopment.

13 (b) SUPPORTIVE RESEARCH ACTIVITIES.—The Sec-  
14 retary shall consider support for additional research activi-  
15 ties to maximize the utility of the research facilities of the  
16 Department, including research—

17 (1) on physical processes to simulate degrada-  
18 tion of materials and behavior of fuel forms; and

19 (2) for validation of computational tools.

20 **SEC. 6. VERSATILE NEUTRON SOURCE.**

21 (a) DETERMINATION OF MISSION NEED.—

22 (1) IN GENERAL.—Not later than December 31,  
23 2016, the Secretary shall determine the mission  
24 need for a versatile reactor-based fast neutron

1 source, which shall operate as a national user facility  
2 (referred to in this section as the “user facility”).

3 (2) CONSULTATION REQUIRED.—In carrying  
4 out paragraph (1), the Secretary shall consult with  
5 the private sector, institutions of higher education,  
6 the National Laboratories, and relevant Federal  
7 agencies to ensure that the user facility will meet the  
8 research needs of the largest possible majority of  
9 prospective users.

10 (b) PLAN FOR ESTABLISHMENT.—On the determina-  
11 tion of the mission need under subsection (a), the Sec-  
12 retary, as expeditiously as practicable, shall submit to the  
13 Committee on Energy and Natural Resources of the Sen-  
14 ate and the Committee on Science, Space, and Technology  
15 of the House of Representatives a detailed plan for the  
16 establishment of the user facility (referred to in this sec-  
17 tion as the “plan”).

18 (c) DEADLINE FOR ESTABLISHMENT.—The Sec-  
19 retary shall make every effort to complete construction of,  
20 and approve the start of operations for, the user facility  
21 by December 31, 2025.

22 (d) FACILITY REQUIREMENTS.—

23 (1) CAPABILITIES.—The Secretary shall ensure  
24 that the user facility shall provide, at a minimum—

1 (A) fast neutron spectrum irradiation ca-  
2 pability; and

3 (B) capacity for upgrades to accommodate  
4 new or expanded research needs.

5 (2) CONSIDERATIONS.—In carrying out the  
6 plan, the Secretary shall consider—

7 (A) capabilities that support experimental  
8 high-temperature testing;

9 (B) providing a source of fast neutrons—

10 (i) at a neutron flux that is higher  
11 than the neutron flux at which research fa-  
12 cilities operate before establishment of the  
13 user facility; and

14 (ii) sufficient to enable research for  
15 an optimal base of prospective users;

16 (C) maximizing irradiation flexibility and  
17 irradiation volume to accommodate as many  
18 concurrent users as possible;

19 (D) capabilities for irradiation with neu-  
20 trons of a lower energy spectrum;

21 (E) multiple loops for fuels and materials  
22 testing in different coolants; and

23 (F) additional pre-irradiation and post-ir-  
24 radiation examination capabilities.

1 (e) COORDINATION.—In carrying out this section, the  
2 Secretary shall leverage the best practices of the Office  
3 of Science for the management, construction, and oper-  
4 ation of national user facilities.

5 (f) REPORT.—The Secretary shall include in the an-  
6 nual budget request of the Department an explanation for  
7 any delay in carrying out this section.

8 **SEC. 7. ENABLING NUCLEAR ENERGY INNOVATION.**

9 (a) ESTABLISHMENT OF NATIONAL NUCLEAR INNO-  
10 VATION CENTER.—The Secretary may enter into a memo-  
11 randum of understanding with the Chairman of the Nu-  
12 clear Regulatory Commission to establish a center to be  
13 known as the “National Nuclear Innovation Center” (re-  
14 ferred to in this section as the “Center”)—

15 (1) to enable the testing and demonstration of  
16 reactor concepts to be proposed and funded, in whole  
17 or in part, by the private sector;

18 (2) to establish and operate a database to store  
19 and share data and knowledge on nuclear science be-  
20 tween Federal agencies and private industry; and

21 (3) to establish capabilities to develop and test  
22 reactor electric and nonelectric integration and en-  
23 ergy conversion systems.

24 (b) ROLE OF NRC.—In operating the Center, the  
25 Secretary shall—

1           (1) consult with the Nuclear Regulatory Com-  
2 mission on safety issues; and

3           (2) permit staff of the Nuclear Regulatory  
4 Commission to actively observe and learn about the  
5 technology being developed at the Center.

6       (c) OBJECTIVES.—A reactor developed under sub-  
7 section (a)(1) shall have the following objectives:

8           (1) Enabling physical validation of fusion and  
9 advanced fission experimental reactors at the Na-  
10 tional Laboratories or other facilities of the Depart-  
11 ment.

12          (2) Resolving technical uncertainty and increase  
13 practical knowledge relevant to safety, resilience, se-  
14 curity, and functionality of novel reactor concepts.

15          (3) Conducting general research and develop-  
16 ment to improve novel reactor technologies.

17       (d) USE OF TECHNICAL EXPERTISE.—In operating  
18 the Center, the Secretary shall leverage the technical ex-  
19 pertise of relevant Federal agencies and National Labora-  
20 tories—

21           (1) to minimize the time required to carry out  
22 subsection (c); and

23           (2) to ensure reasonable safety for individuals  
24 working at the National Laboratories or other facili-  
25 ties of the Department to carry out that subsection.

1 (e) REPORTING REQUIREMENT.—

2 (1) IN GENERAL.—Not later than 180 days  
3 after the date of enactment of this Act, the Sec-  
4 retary, in consultation with the National Labora-  
5 tories, relevant Federal agencies, and other stake-  
6 holders, shall submit to the Committee on Energy  
7 and Natural Resources and the Committee on Envi-  
8 ronment and Public Works of the Senate and the  
9 Committee on Science, Space, and Technology and  
10 the Committee on Energy and Commerce of the  
11 House of Representatives a report assessing the ca-  
12 pabilities of the Department to authorize, host, and  
13 oversee privately proposed and funded reactors (as  
14 described in subsection (a)(1)).

15 (2) CONTENTS.—The report shall address—

16 (A) the safety review and oversight capa-  
17 bilities of the Department, including options to  
18 leverage expertise from the Nuclear Regulatory  
19 Commission and the National Laboratories;

20 (B) potential sites capable of hosting the  
21 activities described in subsection (a);

22 (C) the efficacy of the available contractual  
23 mechanisms of the Department to partner with  
24 the private sector and other Federal agencies,  
25 including cooperative research and development

1 agreements, strategic partnership projects, and  
2 agreements for commercializing technology;

3 (D) how the Federal Government and the  
4 private sector will address potential intellectual  
5 property concerns;

6 (E) potential cost structures relating to  
7 physical security, decommissioning, liability,  
8 and other long-term project costs; and

9 (F) other challenges or considerations  
10 identified by the Secretary.

11 **SEC. 8. BUDGET PLAN.**

12 (a) IN GENERAL.—Not later than 1 year after the  
13 date of enactment of this Act, the Secretary shall submit  
14 to the Committee on Energy and Natural Resources of  
15 the Senate and the Committee on Science, Space, and  
16 Technology of the House of Representatives 3 alternative  
17 10-year budget plans for civilian nuclear energy research  
18 and development by the Department in accordance with  
19 subsection (b).

20 (b) DESCRIPTION OF PLANS.—

21 (1) IN GENERAL.—The 3 alternative 10-year  
22 budget plans submitted under subsection (a) shall be  
23 the following:

24 (A) A plan that assumes constant annual  
25 funding at the level of appropriations for fiscal

1 year 2016 for the civilian nuclear energy re-  
2 search and development of the Department,  
3 particularly for programs critical to advanced  
4 nuclear projects and development.

5 (B) A plan that assumes 2 percent annual  
6 increases to the level of appropriations de-  
7 scribed in subparagraph (A).

8 (C) A plan that uses an unconstrained  
9 budget.

10 (2) INCLUSIONS.—Each plan shall include—

11 (A) a prioritized list of the programs,  
12 projects, and activities of the Department that  
13 best support the development, licensing, and de-  
14 ployment of advanced nuclear energy tech-  
15 nologies;

16 (B) realistic budget requirements for the  
17 Department to carry out sections 5, 6, and 7;  
18 and

19 (C) the justification of the Department for  
20 continuing or terminating existing civilian nu-  
21 clear energy research and development pro-  
22 grams.

23 **SEC. 9. NUCLEAR REGULATORY COMMISSION REPORT.**

24 Not later than December 31, 2016, the Chairman of  
25 the Nuclear Regulatory Commission shall submit to the

1 Committee on Energy and Natural Resources and the  
2 Committee on Environment and Public Works of the Sen-  
3 ate and the Committee on Science, Space, and Technology  
4 and the Committee on Energy and Commerce of the  
5 House of Representatives a report describing—

6           (1) the extent to which the Nuclear Regulatory  
7 Commission is capable of licensing advanced reactor  
8 designs that are developed pursuant to this Act by  
9 the end of the 4-year period beginning on the date  
10 on which an application is received under part 50 or  
11 52 of title 10, Code of Federal Regulations (or suc-  
12 cessor regulations); and

13           (2) any organizational or institutional barriers  
14 the Nuclear Regulatory Commission will need to  
15 overcome to be able to license the advanced reactor  
16 designs that are developed pursuant to this Act by  
17 the end of the 4-year period described in paragraph  
18 (1).

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