

115TH CONGRESS  
1ST SESSION

# 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.

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## IN THE SENATE OF THE UNITED STATES

JANUARY 11, 2017

Mr. CRAPO (for himself, Mr. WHITEHOUSE, Mr. BOOKER, Mr. RISCH, Mr. HATCH, Ms. MURKOWSKI, and Mr. DURBIN) 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 of 2017”.

1 **SEC. 2. NUCLEAR ENERGY INNOVATION CAPABILITIES.**

2 (a) NUCLEAR ENERGY.—Section 951 of the Energy  
3 Policy Act of 2005 (42 U.S.C. 16271) is amended to read  
4 as follows:

5 **“SEC. 951. NUCLEAR ENERGY.**

6 “(a) MISSION.—

7 “(1) IN GENERAL.—The Secretary shall carry  
8 out programs of civilian nuclear research, develop-  
9 ment, demonstration, and commercial application,  
10 including activities under this subtitle.

11 “(2) CONSIDERATIONS.—The programs carried  
12 out under paragraph (1) shall take into consider-  
13 ation the following objectives:

14 “(A) Providing research infrastructure to  
15 promote scientific progress and enable users  
16 from academia, the National Laboratories, and  
17 the private sector to make scientific discoveries  
18 relevant for nuclear, chemical, and materials  
19 science engineering.

20 “(B) Maintaining nuclear energy research  
21 and development programs at the National  
22 Laboratories and institutions of higher edu-  
23 cation, including infrastructure at the National  
24 Laboratories and institutions of higher edu-  
25 cation.

1           “(C) Providing the technical means to re-  
2           duce the likelihood of nuclear proliferation.

3           “(D) Increasing confidence margins for  
4           public safety of nuclear energy systems.

5           “(E) Reducing the environmental impact  
6           of activities relating to nuclear energy.

7           “(F) Supporting technology transfer from  
8           the National Laboratories to the private sector.

9           “(G) Enabling the private sector to part-  
10          ner with the National Laboratories to dem-  
11          onstrate novel reactor concepts for the purpose  
12          of resolving technical uncertainty associated  
13          with the objectives described in subparagraphs  
14          (A) through (F).

15          “(b) DEFINITIONS.—In this subtitle:

16           “(1) ADVANCED NUCLEAR REACTOR.—The  
17          term ‘advanced nuclear reactor’ means—

18           “(A) a nuclear fission reactor with signifi-  
19          cant improvements over the most recent genera-  
20          tion of nuclear fission reactors, which may in-  
21          clude—

22                   “(i) inherent safety features;

23                   “(ii) lower waste yields;

24                   “(iii) greater fuel utilization;

25                   “(iv) superior reliability;

1 “(v) resistance to proliferation;

2 “(vi) increased thermal efficiency; and

3 “(vii) the ability to integrate into elec-  
4 tric and nonelectric applications; or

5 “(B) a nuclear fusion reactor.

6 “(2) COMMISSION.—The term ‘Commission’  
7 means the Nuclear Regulatory Commission.

8 “(3) FAST NEUTRON.—The term ‘fast neutron’  
9 means a neutron with kinetic energy above 100  
10 kiloelectron volts.

11 “(4) NATIONAL LABORATORY.—

12 “(A) IN GENERAL.—Except as provided in  
13 subparagraph (B), the term ‘National Labora-  
14 tory’ has the meaning given the term in section  
15 2.

16 “(B) LIMITATION.—With respect to the  
17 Lawrence Livermore National Laboratory, the  
18 Los Alamos National Laboratory, and the  
19 Sandia National Laboratories, the term ‘Na-  
20 tional Laboratory’ means only the civilian ac-  
21 tivities of the laboratory.

22 “(5) NEUTRON FLUX.—The term ‘neutron flux’  
23 means the intensity of neutron radiation measured  
24 as a rate of flow of neutrons applied over an area.

1           “(6) NEUTRON SOURCE.—The term ‘neutron  
2           source’ means a research machine that provides neu-  
3           tron irradiation services for—

4                   “(A) research on materials sciences and  
5                   nuclear physics; and

6                   “(B) testing of advanced materials, nuclear  
7                   fuels, and other related components for reactor  
8                   systems.”.

9           (b) NUCLEAR ENERGY RESEARCH PROGRAMS.—

10                   (1) IN GENERAL.—Section 952 of the Energy  
11                   Policy Act of 2005 (42 U.S.C. 16272) is amended—

12                           (A) by striking subsection (c); and

13                           (B) by redesignating subsections (d) and  
14                           (e) as subsections (c) and (d), respectively.

15                   (2) CONFORMING AMENDMENT.—Section  
16                   641(b)(1) of the Energy Policy Act of 2005 (42  
17                   U.S.C. 16021(b)(1)) is amended by striking “section  
18                   942(d)” and inserting “section 952(c)”.

19                   (c) ADVANCED FUEL CYCLE INITIATIVE.—Section  
20                   953(a) of the Energy Policy Act of 2005 (42 U.S.C.  
21                   16273(a)) is amended by striking “, acting through the  
22                   Director of the Office of Nuclear Energy, Science and  
23                   Technology,”.

24                   (d) UNIVERSITY NUCLEAR SCIENCE AND ENGINEER-  
25                   ING SUPPORT.—Section 954(d)(4) of the Energy Policy

1 Act of 2005 (42 U.S.C. 16274(d)(4)) is amended by strik-  
2 ing “as part of a taking into consideration effort that em-  
3 phasizes” and inserting “that emphasize”.

4 (e) DEPARTMENT OF ENERGY CIVILIAN NUCLEAR  
5 INFRASTRUCTURE AND FACILITIES.—Section 955 of the  
6 Energy Policy Act of 2005 (42 U.S.C. 16275) is amend-  
7 ed—

8 (1) by striking subsections (c) and (d); and

9 (2) by adding at the end the following:

10 “(c) VERSATILE NEUTRON SOURCE.—

11 “(1) MISSION NEED.—

12 “(A) IN GENERAL.—Not later than De-  
13 cember 31, 2017, the Secretary shall determine  
14 the mission need for a versatile reactor-based  
15 fast neutron source, which shall operate as a  
16 national user facility.

17 “(B) CONSULTATIONS REQUIRED.—In car-  
18 rying out subparagraph (A), the Secretary shall  
19 consult with the private sector, institutions of  
20 higher education, the National Laboratories,  
21 and relevant Federal agencies to ensure that  
22 the user facility described in subparagraph (A)  
23 will meet the research needs of the largest prac-  
24 ticable majority of prospective users.

1           “(2) ESTABLISHMENT.—As soon as practicable  
2 after determining the mission need under paragraph  
3 (1)(A), the Secretary shall submit to the appropriate  
4 committees of Congress a detailed plan for the es-  
5 tablishment of the user facility.

6           “(3) FACILITY REQUIREMENTS.—

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

10           “(i) Fast neutron spectrum irradiation  
11           capability.

12           “(ii) Capacity for upgrades to accom-  
13 modate new or expanded research needs.

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

17           “(i) Capabilities that support experi-  
18 mental high-temperature testing.

19           “(ii) Providing a source of fast neu-  
20 trons at a neutron flux, higher than that  
21 at which current research facilities operate,  
22 sufficient to enable research for an optimal  
23 base of prospective users.

1                   “(iii) Maximizing irradiation flexibility  
2                   and irradiation volume to accommodate as  
3                   many concurrent users as possible.

4                   “(iv) Capabilities for irradiation with  
5                   neutrons of a lower energy spectrum.

6                   “(v) Multiple loops for fuels and ma-  
7                   terials testing in different coolants.

8                   “(vi) Additional pre-irradiation and  
9                   post-irradiation examination capabilities.

10                  “(vii) Lifetime operating costs and  
11                  lifecycle costs.

12                  “(4) DEADLINE FOR ESTABLISHMENT.—The  
13                  Secretary shall, to the maximum extent practicable,  
14                  complete construction of, and approve the start of  
15                  operations for, the user facility by not later than De-  
16                  cember 31, 2025.

17                  “(5) REPORTING.—The Secretary shall include  
18                  in the annual budget request of the Department an  
19                  explanation for any delay in the progress of the De-  
20                  partment in completing the user facility by the dead-  
21                  line described in paragraph (4).

22                  “(6) COORDINATION.—The Secretary shall le-  
23                  verage the best practices for management, construc-  
24                  tion, and operation of national user facilities from  
25                  the Office of Science.”.



1 (f) SECURITY OF NUCLEAR FACILITIES.—Section  
2 956 of the Energy Policy Act of 2005 (42 U.S.C. 16276)  
3 is amended by striking “, acting through the Director of  
4 the Office of Nuclear Energy, Science and Technology,”.

5 (g) HIGH-PERFORMANCE COMPUTATION AND SUP-  
6 PORTIVE RESEARCH.—Section 957 of the Energy Policy  
7 Act of 2005 (42 U.S.C. 16277) is amended to read as  
8 follows:

9 **“SEC. 957. HIGH-PERFORMANCE COMPUTATION AND SUP-**  
10 **PORTIVE RESEARCH.**

11 “(a) MODELING AND SIMULATION.—The Secretary  
12 shall carry out a program to enhance the capabilities of  
13 the United States to develop new reactor technologies  
14 through high-performance computation modeling and sim-  
15 ulation techniques.

16 “(b) COORDINATION.—In carrying out the program  
17 under subsection (a), the Secretary shall coordinate with  
18 relevant Federal agencies as described by the National  
19 Strategic Computing Initiative established by Executive  
20 Order 13702 (80 Fed. Reg. 46177 (July 29, 2015)), while  
21 taking into account the following objectives:

22 “(1) Using expertise from the private sector, in-  
23 stitutions of higher education, and the National  
24 Laboratories to develop computational software and  
25 capabilities that prospective users may access to ac-

1       celerate research and development of advanced nu-  
2       clear reactor systems and reactor systems for space  
3       exploration.

4               “(2) Developing computational tools to simulate  
5       and predict nuclear phenomena that may be vali-  
6       dated through physical experimentation.

7               “(3) Increasing the utility of the research infra-  
8       structure of the Department by coordinating with  
9       the Advanced Scientific Computing Research pro-  
10      gram within the Office of Science.

11              “(4) Leveraging experience from the Energy In-  
12      novation Hub for Modeling and Simulation.

13              “(5) Ensuring that new experimental and com-  
14      putational tools are accessible to relevant research  
15      communities, including private sector entities en-  
16      gaged in nuclear energy technology development.

17      “(c) SUPPORTIVE RESEARCH ACTIVITIES.—The Sec-  
18      retary shall consider support for additional research activi-  
19      ties to maximize the utility of the research facilities of the  
20      Department, including physical processes—

21              “(1) to simulate degradation of materials and  
22      behavior of fuel forms; and

23              “(2) for validation of computational tools.”.

24      (h) ENABLING NUCLEAR ENERGY INNOVATION.—  
25      Subtitle E of title IX of the Energy Policy Act of 2005

1 (42 U.S.C. 16271 et seq.) is amended by adding at the  
2 end the following:

3 **“SEC. 958. ENABLING NUCLEAR ENERGY INNOVATION.**

4 “(a) NATIONAL REACTOR INNOVATION CENTER.—

5 There is authorized a program to enable the testing and  
6 demonstration of reactor concepts to be proposed and  
7 funded, in whole or in part, by the private sector.

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

15 “(c) OBJECTIVES.—The reactors described in sub-  
16 section (b) shall operate to meet the following objectives:

17 “(1) Enabling physical validation of advanced  
18 nuclear reactor concepts.

19 “(2) Resolving technical uncertainty and in-  
20 creasing practical knowledge relevant to safety, resil-  
21 ience, security, and functionality of advanced nuclear  
22 reactor concepts.

23 “(3) General research and development to im-  
24 prove nascent technologies.

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

6           “(1) enabling the testing and demonstration of  
7 advanced nuclear reactor concepts to be proposed  
8 and funded, in whole or in part, by the private sec-  
9 tor;

10          “(2) operating a database to store and share  
11 data and knowledge relevant to nuclear science and  
12 engineering between Federal agencies and the pri-  
13 vate sector;

14          “(3) developing and testing electric and non-  
15 electric integration and energy conversion systems  
16 relevant to advanced nuclear reactors;

17          “(4) leveraging expertise from the Commission  
18 with respect to safety analysis; and

19          “(5) enabling technical staff of the Commission  
20 to actively observe and learn about technologies de-  
21 veloped under the program.

22       “(e) AGENCY COORDINATION.—The Chairman of the  
23 Commission and the Secretary shall enter into a memo-  
24 randum of understanding regarding the following:

25           “(1) Ensuring that—

1           “(A) the Department has sufficient tech-  
2           nical expertise to support the timely research,  
3           development, demonstration, and commercial  
4           application by the civilian nuclear industry of  
5           safe and innovative advanced nuclear reactor  
6           technology; and

7           “(B) the Commission has sufficient tech-  
8           nical expertise to support the evaluation of ap-  
9           plications for licenses, permits, and design cer-  
10          tifications and other requests for regulatory ap-  
11          proval for advanced nuclear reactors.

12          “(2) The use of computers and software codes  
13          to calculate the behavior and performance of ad-  
14          vanced nuclear reactors based on mathematical mod-  
15          els of the physical behavior of advanced nuclear re-  
16          actors.

17          “(3) Ensuring that—

18                 “(A) the Department maintains and devel-  
19                 ops the facilities necessary to enable the timely  
20                 research, development, demonstration, and com-  
21                 mercial application by the civilian nuclear in-  
22                 dustry of safe and innovative reactor tech-  
23                 nology; and

1           “(B) the Commission has access to the fa-  
2           cilities described in subparagraph (A), as need-  
3           ed.

4           “(f) REPORTING REQUIREMENTS.—

5           “(1) IN GENERAL.—Not later than 180 days  
6           after the date of enactment of the Nuclear Energy  
7           Innovation Capabilities Act of 2017, the Secretary,  
8           in consultation with the National Laboratories, rel-  
9           evant Federal agencies, and other stakeholders, shall  
10          submit to the appropriate committees of Congress a  
11          report assessing the capabilities of the Department  
12          to authorize, host, and oversee privately funded ex-  
13          perimental advanced nuclear reactors as described in  
14          subsection (b).

15          “(2) CONTENTS.—The report submitted under  
16          paragraph (1) shall address—

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

21                 “(B) options to regulate privately proposed  
22                 and funded experimental reactors hosted by the  
23                 Department;

1           “(C) potential sites capable of hosting pri-  
2 vately funded experimental advanced nuclear re-  
3 actors;

4           “(D) the efficacy of the available contrac-  
5 tual mechanisms of the Department to partner  
6 with the private sector and Federal agencies,  
7 including cooperative research and development  
8 agreements, strategic partnership projects, and  
9 agreements for commercializing technology;

10           “(E) the liability of the Federal Govern-  
11 ment with respect to the disposal of low-level  
12 radioactive waste, spent nuclear fuel, or high-  
13 level radioactive waste (as those terms are de-  
14 fined in section 2 of the Nuclear Waste Policy  
15 Act of 1982 (42 U.S.C. 10101));

16           “(F) the impact on the aggregate inven-  
17 tory in the United States of low-level radio-  
18 active waste, spent nuclear fuel, or high-level  
19 radioactive waste (as those terms are defined in  
20 section 2 of the Nuclear Waste Policy Act of  
21 1982 (42 U.S.C. 10101));

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

1           “(H) other challenges or considerations  
2           identified by the Secretary.

3           “(3) UPDATES.—Once every 2 years, the Sec-  
4           retary shall update relevant provisions of the report  
5           submitted under paragraph (1) and submit to the  
6           appropriate committees of Congress the update.

7           “(g) SAVINGS CLAUSES.—

8           “(1) LICENSING REQUIREMENT.—Nothing in  
9           this section authorizes the Secretary or any person  
10          to construct or operate a nuclear reactor for the pur-  
11          pose of demonstrating the suitability for commercial  
12          application of the nuclear reactor unless licensed by  
13          the Commission in accordance with section 202 of  
14          the Energy Reorganization Act of 1974 (42 U.S.C.  
15          5842).

16          “(2) FINANCIAL PROTECTION.—Any activity  
17          carried out under this section that involves the risk  
18          of public liability shall be subject to the financial  
19          protection or indemnification requirements of section  
20          170 of the Atomic Energy Act of 1954 (42 U.S.C.  
21          2210) (commonly known as the ‘Price-Anderson  
22          Act’).”.

23          (i) BUDGET PLAN.—Subtitle E of title IX of the En-  
24          ergy Policy Act of 2005 (42 U.S.C. 16271 et seq.) (as



1 amended by subsection (h)) is amended by adding at the  
2 end the following:

3 **“SEC. 959. BUDGET PLAN.**

4       “(a) IN GENERAL.—Not later than 1 year after the  
5 date of enactment of the Nuclear Energy Innovation Ca-  
6 pabilities Act of 2017, the Secretary shall submit to the  
7 Committee on Energy and Natural Resources of the Sen-  
8 ate and the Committee on Science, Space, and Technology  
9 of the House of Representatives 2 alternative 10-year  
10 budget plans for civilian nuclear energy research and de-  
11 velopment by the Secretary, as described in subsections  
12 (b) through (d).

13       “(b) BUDGET PLAN ALTERNATIVE 1.—One of the  
14 budget plans submitted under subsection (a) shall assume  
15 constant annual funding for 10 years at the appropriated  
16 level for the civilian nuclear energy research and develop-  
17 ment of the Department for fiscal year 2016.

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

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

23               “(1) a prioritized list of the programs, projects,  
24               and activities of the Department to best support the

1 development of advanced nuclear reactor tech-  
2 nologies;

3 “(2) realistic budget requirements for the De-  
4 partment to implement sections 955(c), 957, and  
5 958; and

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

9 (j) REPORT ON FUSION INNOVATION.—

10 (1) IN GENERAL.—Not later than 180 days  
11 after the date of enactment of this Act, the Sec-  
12 retary of Energy shall submit to the Committee on  
13 Energy and Natural Resources of the Senate and  
14 the Committee on Science, Space, and Technology of  
15 the House of Representatives a report identifying  
16 engineering designs for innovative fusion energy sys-  
17 tems that have the potential to demonstrate net en-  
18 ergy production not later than 15 years after the  
19 start of construction.

20 (2) INCLUSIONS.—The report submitted under  
21 paragraph (1) shall identify budgetary requirements  
22 that would be necessary for the Department of En-  
23 ergy to carry out a fusion innovation initiative to ac-  
24 celerate research and development of the engineering  
25 designs identified in the report.

1 (k) CONFORMING AMENDMENTS.—The table of con-  
 2 tents for the Energy Policy Act of 2005 is amended by  
 3 striking the item relating to section 957 and inserting the  
 4 following:

“957. High-performance computation and supportive research.

“958. Enabling nuclear energy innovation.

“959. Budget plan.”.

5 **SEC. 3. ADVANCED NUCLEAR ENERGY LICENSING COST-**  
 6 **SHARE GRANT PROGRAM.**

7 (a) DEFINITIONS.—In this section:

8 (1) COMMISSION.—The term “Commission”  
 9 means the Nuclear Regulatory Commission.

10 (2) PROGRAM.—The term “program” means  
 11 the Advanced Nuclear Energy Cost-Share Grant  
 12 Program established under subsection (b).

13 (3) SECRETARY.—The term “Secretary” means  
 14 the Secretary of Energy.

15 (b) ESTABLISHMENT.—The Secretary shall establish  
 16 a grant program, to be known as the “Advanced Nuclear  
 17 Energy Cost-Share Grant Program”, under which the Sec-  
 18 retary shall make cost-share grants to applicants for the  
 19 purpose of funding a portion of the Commission fees of  
 20 the applicant for pre-application review activities and ap-  
 21 plication review activities.

22 (c) REQUIREMENT.—The Secretary shall seek out  
 23 technology diversity in making grants under the program.

1 (d) COST-SHARE AMOUNT.—The Secretary shall de-  
2 termine the cost-share amount for each grant under the  
3 program.

4 (e) USE OF FUNDS.—A recipient of a grant under  
5 the program may use the grant funds to cover Commission  
6 fees, including those fees associated with—

7 (1) developing a licensing project plan;

8 (2) obtaining a statement of licensing feasi-  
9 bility;

10 (3) reviewing topical reports; and

11 (4) other—

12 (A) pre-application review activities;

13 (B) application review activities; and

14 (C) interactions with the Commission.

15 (f) AUTHORIZATION OF APPROPRIATIONS.—There  
16 are authorized to be appropriated to the Secretary to carry  
17 out this section such sums as are necessary.

○