WRITTEN TESTIMONY

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UNITED STATES NUCLEAR REGULATORY COMMISSION

TO THE

COMMITTEE ON ENERGY AND NATURAL RESOURCES

UNITED STATES SENATE

HEARING ON SMALL MODULAR REACTORS

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Mr. Chairman and Members of the Committee, thank you for inviting me to participate in this hearing today. As Director of the U.S. Nuclear Regulatory Commission's (NRC's) Office of New Reactors, I am pleased to have this opportunity to discuss the status of the NRC's preparation activities for performing licensing reviews of small modular reactors (SMRs).

The NRC's job is to license and regulate the Nation's civilian use of byproduct, source, and special nuclear materials in order to protect the public health and safety, promote the common defense and security, and protect the environment. In this capacity, the NRC has been approached by a number of vendors interested in design certifications for a new class of reactors, described as SMRs.

While there is no universally accepted definition of these designs, the power levels for a single module are generally below 300 megawatts electric, and multiple modules can be

installed at a single site. For the purposes of this testimony, we are categorizing the designs -- based on the underlying technology -- as integral pressurized-water reactors (iPWRs), high-temperature gas-cooled reactors (HTGRs), and liquid metal reactors (LMRs). The iPWRs are similar to existing power reactors but are physically smaller, produce less power, and have the steam generators and circulation pumps, if any, installed inside the reactor pressure vessel rather than as separate components. In contrast to iPWRs that use water as the coolant, HTGRs use helium gas as the coolant and operate at much higher temperatures. Experience with HTGRs is limited in the United States, as the Peach Bottom Unit 1 reactor received its operating license in 1966 and was shut down in 1979, and the Fort St. Vrain reactor received its operating license in 1973 and was shut down in 1989.

Liquid metal reactors are significantly different from iPWRs and HTGRs and use liquid metals, such as sodium, as the coolant. The NRC has limited experience in licensing LMR designs, as the agency was conducting a regulatory review of the Clinch River reactor in the early 1980s until the project was terminated in 1983. Review of these SMRs was done on a case-by-case basis without the benefit of well-developed regulatory guidance governing the submission and review of these applications. Development of regulatory guidance would increase the effectiveness and efficiency of the review process and enhance regulatory stability.

The NRC has to a limited extent, been engaged in the review of modular reactors since the mid-1980s. This consisted of preliminary reviews of three conceptual modular reactor designs submitted by the U.S. Department of Energy (DOE). Of these reviews, two were for LMRs (a sodium advanced fast reactor and a power reactor innovative small module) and the other was for an HTGR (a modular high-temperature gas-cooled

reactor). Although formal applications for these designs were never submitted, the preliminary reviews conducted by the NRC provided insights into the key safety and licensing issues for non-light-water reactors.

More recently, in 2004, at the request of the company PBMR Propriety (Pty) Limited, the NRC began a limited scope preliminary review of the pebble bed modular reactor (PBMR), an HTGR design. PBMR (Pty) Limited began submitting a series of white papers to address technical and policy issues. The NRC performed limited reviews of several of the papers but stopped because of the need to focus on work with higher and more immediate priority.

The NRC has received letters from potential SMR licensing applicants outlining proposed application submittal dates. If these plans materialize, the NRC could receive an application for the licensing of an SMR as early as fiscal year (FY) 2011. In or around FY 2012, the NRC expects to receive applications for multiple design certifications, early site permits, combined licenses, and manufacturing licenses related to SMRs. Additionally, the Next Generation Nuclear Plant (NGNP) program is expected to provide a design certification application to the NRC in FY 2013, which will be preceded by pre-application discussions. The NRC has been working closely with DOE to ensure that we will be ready to review this application.

In anticipation of these activities, we established the Advanced Reactor Program, which is dedicated to preparing for and conducting licensing reviews of the SMRs. Our existing regulations and guidance are focused on light-water reactors and do not necessarily translate to other technologies. Therefore, we are identifying and executing needed research, developing analytical tools, identifying and resolving policy issues that could

affect one or all three of the technologies, and preparing review guidance for both the staff and industry. We are also developing the reviewer skills and implementing knowledge management activities to support future licensing activities. This is consistent with the approach being used for the NGNP.

Optimally, the necessary regulatory framework for licensing SMR technologies will be developed in parallel with, and not subsequent to, the development of the SMR technologies themselves. To that end, we have been interacting with the national and international community to stay abreast of developments and refinements in the SMR technologies. We are coordinating research and licensing activities with organizations such as the International Atomic Energy Agency, the Nuclear Energy Agency within the Organization for Economic Cooperation and Development, and the Generation IV International Forum. The NRC has both multilateral and bilateral agreements with many countries, and, as appropriate, we are discussing SMR development and licensing with these countries.

As we have undertaken the review of our regulations and guidance for SMRs, we have identified some common issues, as well as technology-specific issues. While several technologies exist within the broad spectrum of SMRs, the staff intends to address those common licensing issues generically.

Regarding technology-specific issues, for the iPWRs, we are in a relatively good position to undertake these licensing reviews. Our initial assessments suggest that we will need only limited research and revisions to existing regulations and guidance to support licensing activities.

For HTGRs, consistent with the NGNP, the NRC has been working with DOE to develop and coordinate research activities needed to support licensing reviews of these designs. We also are identifying policy issues and gaps in our review guidance and are beginning activities to resolve them. The NRC is sponsoring research that focuses on key issues for HTGRs, such as modeling reactor system performance and materials exposed to very high temperatures. These research activities coupled with those from DOE are expected to support the resolution of licensing issues for HTGRs. While substantial work remains to be completed, the activities underway should support the Agency's licensing review of an HTGR design.

For LMRs, the NRC is just starting to review the regulations and guidance pertinent to these designs. While earlier LMR designs have been reviewed in the United States, we anticipate that many changes will be needed to the existing light-water reactor guidance, and perhaps to the regulations, to support efficient licensing of the new LMR designs. We also expect that significant research will be needed to support these changes. Given the magnitude of the work required and the NRC staff's limited experience with LMRs, preparing the staff to review a LMR licensing application may take several years.

In general, the NRC staff's readiness to review the various reactor technologies will also largely depend on the level of innovation in the proposed design. As increasingly innovative technologies are introduced, it becomes even more important that the development of requirements and regulatory review guidance proceed in tandem with technology development to the extent possible. Furthermore, as applications are submitted to the NRC, the agency's ability to conduct efficient and timely reviews will largely depend on the applicant's ability to submit complete, technically adequate applications of high quality.

In summary, the NRC is working proactively to fulfill its mission and be prepared to review design certification and combined license applications for the different SMR technologies. We appreciate the support we have received from the Congress for our activities in this area. We are actively engaged with our many stakeholders and the international community with respect to the different SMR technologies. The NRC has much work to do before commencing licensing reviews for SMR, but we continue to make progress and look forward to updating the Congress as we proceed.