## Testimony of Nuclear Regulatory Commissioner William D. Magwood, IV Before the U.S. Senate Appropriations Subcommittee on Energy and Water Development, and Related Agencies

## July 14, 2011

Chairman Feinstein, Ranking Member Alexander, and Members of the Subcommittee, I thank you for the opportunity to speak to the subcommittee this morning. I appear today as an individual member of the Commission and will provide my personal views and perspectives. I am not here today to represent the Commission as a whole or to speak for the agency.

The various technology concepts that have become known collectively as "small modular reactors" or "SMRs" have generated a great deal of attention and interest in recent years. The prospects for SMRs have garnered considerable press coverage, significant interest in industry circles, and support from members of Congress and the Administration.

I understand this interest. For utilities, SMRs present the possibility of a new financial model for nuclear power plant deployment—one which allows generating assets to be built and installed on a more certain and predictable basis. Utilities are also attracted by the idea that reactors could be deployed in a modular fashion, avoiding the large, up-front costs inherent to today's nuclear plants.

For vendors, SMRs are technologies that could be manufactured in U.S. facilities at lower and more predicable cost than is typical of conventional nuclear reactors. They envision large numbers of SMRs being built to meet a range of energy requirements, including the possible replacement of outdated, small coal-fired power plants across the country.

For many government officials, SMRs provide a means to support the revitalization of the Nation's heavy manufacturing base, providing thousands of well-paid, skilled jobs, and reducing U.S. reliance on overseas suppliers for vital energy technologies.

These are all laudable and important interests. However, as I'm sure the subcommittee will hear over the course of this morning, all of these possibilities are still just that—possibilities. We are only at the first early steps of this venture and there is much work still to do.

That is not to say that SMRs are a new idea. The conceptual benefits of small reactors have been the subject of discussion and analysis for decades, and all the potential benefits I've mentioned have been considered in the past. The potential advantages of smaller reactors prompted the government to provide considerable financial support for the development of the mid-size, passive-safety reactors in the 1990s and to encourage the pursuit of the pebble-bed modular reactor in the early years of this century. Both efforts proved unable to overcome the economic realities of building and operating nuclear power plants—realities that tend to penalize small reactors and reward larger designs. Thus, instead of the AP-600 and 500 megawatt Simplified Boiling Water Reactor of the early 1990s, the market pushed vendors to increase the size of their designs; today, vendors offer Generation III+ technologies based on those smaller systems—the 1100 megawatt AP-1000 and the 1600 megawatt Economic Simplified Boiling Water Reactor.

Around the turn of the century, both DOE and industry became interested in the Pebble Bed Modular Reactor, or PBMR. This was a small, high-temperature gas-cooled reactor with a generating capacity of about 165 megawatts. This technology captured considerable media attention after U.S. companies became involved in an effort to build a commercial pilot in South Africa. However, as the high costs of the project became apparent, commercial participants began to peel away and eventually the South African project was abandoned.

All small reactor technologies of the past failed to find a way to overcome the fact that the infrastructure required to safely operate a nuclear power reactor of any size is considerable. Tons of steel and concrete are needed to construct containment buildings. Control rod drives, steam generators, and other key systems are hugely expensive to design and build. A larger plant with greater electric generating capacity simply has an inherently superior opportunity to recover these large up-front costs over a reasonable period.

So why is today different from yesterday? The greatest difference is the fact that the technology has evolved significantly over the years. Having learned lessons from the development of Generation III+ technologies and from the failure of previous small reactors, today's SMR vendors clearly believe they have solved the riddle of small reactor economics. They are presenting novel design approaches that could lead to significant improvements in nuclear safety. For example, design concepts that I have seen thus far further advance the use of passive safety systems, applying gravity, natural circulation, and very large inventories of cooling water to reduce reliance on human intervention during an emergency. SMR designs also apply novel technologies such as integral pressure vessels that contain all major system components and use fewer and smaller pipes and pumps, thereby reducing the potential for a serious loss-of-coolant accident.

Very importantly, these new SMRs are much smaller than the systems designed in the 1990s; this choice was made to assure that they could be factory-built and shipped largely intact by rail for deployment. The ability to "manufacture" a reactor rather than "constructing" it on-site could prove to be a major advantage in terms of cost, schedule reliability, and even quality control.

But will innovations like these allow this new breed of SMRs to be successful? Maybe.

Many years of work remain for SMR vendors to refine their designs and allow for the development of realistic and reliable cost estimates. This is much the same state of affairs that existed in the 2002 time frame when DOE launched the Nuclear Power 2010 program to spur the development and certification of Generation III+ designs such as the AP-1000. At that time, the level of design completeness was insufficient to enable vendors to provide utilities with reliable cost and schedule estimates. After the cost-shared effort to complete more design and engineering work, vendors and utilities were able to negotiate contracts on a realistic basis. A decade later, utilities are awaiting final regulatory approval to begin constructing new plants based on technologies advanced by the Nuclear Power 2010 initiative. I understand that DOE has proposed a similar approach that is generally modeled after the success of Nuclear Power 2010 in order to further the development and licensing of SMRs.

At the same time, one often hears that the industry is concerned that the Nuclear Regulatory Commission might make decisions that will render these new systems uncompetitive. Industry representatives have voiced concern over regulatory issues such as the number of operators needed to run these reactors, the size of the security forces needed to protect them, and the requirements for emergency planning. According to these concerns, if NRC holds SMRs to the same requirements as currently operating plants, the operating costs will be too high and utilities will turn away from the potential benefits of small reactors.

In my opinion, these concerns are not well-grounded in an understanding of how the NRC develops regulatory requirements. Using security as a general example, I note that it is certainly true that NRC requires licensees to maintain significant security capabilities to protect existing nuclear power plants from a range of potential threats. U.S. nuclear plants are protected by highly trained security professionals, many of whom have military or law enforcement backgrounds. With these people on the job, U.S. nuclear plants are the most secure, best-protected privately-owned commercial facilities on the planet. Given the threats that exist in the world today, it is essential that U.S. nuclear plants be secured in this manner.

But the size of guard forces and the nature of security barriers protecting U.S. nuclear power plants are not determined by NRC in accordance with a set formula that might somehow be applied to SMRs. The security strategies of each individual plant are designed to defend these facilities against postulated threats. These strategies are tested on a periodic basis using Force-on-Force exercises and when issues arise as a result of these exercises, licensees are obligated to make the necessary adjustments. If, for example, the layout of a particular plant creates a blind spot that could be exploited by a potential adversary, then the security strategy must be modified to eliminate this vulnerability.

In my opinion, it would be perfectly reasonable to apply the same basic approach to SMRs. Future operators of SMRs should be required to deal with the same potential security threats as today's plants. The size and configuration of the security forces required for a given SMR should depend on what is needed to assure the protection of the facility. As issues are found, SMR operators should have the same responsibility as current licensees to close any security concerns.

From the early discussions I've had with SMR vendors, I understand that they are designing facilities that are to be largely subsurface facilities with security requirements anticipated in the choices made with regard to their configuration. I would expect to see the regulatory process credit the security benefits of design, configuration, and plant lay-out—just as it does in the case of today's plants. I therefore believe the current regulatory approach provides a reasonable framework for industry to pursue the development and deployment of small reactors.

Hopefully, this simple example illustrates what I believe is a vital point. Whatever else they are, SMRs are power reactors. While the size of SMRs may eventually prove to have financial or implementation benefits, the fact that they are "small" has far less significance from a regulatory standpoint than I think many expect. SMR concepts may have unique characteristics that prompt issues such as the size of security forces and control room operations, but the basic concepts related to the licensing of reactors should not fundamentally change as a result of the size of the reactors. That said, SMR vendors have proposed design concepts that, if fully realized, incorporate technologies and approaches that can have significant safety benefits. The application of passive safety design strategies, very large water inventories, and subsurface configurations all must be considered as risk-informed regulatory decisions are made.

The safety and security of the American people require a clear, strong, and consistent regulatory approach if the construction and operation of SMRs is to be permitted. At the same time, it is only rational to apply this regulatory approach in a graded manner that takes account of the safety and security risks presented by each design. I have been informed that the NRC

staff is already working on these issues and considering how best to apply this framework to SMR designs.

While I have attempted to draw a clear line today to identify fundamental issues, there remain numerous complex regulatory decisions to be made. I still have many questions that will need to be answered. For example, what are the safety and security implications of installing single SMRs in remote locations? In the case of multi-module facilities, what measures might be necessary to assure the safety of adjacent modules should a problem occur with one reactor?

It is important to highlight the fact that industry has not yet submitted SMR applications for regulatory review. Once this is done, I'm certain that for each SMR design, there will be a public, transparent discussion about these and no doubt many other issues. In anticipation of applications that could be forthcoming in 2012 and 2013, the NRC staff recently issued a general schedule anticipating that SMR-relevant analysis, stakeholder interaction, and publication of guidance documents regarding issues such as emergency planning requirements and control room staffing will continue into next year.

At the end of the day, as these issues are discussed and resolved, I do not expect that the outcomes of decisions made by NRC are likely to be the critical factor in the success or failure of SMRs. More likely, the success or failure of this newest attempt to build small reactors will depend on the ability of today's SMR vendors to avoid the pitfalls of the past.

Thank you for your attention.