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REPORT
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NUCLEAR ENERGY RESEARCH INITIATIVE IMPROVEMENT ACT

SEPTEMBER 27, 2010.—Ordered to be printed

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

R E P O R T

[To accompany S. 2052]

The Committee on Energy and Natural Resources, to which was referred the bill (S. 2052) to amend the Energy Policy Act of 2005 to require the Secretary of Energy to carry out a research and development and demonstration program to reduce manufacturing and construction costs relating to nuclear reactors, 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. 2052 is to require the Secretary of Energy to carry out a research and development and demonstration program to reduce manufacturing and construction costs relating to nuclear reactors.

BACKGROUND AND NEED

The 104 nuclear power plants currently operating in the United States generate roughly 20 percent of the nation's electricity, and roughly 70 percent of the nation's carbon-free electricity. New nuclear power plants will need to be built in the years ahead to replace existing plants as they age and are retired, to meet increased energy demand, and to help reduce carbon dioxide emissions.

The greatest challenge to the deployment of new nuclear power plants is their large capital cost. A new nuclear power plant is estimated to cost between $6 billion and $8 billion. Congress has previously sought to address this problem through loan guarantees in title XVII of the Energy Policy Act of 2005, insurance against regu-

latory delays in section 638 of the Energy Policy Act of 2005, production tax credits in section 1306 of the Energy Policy Act of 2005, and improvements in the licensing process in title XXVIII of the Energy Policy Act of 1992. In addition, section 952 of the Energy Policy Act of 2005 established a Nuclear Energy Research Initiative within the Department of Energy for research and development on nuclear energy systems.

Additional legislation is needed to make lowering the cost of nuclear reactor systems a primary objective of the Department of Energy's Nuclear Energy Research Initiative.

LEGISLATIVE HISTORY

S. 2052 was introduced by Senator Mark Udall on October 29, 2009. Senators Bingaman, Murkowski, Crapo, Landrieu, Risch, and Klobachar are cosponsors. Similar legislation, H.R. 5163, was introduced in the House of Representatives on April 28, 2010.

The Committee on Energy and Natural Resources held a legislative hearing on S. 2052 on December 15, 2009. S. Hrg. 111–375. In addition, the Committee held an oversight hearing on nuclear energy development on March 18, 2009. S. Hrg. 111–21.

The Committee ordered S. 2052 favorably reported, without amendment, at its business meeting on July 21, 2010.

COMMITTEE RECOMMENDATION

The Senate Committee on Energy and Natural Resources, in open business session on July 21, 2010, by voice vote of a quorum present recommends that the Senate pass S. 2052.

Senator Sanders asked to be recorded as voting no.

SECTION-BY-SECTION ANALYSIS

Section 1 provides a short title.

Section 2 amends section 952(a) of the Energy Policy Act of 2005 (42 U.S.C. 16272(a)) by redesignating the existing subsection, which authorizes the Department of Energy's Nuclear Energy Research Initiative, as paragraph (1), and by adding five new paragraphs, numbered (2) through (6).

Paragraph (2) requires the Secretary of Energy to conduct research to lower the cost of nuclear reactor systems as part of the Nuclear Energy Research Initiative, and identifies research on modular and small-scale reactors, balance-of-plant issues, cost-efficient manufacturing and construction, licensing issues, and enhanced proliferation controls as types of research included within the initiative.

Paragraph (3) directs the Secretary of Energy, in carrying out research under paragraph (2), to consult with the Secretary of Commerce, the Secretary of the Treasury, the Nuclear Regulatory Commission, and any other individual who the Secretary determines to be necessary.

Paragraph (4) directs the Secretary of Energy to develop and post on the Department of Energy's website a schedule outlining a five-year strategy to lower effectively the costs of nuclear reactors. Subparagraphs require the Nuclear Energy Advisory Committee to review the schedule, and the Secretary to update it annually. The

Secretary is also required to solicit public comment through public workshops when developing and updating the schedule.

Paragraph (5) applies the cost-sharing requirements of section 988 of the Energy Policy Act of 2005 to the Nuclear Energy Research Initiative.

Paragraph (6) authorizes appropriation of $50 million for each of fiscal years 2011 through 2015.

COST AND BUDGETARY CONSIDERATIONS

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

S. 2052—Nuclear Energy Research Initiative Improvement Act of 2009

Summary: S. 2052 would authorize the appropriation of $50 million in each of fiscal years 2011 through 2015 for the Department of Energy (DOE) to conduct research aimed at reducing the costs of deploying new commercial nuclear reactors. Assuming appropriation of the authorized amounts, CBO estimates that implementing S. 2052 would cost $224 million over the 2011–2015 period, and $26 million in later years. Enacting S. 2052 would not affect direct spending or revenues; therefore, pay-as-you-go procedures do not apply.

S. 2052 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: For this estimate, CBO assumes that S. 2052 will be enacted in 2010 and that authorized amounts will be provided near the start of each fiscal year. Estimates of outlays are based on historical spending patterns for existing DOE programs related to research and nuclear energy. The estimated budgetary impact of S. 2052 is shown in the following table. The costs of this legislation fall within budget function 270 (energy).

	By fiscal year, in millions of dollars—					
	2011	2012	2013	2014	2015	2011–2015
CHANGES IN SPENDING SUBJECT TO APPROPRIATION						
Authorization Level	50	50	50	50	50	250
Estimated Outlays	15	44	50	60	55	224

Pay-As-You-Go Considerations: None.

Intergovernmental and private-sector impact: S. 2052 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. 2052.

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. 2052.

CONGRESSIONALLY DIRECTED SPENDING

S. 2052, 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. 2052 given by the Assistant Secretary for Nuclear Energy at the Committee's December 15, 2009 hearing, and the written comments of the Nuclear Regulatory Commission submitted following the hearing follow:

STATEMENT OF WARREN F. MILLER, JR., ASSISTANT SECRETARY FOR NUCLEAR ENERGY, DEPARTMENT OF ENERGY

INTRODUCTION

Thank you, Chairman Bingaman, Ranking Member Murkowski, and Members of the Committee. I appreciate the opportunity to appear before you and comment on legislation under consideration by the committee, as well as to provide information on where small modular reactors fit in the Department of Energy's portfolio.

Let me start by saying clearly that the administration views nuclear power as an important element in its strategy to increase energy security and combat climate change. As the President said in Prague, "[w]e must harness the power of nuclear energy on behalf of our efforts to combat climate change, and to advance peace and opportunity for all people."

Secretary Chu and I are working hard to advance nuclear power in the United States, and we expect the Department of Energy to award the first conditional loan guarantee for new nuclear plant construction soon.

In the Office of Nuclear Energy, we have developed five imperatives to guide our activities.

First, we are working with industry and the Nuclear Regulatory Commission to extend the lifetime of the existing reactor fleet. The 104 NRC-licensed commercial nuclear reactors produce roughly 20 percent of our nation's electricity but 70 percent of our carbon-free electricity. Whether those plants retire at 60 or, for example, 80 years of age could greatly affect our carbon emissions profile in the future. Research is needed to answer outstanding

questions about how long these reactors can safely be operated.

Second, we are engaged with industry to enable new plant builds and improve the affordability of nuclear energy. I mentioned our efforts with respect to loan guarantees, but also some of our research, such as the soon-to-be-implemented Modeling and Simulation Hub, we expect will also help reduce costs.

Third, we are working to reduce the carbon footprint of the transportation and industrial sectors. Nuclear power can supply more low-carbon electricity for increased electrification of the transportation sector, and provide low-carbon process heat for a range of industrial applications.

Fourth, we are researching ways to create a sustainable nuclear fuel cycle. In particular, we are looking at ways of extending nuclear fuel supplies and reducing the amount and toxicity of waste requiring a permanent repository.

And fifth, we are working to understand and minimize proliferation risks. All nuclear fuel cycles entail some amount of risk, but that risk can be reduced with appropriate technology applications and international guidelines and agreements.

SMALL MODULAR REACTORS

With that, let me turn to the focus of today's hearing: small modular reactors (SMRs) and their potential benefits.

Let me first define what we mean by "small" and "modular".

To begin with, there is no exact definition for what constitutes a "small" reactor. The International Atomic Energy Agency defines them to be less than 300 MWe as does S. 2812. This boundary is based mainly on two factors: (1) liability insurance, and (2) factory fabrication and portability to a site by rail or truck. For liability reasons, reactors above 300 MWe must carry separate indemnification insurance for each unit. Reactors modules that are sized 300 MWe and below can be linked together to form one reactor-unit for liability insurance. Reactor modules of this size are conducive to off-site fabrication prior to transportation by rail or truck, rather than by barge, to an approved site for assembly.

The term "modular" implies several things that could create a potential advantage over larger plants. First, modular reactors can be linked together to create a larger power plant. This is potentially advantageous because it allows an owner the flexibility to incrementally increase the size of a plant. As demand increases, the owner can add more modules. Secondly, a smaller plant requires less initial capital outlay or investment. The existing operating modules can then be used to finance future additions. Multiple units are also important during refueling or maintenance because taking a single module offline does not require the shutdown of the entire plant.

The term "modular" can also refer to potentially faster and more efficient construction techniques using factory fabrication. The U.S. defense nuclear shipbuilding industry is an excellent example where modular construction techniques have been proven to be highly successful. These same techniques can be applied to the commercial nuclear industry. This fabrication technique has the potential to make nuclear energy more economical and appealing to investors because it reduces the perceived "risks" associated with new nuclear builds such as construction delays and schedule uncertainty.

There are several reasons why small modular reactors may prove advantageous compared to the Generation III+ nuclear plants in terms of economics, performance, and security.

First, the high capital cost for new nuclear reactors has been a challenge for private entities to finance. Smaller projects would carry lower investment risk and could be more affordable to smaller utilities. This reduction in investment risk also provides an advantage in rate recovery, regardless of whether the licensee is regulated through state public utility commissions or whether it must sell the electricity in unregulated commercial markets.

Second, there are areas in this country—and elsewhere in the world—where large plants are not needed or the existing infrastructure cannot support the larger capacity. Small modular reactors could be used to provide power to these smaller electrical markets, isolated areas or smaller grids. There is both a domestic and international market for small modular reactors and U.S. industry is well positioned to lead and compete for these markets.

Third, some of the SMR designs may offer significant environmental or safety advantages for siting in industrial settings or where, for example, water for cooling is a problem. Some reactor designs would produce a higher temperature outlet heat that can be used for either electricity or process heat for nearby industries while others use little or no water for cooling.

Fourth, there are also some potential nonproliferation benefits to use of small reactors that could be designed to operate for decades without refueling. These reactors could be fabricated and fueled in a factory, sealed and shipped to the site for power generation, and then shipped back to the factory to be defueled. This approach could minimize the spread of nuclear material.

Fifth, small reactors could also enter into traditionally non-nuclear energy markets for applications beyond electricity production. The possibilities include low carbon process heat for: fossil fuel recovery and refinement, synthetic or biofuel production, water desalination, hydrogen production, and a range of other petrochemical applications.

Finally, while traditional economy-of-scale concepts favor larger nuclear plants, there are a number of reasons why SMRs may have some economic advantages.

As mentioned previously, a sizeable portion of the cost and schedule uncertainty for building large nuclear plants is the amount of work that must be performed on site. Factory production and fabrication, and transport to and assembly onsite can significantly reduce that uncertainty.

Research into small modular reactors could address several of the Office of Nuclear Energy's imperatives: improving the affordability of nuclear power; supplying low-carbon electricity and process heat to the transportation and industrial sectors; and minimizing proliferation risks. More importantly, the advancement of SMRs will respond to U.S. economic and environmental market conditions for low-carbon energy sources.

COMMENTS ON S. 2052 AND S. 2812

It should be clear from the preceding comments that the Department believes that small modular reactors are an important area of research and development.

The Nuclear Energy Research Initiative Improvement Act of 2009, S. 2052, gives broad authority to conduct research into small modular reactors, as well as other related issues. The Department is still evaluating the details of the bill.

S. 2812, 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. The Department is still evaluating the details of the bill.

CONCLUSION

In considering a small modular reactor program, a variety of factors need to be assessed, including issues such as reactor size, industry readiness and responsibilities, and research and development needs.

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.

UNITED STATES
NUCLEAR REGULATORY COMMISSION,
Washington, DC, December 10, 2009.

Hon. JEFF BINGAMAN,
Chairman, Committee on Energy and Natural Resources,
U.S. Senate, Washington, DC.

DEAR MR. CHAIRMAN: As requested in your letter dated December 1, 2009, I am submitting, on behalf of the U.S. Nuclear Regulatory Commission (NRC), the following comments regarding S. 2052, the "Nuclear Energy Research Initiative Improvement Act of 2009," and S. 2812, the "Nuclear Power 2021 Act."

Because of our role as a regulator, the NRC offers no comments on whether, as a policy matter, small modular reactors or other new nuclear reactor technologies should or should not be pursued. The NRC's role would be limited to ensuring that any reactors utilizing new technologies will be constructed and operated in a man-

ner that will provide adequate protection of public health and safety and the common defense and security. Accordingly, the NRO's comments relate to the NRC's regulatory role.

S. 2052

S. 2052 would require the U.S. Department of Energy (DOE) to "conduct research to lower the cost of nuclear reactor systems." This language would not, though, expressly direct the DOE to conduct research on safety in conjunction with its research related to cost reduction for nuclear reactor systems. Such safety research could be valuable in supporting the NRC's role in determining whether particular cost-saying measures are consistent with public health and safety—a determination the NRC would need to make before making any licensing decisions. Accordingly, the NRC suggests adding the words "consistent with protection of public health and safety" after the words "lower the cost of nuclear reactor systems" in the provision of Section 2 of S. 2052 that would add a new paragraph (2) to section 952(a) of the Energy Policy Act of 2005.

To the extent that the research into nuclear reactor systems leads to submission to the NRC of applications based upon new technologies or designs, the NRC may need to conduct infrastructure development and confirmatory research before receiving applications in order to ensure an efficient and effective review process once applications do arrive. To facilitate efficient licensing reviews, Congress would therefore need to provide the NRC with adequate appropriations to cover this pre-application work.

S. 2812

S. 2812 requires the DOE to obtain two small modular reactor design certifications from the NRC by January 1, 2018, and to obtain two NRC combined licenses—one for each certified design—by January 1, 2021. As the NRC staff has indicated in prepared written testimony for the Committee's December 15, 2009 hearing, the NRC has already begun conducting preparatory work on various matters related to small modular reactors. However, the amount of additional work that the NRC must do to prepare itself for efficient reviews of the small modular reactor design certification and combined license applications described in S. 2812 will vary based upon the technologies ultimately chosen. For example, the NRC expects that it is much closer to being able to efficiently evaluate applications for small modular reactors that would utilize light water reactor technology—the same technology employed in the existing fleet of large commercial nuclear plants—than applications reliant on technologies with which the NRC has much less experience.

Thus, while the NRC is not contending that the deadlines in S. 2812 are unattainable, and while the NRC would make a concerted effort to make licensing decisions within any statutory timeframe, the NRC emphasizes that the time and resources it will need to develop the appropriate infrastructure and conduct any necessary confirmatory research could vary substantially depending upon which small modular reactor technologies are ultimately pursued. S. 2812 does set target dates for ultimate receipt of NRC licenses, but it sets no deadline for determining which technologies will be chosen as the basis for the designs that the DOE and its private-sector partners would seek to have licensed. Therefore, it is not

clear how much advance warning the NRC would have about which technologies the license applications will reference.

In addition, pursuant to its Atomic Energy Act responsibilities, the NRC will not grant a license if the applicant does not demonstrate to the NRC that public health and safety and common defense and security will be adequately protected. Therefore, for the deadlines in S. 2812 to be met, the NRC would need to receive appropriations adequate to support any necessary infrastructure development and confirmatory research as well as the application reviews themselves, and applicants would need to submit high quality applications in a timely manner.

In light of the considerations described above, the NRC suggests adding language to the deadline provisions of S. 2812 to ensure there is no undue pressure on the DOE or the NRC to compromise on safety or security because of impending statutory deadlines. Section 645 of the Energy Policy Act of 2005 provides an example of possible alternative language. That act established the Next Generation Nuclear Plant Project, and Section 645(c) sets forth a specific date by which the DOE is to complete construction and begin operations of a prototype nuclear plant and associated facilities. But Section 645(c) also gives the DOE the option—in the event it cannot comply with the statutory deadline—of "submit[ting] to Congress a report establishing an alternative date for completion." The NRC believes that similar safety-valve language would be appropriate for S. 2812 to account for any complications related to safety or security that might arise as new small modular reactor technologies are developed and assessed.

If you have questions about these views, please do not hesitate to contact me.

Sincerely,

GREGORY B. JACZKO,
Chairman.

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. 2052, 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.

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TITLE IX—RESEARCH AND DEVELOPMENT

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Subtitle E—Nuclear Energy

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SEC. 952. NUCLEAR ENERGY RESEARCH PROGRAMS.

(a) NUCLEAR ENERGY RESEARCH INITIATIVE.—

(1) IN GENERAL.—The Secretary shall carry out a Nuclear Energy Research Initiative for research and development related to nuclear energy.

(2) AUTHORIZED RESEARCH INITIATIVES.—In carrying out the program under this subsection, the Secretary shall conduct research to lower the cost of nuclear reactor systems, including research regarding—

(A) modular and small-scale reactors;

(B) balance-of plant issues;

(C) cost-efficient manufacturing and construction;

(D) licensing issues; and

(E) enhanced proliferation controls.

(3) CONSULTATION REQUIREMENT.—In carrying out initiatives under paragraph (2), the Secretary shall consult with—

(A) the Secretary of Commerce;

(B) the Secretary of the Treasury;

(C) the Nuclear Regulatory Commission; and

(D) any other individual who the Secretary determines to be necessary.

(4) SCHEDULE.—

(A) IN GENERAL.—Not later than 180 days after the date of enactment of this paragraph, the Secretary shall develop and publish on the website of the Department of Energy a schedule that contains an outline of a 5-year strategy to lower effectively the costs of nuclear reactors.

(B) PUBLIC WORKSHOPS.—In developing the schedule under subparagraph (A), the Secretary shall conduct public workshops to provide an opportunity for public comment.

(C) REVIEW.—Before the date on which the Secretary publishes the schedule under subparagraph (A), the Nuclear Energy Advisory Committee shall conduct a review of the schedule.

(D) ANNUAL UPDATES.—

(i) IN GENERAL.—Not later than 180 days after the date on which the Secretary publishes the schedule under subparagraph (A) and annually thereafter, the Secretary shall update this schedule.

(ii) PUBLIC WORKSHOPS.—In updating the schedule under clause (i), the Secretary shall conduct public workshops in accordance with subparagraph (B).

(5) COST SHARING.—Section 988 shall apply to initiatives carried out under this section.

(6) AUTHORIZATION OF APPROPRIATIONS.—There is authorized to be appropriated to carry out this section $50,000,000 for each of fiscal years 2011 through 2015.

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