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on S. 512, "The Nuclear Power 2021 Act"

and

S. 1067, "The Nuclear Energy Research Initiative Improvement Act of 2011"

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Good morning. On behalf of the Union of Concerned Scientists, I would like to thank Chairman Bingaman, Ranking Member Murkowski, and the other distinguished members of the Committee on Energy and Natural Resources for the opportunity to provide our views on S. 512, the Nuclear Power 2021 Act, and S. 1067, the Nuclear Energy Research Initiative Improvement Act of 2011.

The Union of Concerned Scientists is neither pro nor anti-nuclear power, but has served as a nuclear power safety and security watchdog for over 40 years. UCS is also deeply concerned about global climate change and has not ruled out an expansion of nuclear power as an option to help reduce greenhouse gas emissions—provided that it is affordable relative to other low-carbon options and that it meets very high standards of safety and security. However, the Fukushima Daiichi crisis has revealed significant vulnerabilities in nuclear safety. If we want to reduce the risk of another Fukushima in the future, new nuclear plants will have to be substantially safer than the current generation. To this end, we appreciate the initiative of members of Congress who seek to bolster the development of innovative nuclear technologies through legislation such as S. 512. But to help ensure that the Energy Department will spend taxpayer money only on technologies that will actually increase nuclear safety, we believe that S. 512 should provide more stringent and specific safety criteria than it currently does.

S. 512 supports the development and licensing of two small modular reactor (SMR) designs, which are defined by the bill to be less than 300 electric megawatts. In our view, any advantages that SMRs may offer over larger reactors would be modest at best. On the other hand, unless

they are carefully designed, licensed, deployed and inspected, SMRs could pose greater safety, security and proliferation risks than large reactors.

Because nuclear reactor costs follow the principle of economies of scale, smaller reactors will begin with a large economic disadvantage. For example, a standard formula indicates that the overnight capital cost per kilowatt of a 125 megawatt reactor would be roughly 2.5 times greater than that of a 1250 megawatt unit, all other factors being equal. Advocates argue that SMRs offer advantages that can offset this economic penalty, such as a better match of supply and demand, reduced up-front financing costs, reduced construction times, and an accelerated benefit from learning from the construction of multiple units. However, a 2007 paper by Westinghouse scientists and their collaborators that quantified the cost savings associated with some of these factors did not find that they could overcome the size penalty: the paper found that at best, the capital cost of four 335 megawatt reactors was slightly greater than that of one 1340 megawatt reactor.[1]

Given that there is no apparent capital cost benefit for SMRs, it is not surprising that the SMR industry is seeking to reduce operating and maintenance (O&M) costs by pressuring the Nuclear Regulatory Commission to weaken certain regulatory requirements for SMRs. Deputy Assistant Energy Secretary John Kelly told the Nuclear Regulatory Commission in March that the NRC's regulatory requirements for SMRs will "directly influence the operating cost, which will be a large determinant into the economic feasibility of these plants."

[1] M.D. Carelli et al., "Economic Comparison of Different Size Nuclear Reactors," 2007 LAS/ANS Symposium, Cancun, Mexico, 1-5 July 2007. Available at http://www.las-ans.org.br/Papers%202007/pdfs/Paper062.pdf

For example, the industry argues that regulatory requirements for SMRs in areas such as emergency planning, control room staffing and security staffing can be weakened because SMRs contain smaller quantities of radioactive substances than large reactors and therefore pose lower risks to the public. The NRC is currently considering the technical merits of these arguments. But even a single 50-megawatt SMR will contain an enormous quantity of radioactive fission products and could pose a severe public health threat if the core is damaged by an accident or sabotage.

Moreover, small reactors will not necessarily be safer than large reactors on a per-megawatt basis. Simply put, the risk to the public posed by one 1200-megawatt reactor will be comparable to that posed by six 200-megawatt reactors (assuming that all units are independent), unless the likelihood of a serious accident is significantly lower for each small reactor. But such an outcome will not be assured under the current regulatory regime. The Nuclear Regulatory Commission has a long-standing policy that new nuclear reactors, large or small, are not required to be safer than operating reactors. One consequence of this policy is that new reactor designs that have inherent safety features not present in current reactors may not actually end up being safer in the final analysis if designers compensate by narrowing safety margins in other areas, such as by reducing containment strength or the diversity and redundancy of safety systems. Any safety advantages will be eroded further if the NRC allows SMR owners to reduce emergency planning zones and the numbers of operators and security officers per reactor.

One of the early lessons from Fukushima is that prevention of serious nuclear accidents requires significant margins of safety to protect against extreme events. After Fukushima the NRC should be strengthening nuclear safety requirements across the board, rather than weakening them for SMRs. Consider the following examples:

- Emergency planning zones around U.S. nuclear plants extend to a radius of ten miles. Yet significant radiological contamination from the Fukushima accident has been detected well beyond a distance of ten miles from the plant. In fact, radiation levels high enough to trigger resettlement if they occurred in the United States have been detected over 30 miles away from the Fukushima site. The discussion we should be having today is whether current emergency planning zones need to be increased, not whether we can shrink them for SMRs.
- As we have seen in Fukushima, nuclear plants with multiple reactors that experience severe conditions present extreme challenges. At Fukushima, the need to manage multiple simultaneous crises resulted in what sometimes appeared to be a game of "whack-a-mole" as the plant operator was forced to shift limited resources from one unit to another as new problems cropped up. These considerations make multiple-reactor sites less attractive from a safety perspective. Yet many plans entail multiple SMRs at one site—in some proposals, up to twelve SMRs would be co-located. The need to maintain adequate physical separation between individual SMRs and sufficient equipment and resources to ensure all the reactors could be safely shutdown and managed in an emergency would likely drive up costs.
- Fukushima also demonstrated how rapidly a nuclear reactor accident can progress to a core meltdown if multiple safety systems are disabled. A well-planned and executed

terrorist attack could cause damage comparable to or worse than the earthquake and tsunami that initiated the Fukushima crisis, potentially in even less time. And although Osama bin Laden is gone, the terrorist threat to domestic infrastructure may actually increase over time as al Qaeda seeks to retaliate. This is the wrong time to consider reducing security requirements for nuclear power plants, regardless of their size.

UCS is also concerned that reducing safety and security requirements for SMRs could facilitate their sale to utilities or other entities in the United States and abroad that do not have prior experience with nuclear power. Some SMR vendors argue that their technology is well-suited for deployment to remote areas, military bases, and countries in the developing world that have relatively low electric demand and no nuclear experience or emergency planning infrastructure. In the United States, for example, a rural electric cooperative might be interested in replacing an old coal-fired plant with a small nuclear plant. As another example, high-temperature gas-cooled SMR vendors are marketing reactors to the chemical industry worldwide for the production of process heat. However, SMRs deployed in this manner would raise additional safety, security and proliferation concerns compared to their deployment by experienced nuclear utilities.

The distributed deployment of small reactors would put great strains on licensing and inspection resources. Nuclear reactors are qualitatively different from other types of generating facilities, not least because they require a much more intensive safety and security inspection regime. Similarly, deployment of individual small reactors at widely distributed and remote sites around the world would strain the resources of the International Atomic Energy Agency (IAEA) and its ability to adequately safeguard reactors to guard against proliferation, since IAEA inspectors would need to visit many more locations per installed megawatt around the world. Maintaining

robust oversight over vast networks of SMRs around the world would be difficult, if even feasible.

UCS does not support the deployment of SMRs to any entity that does not have a demonstrated or plausible capability to manage and operate nuclear facilities safely. UCS believes that the United States needs to carefully control the deployment of SMRs, especially those that it supports through proposed cost-sharing programs.

How can legislation address these problems? S. 512 has a provision that requires DOE to take into account "the efficiency, cost, safety and proliferation resistance of competing reactor designs." We would suggest that even more stringent factors be applied. Congress should direct DOE to consider only designs that have the potential to provide significantly greater levels of safety and security than currently operating reactors (and hence exceed NRC requirements). As a corollary, Congress should prohibit DOE from selecting designs with a business case that depends on a weakening of NRC safety and security regulations or marketing reactors to countries with inadequate safety rules.

S. 512 requires DOE to establish a program to develop designs for two SMRs and then to obtain design certifications from the NRC by January 1, 2018 and combined operating licenses by January 1, 2021. We are concerned about the establishment of statutory requirements of dates certain for the completion of licensing actions on these new reactor designs. This requirement could put undue political pressure on the NRC to accelerate its reviews of these novel

technologies (if, for instance, DOE blames the NRC for schedule delays), and potentially force it to cut short its examination of complex technical issues. It would be counterproductive to undermine the thoroughness of the review of new reactor designs, because it would be much more costly to fix problems discovered after construction has already begun. Therefore, we respectfully suggest that while the bill could instead impose a deadline on DOE to submit its licensing applications to the NRC, it should not impose a deadline on the final approval of those applications, but rather let the NRC reviews proceed at a pace determined by the technical complexity of the reviews.

We would also like to comment on S. 1067, which requires the Secretary of Energy to conduct a research program to "lower the cost of nuclear reactor systems." We suggest that the bill direct the Secretary to "conduct research to lower the cost of nuclear reactor systems **while increasing their levels of safety and security**." After all, one can always reduce costs by cutting corners: the real research challenge is how to reduce cost without compromising safety. Given that the Fukushima accident review may well indicate the need for additional—and potentially costly—safety requirements for both operating and new reactors, there is an acute need for research on how to enhance safety as cost-effectively as possible.

Thank you for your attention. I would be pleased to answer your questions.