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SMR Deployment Faces Challenges despite National Interest A Summary of Findings from the November 14 CSIS Workshop on SMRs

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Roughly 40 participants from the federal government, industry, and environmental community gathered together in a three-hour session to discuss two issues:

1. Why electric utilities are interested in small modular reactors (SMR) and their potential domestic market; and
2. The potential role for the U.S. government—outside of the Department of Energy (DOE) SMR program—in helping develop the domestic *and* global market for SMRs.

Below is a brief summary of the discussion, which was governed by the Chatham House rule. For each of the key topics, the Nuclear Energy Program at CSIS recommends follow-up to significant policy points and concerns that were identified during the event.

1. Why are electric utilities interested in small modular reactors?

The licensing process of the Nuclear Regulatory Commission (NRC) must be addressed to commercialize SMRs. However, a wide range of electric utilities are increasingly interested in SMRs, ranging in size from small municipals and rural cooperatives to the largest publicly and privately owned entities. The Tennessee Valley Authority, for example, is working with Babcock & Wilcox on a plan to build reactors to supply power to their service area in Oak Ridge, Tennessee. Ameren also has partnered with Westinghouse to develop plans to deploy an SMR in Missouri. At the same time, Energy Northwest, a public power utility, is collaborating with NuScale, and Public Service Electric and Gas Company (PSEG) has teamed up with Holtec.

Many utilities are intrigued by the potential role that small modular reactors could play in their electricity mix, given the likelihood of continued air quality regulation and increased renewable penetration. Although SMRs are about a decade away from commercialization in the United States, utility executives understand that addressing the regulatory process and other challenges to deployment needs to start today if SMRs are to be available in time to help the power sector comply with anticipated Environmental Protection Agency (EPA) rules and provide clean, reliable power to a growing economy and expanding population.

Policy uncertainty at the federal and state level clearly impacts the thought process of utility executives as they ponder what that means for investment decisions in power generation. A number of participants pointed to mandates and subsidies for renewables at the federal and state level as significant obstacles to the maintenance of existing nuclear plants and the building of new nuclear power, including SMRs.

In the opinion of some contributors, these market “distortions” or “externalities” must be addressed in merchant electricity markets before SMRs can be deployed. In addition, the failure of merchant markets to adequately value reliability and other critical infrastructure functions further damage investment prospects in any new nuclear plant construction.

Utilities operating in regulated markets, however, are better situated to manage these problems because of the role of public utility commissions (PUCs), which have remained committed to ensuring power price stability and security and diversity of supply for their constituents. Government-backed utilities like the Tennessee Valley

Authority and Bonneville Power Administration act much like regulated market utilities and are also able to consider long-term impacts and the need for an appropriate mix of new generation.

Still, the economics of nuclear power across the country is likely to improve over time. Over the next decade, natural gas prices are expected to increase because of greater regulation of hydraulic fracturing and fuel switching by electric companies from coal to natural gas as a result of EPA rules. In addition, new chemical plants and liquefied natural gas (LNG) facilities, and subsequent exports, will drive up demand for natural gas. If the climate agenda progresses over the coming decades and overcomes litigation challenges, natural gas generation will face increased pressure from tighter air quality emissions standards. President Barack Obama has called for a reduction in U.S. greenhouse gas (GHG) emissions by more than 80 percent by 2050, which if pursued will force major quantities of natural gas generation from the nation's electricity supply.

Non-hydro renewables (with exceptions such as waste-to-energy) are expected to remain an intermittent source for power generation in the foreseeable future, despite the likelihood of continued government support. Because of the structure of government policies that actually deter private investment, a major breakthrough over the next few decades in storage technology is not expected—an occurrence that would enable wind and solar to transition to base load power. In addition, transmission infrastructure issues are likely to remain a substantial hurdle, given the distance between areas of the country with abundant and economic renewable resources and urban areas. It was also noted that greater renewable penetration will have the potential to increase the importance of SMRs, which have significant value in distributed generation and can play a stabilizing role in a grid.

Many utilities find SMRs more compelling than larger reactors because of the reduced financial risk and the ability to finance them in phases or reactor unit-by-unit. Four new AP1000 nuclear reactors are currently being constructed domestically, but most utilities are not inclined to finance the multibillion dollar investment that large reactors represent—up to \$10 billion or more in a new plant. Even the largest of the privately held companies that supply most of the country's electricity have market capitalizations of less than \$40 billion, and most are half that number. In addition, utilities could deploy SMRs on existing nuclear reactor locations, as well as on retired coal plant sites, further reducing costs.

Another consideration is load growth in most areas of the country, which is unlikely to support the economics of building new large generation. Because of their smaller capacity, SMRs allow for matching smaller load growth requirements—a quality that is particularly attractive to municipalities and rural electric cooperatives.

SMR technology also incorporates post-Fukushima lessons, including passive safety features that make it extremely unlikely that a Fukushima-type event can occur. In addition, because of their size and reduced complexity, SMRs have a smaller footprint, which allows for greater flexibility in siting. Although SMRs may have lower staffing requirements including security personnel, issues with NRC regulation will have to be resolved. The generally simpler design of SMRs should also reduce maintenance costs. As some more advanced designs can be air-cooled, there is potential for minimizing water usage as well.

CSIS Nuclear Energy Program Recommendations:

- Broader nuclear and base load policy discussions, as well as those impacting SMRs, should focus on the status of electricity markets, distinguishing between merchant and regulated markets, as well as recognizing the significant differences between smaller municipalities and cooperatives and larger companies that have generation fleets.
- Because the power sector is impacted by federal and state policy, involving multiple government entities, there needs to be a more comprehensive approach to educating policymakers, their staff, and thought leaders. Few people in Washington actually understand how federal policy combines with state regulation to impact investment decisions in the power sector.

- Federal policymaking that affects electricity markets involves a number of different agencies and departments—including EPA, the Federal Energy Regulatory Commission (FERC), DOE, and the Treasury Department. Accordingly, we recommend that the White House appoint a person to coordinate that interagency activity and then coordinate with relevant state authorities to craft a more integrated governmental approach to policymaking that impacts the power sector.

2. What is the potential role of the federal government in helping develop the domestic and global market for small modular reactors?

There was overall agreement that the federal government should promote the development and deployment of SMRs, domestically and internationally, specifically for the following reasons:

- The understanding that a strong civil nuclear program gives the United States greater ability to influence global nuclear safety and nonproliferation standards;
- The need for reliable, affordable electricity that meets air quality standards and expected load growth, particularly in the face of increased renewable penetration; and
- The recognition that a successful SMR program would create jobs and place the United States in a better competitive position to capture what is likely to be a key nuclear export market.

As noted by many respondents, these comments also apply to the civil nuclear sector in general—not just to SMRs.

Recognizing that NRC licensing and regulatory issues have been discussed frequently in other venues, this exchange focused on the potential role of other federal agencies and departments in supporting SMRs. Certainly, the federal government is in the early stages of SMR policy development, but important steps have been taken by DOE to advance U.S. leadership in the technology.

The DOE SMR Licensing Technical Support (LTS) program is progressing. Under the program, DOE plans to provide \$452 million over six years to two SMR designs to cost-share funding and reduce risk for completion of near-term certification and licensing efforts.¹ As part of its long-term thinking, DOE has commissioned economic and market analysis studies that will help policymakers and stakeholders understand the economics of SMR deployment and help to establish the role the federal government could play in commercialization.

As the NRC SMR licensing process progresses, industry participants asked for federal policy to begin the transition to the next phase of helping support first movers and early adopters of first-of-a-kind SMR plants. In taking this step, the federal government could provide an indispensable role in helping fill an “order book” for a number of plants, which would support existing manufacturing capacity, drive down production costs, and increase the odds of wider domestic deployment of SMRs. DOE is considering how loan guarantees, long-term power purchase agreements (PPAs), or other tax incentives or policies could also reduce financial risks to utilities, which would own and operate the plants.

However, contributors noted that agencies and departments do not typically allow for long-term PPAs for nuclear power due to the economics involved.² This issue would need to be addressed in order to make the economics work for utility investment in SMRs, as at least one participant noted. Of equal concern to government participants

¹ On December 12, 2013, DOE announced the second LTS award to NuScale. The first award was given in March 2013 to mPower.

² The Department of Defense (DOD) has an authority called an energy production facility agreement (i.e., 10 U.S.C., Sec 2922a authority), which is a contract enabling the DOD to enter into agreements for the provision and operation of energy production facilities and the purchase of energy from such facilities (DOD, *Annual Energy Management Report: Fiscal Year 2012*, June 2013, p. 34, http://www.acq.osd.mil/ie/energy/energymgmt_report/FY%202012%20AEMR.pdf). This authority allows DOD to initiate an up to 30-year PPA. However, under its 10 U.S.C., Sec 2922a authority, DOD projects must be life cycle cost effective.

was how such a PPA would be scored in specific agency budgets and how the Office of Management and Budget (OMB) and the Congressional Budget Office (CBO) would review those efforts. One agency participant noted that a better approach would simply consider each source equally based on technical feasibility and cost competitiveness. Additionally, federal procurement of power from SMRs would need to square with existing renewable energy requirements for agencies that do not give “clean energy” credit to nuclear power. It was noted that most, if not all, agencies would not favor adding nuclear power in the renewable energy definition for goal purposes.

Many participants argued that the positive attributes of nuclear that are not already considered in federal procurement policy should somehow be given value and included in an agency’s decisionmaking process in determining its mix of electricity supply. Such a deliberation should examine factors like reliability and the national security co-benefits of a healthy U.S. nuclear power program, including SMRs. Moreover, at least one industry participant identified the potential value of SMRs in helping address the vulnerability of U.S. military bases and sensitive data centers to power disruptions from terrorists, cyber attack, or natural phenomena (e.g., tornados and hurricanes). Some SMR designs could provide continuous base load power on a single fuel loading for four or more years, providing a military base and its environs with reliability that is independent of the commercial grid.³

However, if considered in isolation, load requirements for most facilities could severely limit SMR deployment. For example, the leading U.S. SMR designs (the light-water-based designs that are most likely to be deployed in the 2020–2025 timeframe) typically produce much more electricity than is required by the average military installation.⁴ There are advanced SMR designs that may be compatible with the load requirements of individual bases, but these designs have a much longer-term licensing horizon. In most cases, multiple federal facilities, involving several agencies and departments, would need to be involved to help justify a U.S. government business case for a dedicated SMR. For its part, DOE is supporting a study that will address the feasibility of siting SMRs in the Hampton Roads, Virginia, area and identify at least five locations across the United States that have “clusters” of federal facilities requiring high energy use.

Given the limits of domestic deployment, a number of participants emphasized the importance of global markets and the need to pursue an aggressive, rational approach to nuclear trade that would lead to robust SMR exports. We expect smaller developed and developing economies to pursue SMRs—rather than large reactors—for the same reasons that have resulted in smaller U.S. utilities, cooperatives, and municipals expressing an interest in SMRs.

A number of nuclear suppliers, including South Korea and Russia, are already positioning themselves to capture these markets. These suppliers are frequently at least partially government owned with government financing and other government-based market supports, including potential “fuel take-back” programs where used nuclear fuel is returned. For smaller countries interested in clean energy, such programs create a distinct market advantage.

A U.S. failure to take advantage of trade opportunities would place the domestic SMR industry in peril. Depending on assumptions regarding the size and scope of industry, experts estimate a wide range of how many SMR annual orders are needed to sustain long-term profitable manufacturing viability here in the United States—from roughly 10 to 50. However, participants agreed that the nation’s ability to negotiate timely 123 Agreements successfully and maintain a regulatory regime for export control that does not disadvantage U.S. firms vis-à-vis their foreign competitors is vital to building and preserving the domestic SMR enterprise.

³ It is important to note that DOD currently has on-site power generation on some of its installations that provide reliable and continuous power (e.g., waste-to-energy and natural gas power plants). Thus, DOD support for SMRs to fulfill base load power would also need to balance with economic and technical feasibility.

⁴ While the overall production capacity of a complete SMR facility might be more than needed, individual SMRs (45 MWe) can be dedicated to a specific application if the transmission supports this.

The State Department plays a key role in helping develop foreign markets for U.S. vendors. Besides leading U.S. efforts to negotiate 123 Agreements, the department identifies capacity-building issues, including reforms and other steps needed to create an investment climate favorable for SMR deployment and to enable exports. Consequently, the timeline of the State Department's work with foreign governments should be aligned as much as possible with what other federal entities, including NRC, are doing to commercialize SMRs domestically.

CSIS Nuclear Energy Program Recommendations:

- SMR-related policy discussions should focus on tackling “mundane” issues that have major impacts on agency decisions, including their ability to enter into long-term PPAs and how OMB and CBO will score these actions. Moreover, the question of how all positive attributes of nuclear power can be included in energy supply procurement needs to be answered.
- These “mundane” issues are highly relevant to the potential multiagency effort to build a business case for SMRs, given the need to align PPAs, scoring, and other related issues. Perhaps, an interagency task force, with stakeholder input, should be formed as a follow-up to DOE's upcoming study on understanding the energy demands of “clusters” of federal facilities.
- Furthermore, in our opinion, we *should not* seek a revision of an agency's definition of renewable energy that would allow nuclear to qualify because of the politics surrounding the artificial renewable energy market. However, we *should* seek to focus on “carbon-free” sources of energy rather than restricting options to the accepted “renewable” energy definition.
- Domestic and international policymaking on civil nuclear power needs better alignment. U.S. policymakers require a better understanding of the link between U.S. domestic manufacturing capacity—including the SMR program—and foreign markets. They also need to realize that foreign competitors will certainly seize the SMR market if the United States does not act decisively on the trade front. Specifically, we see a need to develop a U.S. policy/agenda for advocacy of SMR concepts along with 123 Agreement efforts to facilitate international sales and deployment of U.S. SMR technology.
- Unless addressed adequately, these issues will represent a substantial hurdle to effective federal support of SMR deployment—both domestically and internationally.

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