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### NUCLEAR POWER 2021 ACT

AUGUST 30 (legislative day, AUGUST 2), 2011.—Ordered to be printed

Filed under authority of the order of the Senate of August 2, 2011

Mr. BINGAMAN, from the Committee on Energy and Natural Resources, submitted the following

### R E P O R T

[To accompany S. 512]

The Committee on Energy and Natural Resources, to which was referred the bill (S. 512) to amend the Energy Policy Act of 2005 to require the Secretary of Energy to carry out programs to develop and demonstrate 2 small modular nuclear reactor designs, and for other purposes, having considered the same, reports favorably thereon with an amendment and an amendment to the title and recommends that the bill, as amended, do pass.

The amendments are as follows:

1. Strike out all after the enacting clause and insert in lieu thereof the following:

#### SECTION 1. SHORT TITLE.

This Act may be cited as the “Nuclear Power 2021 Act”.

#### SEC. 2. NUCLEAR POWER 2021 INITIATIVE.

Section 952 of the Energy Policy Act of 2005 (42 U.S.C. 16272) is amended by striking subsection (c) and inserting the following:

“(c) NUCLEAR POWER 2021 INITIATIVE.—

“(1) DEFINITIONS.—In this subsection:

“(A) COMBINED LICENSE.—The term ‘combined license’ has the meaning given the term in section 52.1 of title 10, Code of Federal Regulations (or a successor regulation).

“(B) DESIGN CERTIFICATION.—The term ‘design certification’ has the meaning given the term in section 52.1 of title 10, Code of Federal Regulations (or a successor regulation).

“(C) EARLY SITE PERMIT.—The term ‘early site permit’ has the meaning given the term in section 52.1 of title 10, Code of Federal Regulations (or a successor regulation).

“(D) SMALL MODULAR REACTOR.—The term ‘small modular reactor’ means a nuclear reactor—

“(i) with a rated capacity of less than 300 electrical megawatts; and

- “(ii) that can be constructed and operated in combination with similar reactors at a single site.
- “(2) DUTY OF SECRETARY.—The Secretary shall carry out, through cooperative agreements with private sector partners—
- “(A) a program—
- “(i) to develop a standard design for not less than 2 small modular reactors, at least 1 of which has a rated capacity of not more than 50 electrical megawatts; and
- “(ii) to obtain a design certification from the Nuclear Regulatory Commission for each of the standard designs by January 1, 2018;
- “(B) a program to demonstrate the licensing of small modular reactors by—
- “(i) developing applications for a combined license for each of the designs certified pursuant to subparagraph (A); and
- “(ii) obtaining a combined license from the Nuclear Regulatory Commission for each of the designs by January 1, 2021; and
- “(C) a program to obtain an early site permit for 1 or more small modular reactors.
- “(3) MERIT REVIEW OF PROPOSALS.—The Secretary shall select proposals for cooperative agreements under this subsection—
- “(A) on the basis of an impartial review of the scientific and technical merit of the proposals; and
- “(B) through the use of competitive procedures.
- “(4) TECHNICAL CONSIDERATIONS.—In evaluating proposals, the Secretary shall take into account the efficiency, cost, safety, and proliferation resistance of competing reactor designs.
- “(5) COST-SHARE REQUIREMENTS.—
- “(A) DESIGN DEVELOPMENT.—Notwithstanding section 988, the Secretary shall require that not less than 50 percent of the cost of the development of each small modular reactor design under paragraph (2)(A), and each early site permit under paragraph (2)(C), be provided by a non-Federal source.
- “(B) LICENSING DEMONSTRATION.—Notwithstanding section 988, the Secretary shall require that not less than 75 percent of the cost of the licensing demonstration of each small modular reactor design under paragraph (2)(B) be provided by a non-Federal source.
- “(C) CALCULATION OF AMOUNT.—Non-Federal contributions under this subsection shall be calculated in accordance with section 988(d).”.

2. Amend the title so as to read as follows: “To amend the Energy Policy Act of 2005 to require the Secretary of Energy to carry out programs to develop and demonstrate small modular nuclear reactor designs, and for other purposes.”.

#### PURPOSE

The purpose of S. 512 is to require the Secretary of Energy to carry out programs to develop and demonstrate small modular nuclear reactor designs.

#### BACKGROUND AND NEED

The first nuclear power plants built in this country were small. The first, Shippingport, which was built by the Atomic Energy Commission and began generating power in 1957, could generate 60 megawatts of electric power. The second, though first privately financed nuclear power plant, Dresden, which began operating in 1960, could generate 180 megawatts of electricity. The third, Yankee Rowe, which began commercial operation in 1961, could generate 140 megawatts of electricity.

From these modest beginnings, the nuclear industry scaled up the size of nuclear power plants rapidly. The four reactors that began operating in 1969 ranged in size from 581 to 867 megawatts of electric capacity. Five years later, four reactors with a rated ca-

capacity of more than 1,000 megawatts electricity were in commercial service.

Larger reactors offered utilities economies of scale, reducing the cost-per-kilowatt-hour of the electricity they generated. But increasing plant size also increased problems. Greater size increased capital costs, lengthened construction times, compounded financing expenses, added to design complexity and safety concern, and contributed to regulatory delay and uncertainty. These problems pose a substantial barrier to the deployment of new nuclear power plants, and they have led to a reexamination of the use of small modular reactors.

The term “small modular reactor” is generally understood to refer to a reactor with a rated capacity of less than 300 megawatts electric, which can be linked together with other small modular reactors, which can then be operated in combination. Small modular reactors offer several advantages over large nuclear power plants. They would have a lower capital cost, and thus would pose less financial risk, carry lower financing charges, and be more affordable to smaller utilities. They could also be used in smaller markets, which might not otherwise be able to support a large base-load nuclear power plant, or for industrial applications other than electric power production. Small modular reactor designs may also offer significant environmental and safety advantages and nonproliferation benefits. Importantly, they may also be fabricated in a factory, then transported and assembled onsite, improving quality control and significantly reducing the cost and schedule uncertainty of onsite construction.

Legislation is needed to increase research, development, and demonstration of small modular reactors in order to make nuclear power safer, more affordable, and more secure, and to remove barriers to its deployment.

#### LEGISLATIVE HISTORY

S. 512 was introduced by Senator Bingaman on March 8, 2011. Senators Murkowski, Udall, Pryor, Landrieu, Risch, and Crapo are cosponsors. Similar legislation, H.R. 1108 was introduced in the House of Representatives on May 10, 2011.

The Committee on Energy and Natural Resources held a legislative hearing on S. 512 on June 7, 2011. The Committee ordered S. 512 favorably reported on July 21, 2011.

Similar legislation was considered in the 111th Congress. S. 2812 was introduced by Senator Bingaman on November 20, 2009. Senators Murkowski, Udall, Pryor, Landrieu, Risch, and Crapo were cosponsors. Similar legislation, H.R. 5164, was introduced in the House of Representatives on April 28, 2010. The Committee on Energy and Natural Resources held a legislative hearing on S. 2812 on December 15, 2009. S. Hrg. 111–375. The Committee ordered S. 2812 favorably reported, with amendments, at its business meeting on September 27, 2010.

#### COMMITTEE RECOMMENDATION

The Senate Committee on Energy and Natural Resources, in open business session on July 21, 2011, by voice vote of a quorum

present recommends that the Senate pass S. 512, if amended as described herein. Senator Sanders asked to be recorded as voting no.

#### COMMITTEE AMENDMENTS

During its consideration of S. 512, the Committee adopted two amendments. The first amendment is in the nature of a substitute, which makes a number of changes to the bill as originally introduced. The substitute amendment replaces the authority for the Nuclear Power 2010 program now found in section 952(c) of the Energy Policy Act of 2005 with authority for a new Nuclear Power 2021 program. The substitute amendment expands the cooperative design development and licensing program from 2 to “not less than 2” small modular reactors, adds a new program to obtain an early site permit for one or more small modular reactors, and adds a definition of the term “early site permit.” The second amendment amends the title of the bill to remove the reference to “2” small modular reactor designs.

#### SECTION-BY-SECTION ANALYSIS

*Section 1* provides a short title.

*Section 2* amends section 952(c) of the Energy Policy Act of 2005 (42 U.S.C. 16272) by striking the Nuclear Power 2010 Program and replacing it with a new Nuclear Power 2021 Initiative.

Paragraph (1) of the new subsection (c) defines terms used in the subsection. The terms “combined license”, “design certification”, and “early site permit” are defined by reference to definitions adopted by the Nuclear Regulatory Commission. The term “small modular reactor” is defined as a nuclear reactor that is both “small,” which, consistent with the International Atomic Energy Agency’s definition of “small,” means that it has a rated capacity of less than 300 electrical megawatts, and “modular,” which means that individual units “can be constructed and operated in combination” with similar units, though a single unit could be constructed and operated by itself.

Paragraph (2) directs the Secretary of Energy to carry out, through cooperative agreements with private sector partners, programs to develop and demonstrate small modular reactors.

Paragraph 2(A) requires the Secretary to carry out a program to develop a standard design for not less than two small modular reactors, at least one of which has a rated capacity of not less than 50 electrical megawatts, and obtain a design certification from the Nuclear Regulatory Commission for each of the two standard designs by January 1, 2018.

Paragraph 2(B) requires the Secretary to carry out a program to demonstrate the licensing of small modular reactors by developing applications for a combined license for each of the designs and obtaining a combined license from the Nuclear Regulatory Commission for each design by January 1, 2021. Although this paragraph requires the Secretary to demonstrate the licensing of not less than 2 small modular reactors using combined licenses, it is not intended to preclude private sector partners from licensing other small modular reactors using separate construction permits and operating licenses.

Paragraph 2(C) requires the Secretary to carry out a program to obtain an early site permit for one or more small modular reactors.

Paragraph (3) requires the Secretary to select proposals for cooperative agreement on the basis of an impartial review of their scientific and technical merit, and through the use of competitive procedures.

Paragraph (4) requires the Secretary to take into account the efficiency, cost, safety, and proliferation resistance of competing reactor designs in evaluating proposals.

Paragraph (5) requires that at least 50 percent of the cost of developing small modular reactor designs and early site permits under subparagraphs (A) and (C) of paragraph (2), and at least 75 percent of the cost of the licensing demonstration of each small modular reactor design under paragraph (2)(B) be provided by a non-Federal source.

#### COST AND BUDGETARY CONSIDERATIONS

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

##### *S. 512—Nuclear Power 2021 Act*

Summary: S. 512 would authorize the Department of Energy (DOE) to enter into cooperative agreements with private-sector entities to develop and license standard designs for small modular nuclear reactors. CBO estimates that implementing S. 512 would cost \$414 million over the 2012–2016 period, assuming appropriation of the necessary amounts. Enacting S. 512 would not affect direct spending or revenues; therefore, pay-as-you-go procedures do not apply.

S. 512 contains no intergovernmental or private-sector mandates as defined in the Unfunded Mandates Reform Act (UMRA).

Estimated cost to the Federal Government: The estimated budgetary impact of S. 512 is shown in the following table. The costs of this legislation fall within budget function 270 (energy).

	By fiscal year, in millions of dollars—					
	2012	2013	2014	2015	2016	2012–2016
CHANGES IN SPENDING SUBJECT TO APPROPRIATION						
Estimated Authorization Level .....	67	100	100	100	100	467
Estimated Outlays .....	40	79	95	100	100	414

Basis of estimate: S. 512 would direct the Secretary of Energy to enter into cooperative agreements with private-sector entities to develop standard designs for small modular nuclear reactors as well as processes for licensing such reactors with the Nuclear Regulatory Commission (NRC). The bill would authorize DOE to cover up to 50 percent of the cost of developing designs for such reactors and up to 25 percent of the cost to demonstrate licensing processes and would specify a final deadline for all work to be completed by January 1, 2021.

CBO estimates that fully funding S. 512 would require appropriations totaling \$467 million over the 2012–2016 period. That estimate is based on information from DOE about the agency's costs to develop facilities and demonstrate licensing processes for new,

large-scale nuclear reactors and takes into account the cost-share requirements specified in the bill. Assuming appropriation of those amounts, CBO estimates that resulting outlays would total \$414 million over the 2012–2016 period.

The NRC also would incur costs to certify designs and develop licensing procedures for small reactors under S. 512. However, according to the NRC, the agency already plans to develop its capacity to support regulatory processes for small modular nuclear reactors. As a result, CBO estimates that implementing S. 512 would not significantly affect net spending by that agency; any such spending would be subject to appropriation and would be largely offset by fees that the NRC is authorized to collect from regulated entities.

Pay-As-You-Go considerations: None.

Intergovernmental and private-sector impact: S. 512 contains no intergovernmental or private-sector mandates as defined in UMRA and would impose no costs on state, local, or tribal governments.

Estimate prepared by: Federal Costs: Megan Carroll; Impact on State, Local, and Tribal Governments: Ryan Miller; Impact on the Private Sector: Amy Petz.

Estimate approved by: Theresa Gullo, Deputy Assistant Director for Budget Analysis.

#### 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. 512.

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. 512.

#### CONGRESSIONALLY DIRECTED SPENDING

S. 512, as ordered 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

The testimony on S. 512 given by the Deputy Assistant Secretary for Reactor Technologies, Office of Nuclear Energy, The U.S. Department of Energy, at the Committee's June 7, 2011 hearing as follows:

STATEMENT OF JOHN E. KELLY, DEPUTY ASSISTANT SECRETARY FOR REACTOR TECHNOLOGIES, OFFICE OF NUCLEAR ENERGY, DEPARTMENT OF ENERGY

#### INTRODUCTION

Thank you, Chairman Bingaman, Ranking Member Murkowski, and Members of the Committee. This is my

first testimony before Congress and it is a particular pleasure to be discussing small modular reactors (SMRs) with you, as they have been an area of great interest to me for some time.

Before joining the Department of Energy, I co-chaired an American Nuclear Society special committee that was developing solutions to generic licensing issues for small modular reactors. Over the course of the last 18 months, this special committee, together with the Nuclear Energy Institute, the Nuclear Regulatory Commission and the nuclear industry, has made great progress in forging the blueprint for the regulatory framework for small modular reactors. This progress demonstrates an increased interest in the licensing and commercialization of SMRs.

The Administration continues to view nuclear power as an important clean energy option. Small modular reactors, specifically reactors that have an electrical output of less than 300 megawatts, are a promising and innovative technology. We see these smaller reactors as giving our utilities additional clean energy options and allowing nuclear power to penetrate the energy market more broadly. Secretary Chu has written that, "if we can develop this technology in the U.S. and build these reactors with American workers, we will have a key competitive edge". SMRs are already inspiring American innovation and have the potential to significantly enhance U.S. competitiveness.

Since former Assistant Secretary Dr. Pete Miller testified to this Committee in 2009 on the two bills we are discussing today, several developments have taken place. A little over a year ago, we released our fiscal year 2011 budget request, which proposed a small modular reactor program with \$40 million of funding. The proposal was to spend half of that funding on R&D efforts and half to initiate a competitive selection process to establish public-private partnerships to cost-share design certification and licensing efforts with the selected winners.

Earlier this year, the Department released its fiscal year 2012 budget request, which included an expanded version of the small modular reactor program. The request for FY 2102 is \$29 million for R&D and \$67 million for design certification and licensing activities. The DOE request outlines a multi-year, \$452 million program that would use cost-shared arrangements with industry partners to complete design certification activities for up to two light water small modular reactor designs. There are several potential SMR vendors pursuing both LWR designs and more advanced concepts. Many utilities are interested in this technology to replace aging fossil plants.

The events at the Fukushima nuclear power plants have led the Nuclear Regulatory Commission to launch a 90-day review to see what lessons can be learned from the Japanese experience and applied to U.S. nuclear plants. I want to note that designers of light water SMRs have already placed major emphasis on the inherent safety of these reactors. Because of their lower power level, SMRs have a

much lower level of decay heat and therefore may require less cooling after reactor shutdown. Several designs incorporate passive safety features that utilize gravity-driven systems rather than engineered, pump-driven systems to supply backup cooling in unusual circumstances. Some concepts use natural circulation for normal operations, requiring no primary system pumps and providing an even more robust safety case. In addition, many SMR designs utilize integral designs for which all major primary components are located in a single pressure vessel. That feature results in a much lower susceptibility to certain potential events, such as a loss of coolant accident, because there is no large external primary piping. Lastly, most SMRs can be sited underground, which should improve their security profile and may enhance seismic safety.

#### COMMENTS ON S. 512 AND S. 1067

Turning to the two bills under consideration by the Committee, the Department has a few comments.

S. 1067 gives broad authority to conduct research into small modular reactors, as well as other connected issues.

S. 512, the Nuclear Power 2021 Act, would require the Department of Energy to carry out a program to develop and demonstrate two small modular reactor designs. If passed, several factors would be important to consider:

- The requirement that at least one of the designs be less than 50 MW is too restrictive; simply having an upper bound of approximately 300 MW<sub>e</sub> would be more appropriate. Cost-shared design development and licensing should be based on competitive procurements and the market place should establish the appropriate design parameters.
- The licensing effort should include two different designs.
- The program should initially be focused on light water reactor technology based on the large amount of experience—both design and licensing—with such reactors.

#### CONCLUSION

That concludes my formal remarks. Thank you for the opportunity to testify and I look forward to answering your questions and working with the Committee to achieve the administration's goals of energy security and reducing the nation's carbon emissions.

#### 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 S. 512, as ordered 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):



**ENERGY POLICY ACT OF 2005**

Public Law 109–58

AN ACT To ensure jobs for our future with secure, affordable, and reliable energy.

\* \* \* \* \*

**TITLE IX—RESEARCH AND DEVELOPMENT**

\* \* \* \* \*

**Subtitle E—Nuclear Energy**

\* \* \* \* \*

**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.]

(c) **NUCLEAR POWER 2021 INITIATIVE.**—

(1) **DEFINITIONS.**—*In this subsection:*

(A) **COMBINED LICENSE.**—*The term “combined license” has the meaning given the term in section 52.1 of title 10, Code of Federal Regulations (or a successor regulation).*

(B) **DESIGN CERTIFICATION.**—*The term “design certification” has the meaning given the term in section 52.1 of title 10, Code of Federal Regulations (or a successor regulation).*

(C) **EARLY SITE PERMIT.**—*The term “early site permit” has the meaning given the term in section 52.1 of title 10, Code of Federal Regulations (or a successor regulation).*

- (D) *SMALL MODULAR REACTOR.*—The term “small modular reactor” means a nuclear reactor—
- (i) with a rated capacity of less than 300 electrical megawatts; and
  - (ii) that can be constructed and operated in combination with similar reactors at a single site.
- (2) *DUTY OF SECRETARY.*—The Secretary shall carry out, through cooperative agreements with private sector partners—
- (A) a program—
    - (i) to develop a standard design for not less than 2 small modular reactors, at least 1 of which has a rated capacity of not more than 50 electrical megawatts; and
    - (ii) to obtain a design certification from the Nuclear Regulatory Commission for each of the standard designs by January 1, 2018;
  - (B) a program to demonstrate the licensing of small modular reactors by—
    - (i) developing applications for a combined license for each of the designs certified pursuant to subparagraph (A); and
    - (ii) obtaining a combined license from the Nuclear Regulatory Commission for each of the designs by January 1, 2021; and
  - (C) a program to obtain an early site permit for 1 or more small modular reactors.
- (3) *MERIT REVIEW OF PROPOSALS.*—The Secretary shall select proposals for cooperative agreements under this subsection—
- (A) on the basis of an impartial review of the scientific and technical merit of the proposals; and
  - (B) through the use of competitive procedures.
- (4) *TECHNICAL CONSIDERATIONS.*—In evaluating proposals, the Secretary shall take into account the efficiency, cost, safety, and proliferation resistance of competing reactor designs.
- (5) *COST-SHARE REQUIREMENTS.*—
- (A) *DESIGN DEVELOPMENT.*—Notwithstanding section 988, the Secretary shall require that not less than 50 percent of the cost of the development of each small modular reactor design under paragraph (2)(A), and each early site permit under paragraph (2)(C), be provided by a non-Federal source.
  - (B) *LICENSING DEMONSTRATION.*—Notwithstanding section 988, the Secretary shall require that not less than 75 percent of the cost of the licensing demonstration of each small modular reactor design under paragraph (2)(B) be provided by a non-Federal source.
  - (C) *CALCULATION OF AMOUNT.*—Non-Federal contributions under this subsection shall be calculated in accordance with section 988(d).

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