Written Testimony Of
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Hearing on
Powering the Nuclear Renaissance: Accelerating U.S. Leadership in Advanced Nuclear Reactors

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Brief synopsis of testimony

- The deployment of a fleet of advanced nuclear reactors can be accelerated through support of advanced research and testing infrastructure, including on-campus advanced reactor facilities, that can support both technology advancement and hands-on workforce development training.
- To achieve the workforce needs for a target of 300GW of additional nuclear capacity on top of our current 100GW capacity, the infrastructure for training trades, engineers, and researchers will need to grow comparably; programs at all levels of training will need facilities and instructors to facilitate this growth.
- Continued support of strong partnership between academia, the national laboratory network, and industry will accelerate nuclear commercialization and deployment
- Sustained federal investment aligned with the technical and workforce development needs of the nuclear sector are vital during this period of accelerating growth.

Introduction

Nuclear power in the United States is experiencing a moment that it has not seen in decades. Nuclear technologies born, cultivated, and scaled for commercialization at US universities, laboratories, and companies are ready to contribute to the nation's energy needs. Nuclear power may appear to have been put on a decades-long pause in the United States, but over those same decades, Congress has continued to invest in the research and technology development necessary to advance key area of nuclear research to ensure that reactors were safer and that new materials and designs would be ready when needed. This work and innovation continued in academia, in the national laboratories, and in industry. New materials, advanced designs, advanced instrumentation and controls, all centered on improved safety, security, and economic sustainability promise to make advanced nuclear reactors a more affordable and reliable source of energy for our nation's economy and security. This work must continue the same march as innovation efforts in other areas of the United States high technology economy. Artificial intelligence, machine learning, biotechnology, advanced manufacturing, space exploration, aviation, advanced electronics. The US leads in these areas because the work continues beyond commercialization, across universities, laboratories, and companies. Such must be the case for advanced nuclear reactor technology.

The nation's universities have consistently advanced nuclear technology and trained the skilled workforce necessary for this moment. University campuses have long been among the primary incubators for innovation and entrepreneurship across the entire technical sector, and nuclear power is no different. At this moment, the growth and innovation coming out of the nuclear sector has energized young scientists and engineers to enter the field. Enrollment in nuclear engineering programs have experienced unprecedented growth. Undergraduate enrollment in nuclear engineering at NC State has more than doubled in three short years and this year we welcomed our largest incoming class ever, with over 100 of the nation's top students currently enrolled in our introductory nuclear engineering course this fall. Peer institutions are seeing similar growth. Nuclear engineering programs at the University of Illinois, University of Tennessee, Texas A&M, and others have all experienced similar growth. Alongside this, the synergy in workforce development across the universities, laboratories, and companies continues to strengthen and grow through collaboration and integration of workforce development efforts. University led / industry driven research consortia, national laboratory collaboration with the private sector, and laboratory driven research opportunities for faculty and students help ensure that the science mission is aligned across all stakeholders. Programs such as the National Science Foundation's new University-Industry Doctoral Program (UIDP) program further strengthen these collaborations. Online offering of advanced degrees and certifications continues to grow with online delivery of certificates, masters and doctoral degrees. These programs enable continuing education for full time engineers, opportunities to train for opportunities in nuclear from other professions, and lower the practical barriers to get an advanced degree.

As the path toward commercialization accelerates, The U.S. advanced-reactor program is increasingly shifting from concept development toward integral testing, qualification, demonstration, licensing, and commercialization. Several universities, with the support of their states, have proactively worked towards the feasibility and design of on-campus advanced reactor facilities. These efforts are in close collaboration with state and industry partners and have support from both vendors and utilities and focus on both the basic science mission and the need for these facilities to accelerate deployment of these systems and provide the necessary science and training facilities to advance technology and train a growing workforce. Along the same line, the Department of Energy's Advanced Reactor Demonstration Program combines demonstrations with risk-reduction work intended to resolve technical, operational, and regulatory challenges, while facilities such as the National Reactor Innovation Center's (NRIC's) Demonstration of Microreactor Experiments (DOME) will generate experimentally measured data needed to raise the level of confidence in new designs and to facilitate licensing of first-of-a-kind reactors. The central motivation of these facilities, both at universities and the national lab system is to carry out the necessary research that will produce experimental data, qualification infrastructure, integral testing, and demonstrations required to turn advanced-reactor concepts into repeatable, licensable, economically competitive commercial plants.

Research, testing, and demonstration needs

As advanced nuclear reactor technology moves closer to deployment, the research, testing, and demonstration needs should continue to center on innovation while addressing the challenges that face the eventual deployment of commercial systems. Advanced reactors employ fuel types and materials that are a departure from the existing nuclear reactor fleet, and efforts in the qualification of existing and new fuel forms and materials should continue. Similarly, component level testing is critical for initial construction as well as continuous improvement efforts to bring down cost and improve safety margins of deployed and planned facilities. These efforts segue into efforts to experimentally validate models that will be valuable tools for reactor design and provide accurate digital twins of reactor systems for virtual design and tests of existing reactor systems and new reactor concepts. These are necessary tools for reactor and energy system demonstrations. This includes the potential for coupling advanced reactors to Thermal Energy Storage (TES) systems to address the intermittency of renewable sources while providing nuclear baseload. Finally, these efforts will also play a critical role in the licensing process for these reactors, as these smaller research scale reactors could likely be part of the first wave of license requests and could provide a valuable intermediate step toward licensing full scale commercial reactors. All of this said, commercialization and deployment should not be conflated with a perception that the foundational research that got nuclear technology to this moment should take a back seat. On the contrary, the experiments, tools, and training that is enabled by these efforts will play a significant role in the next phase of commercialization and deployment.

Technology needs - research and infrastructure

The technology challenge for advanced reactor deployment is best viewed as a combination of research and infrastructure. Reactor developers need both improved technologies but also the facilities to test, qualify, validate, demonstrate, and license them. Networking research facilities to this goal can ensure that technical gaps are minimized and access to necessary facilities and expertise is maximized. The current Nuclear Science User Facilities (NSUF) network is one of many good examples of this that are stood up by the Department of Energy. Expansion of these capabilities to provide a commercialization and deployment-centric network of facilities would play a significant role in accelerating deployment of these technologies. Several of the advanced reactor concepts proposed by universities, laboratories, and companies in response to the proposal to support construction of advanced research and test reactors on university campuses speak directly to this need. At NC State University, an advanced research and test reactor (ARTR) that has identified a national gap in testing components under the higher neutron energies expected in many advanced reactor designs is currently moving into the design and license application phase. This facility would operate in conjunction with a proposed full-scale, commercially representative molten salt loop (MSL) that is also nearing the completion of a preliminary feasibility study, enabling timely testing, data, and validation of reactor systems for energy production and thermal energy storage across a plurality of advanced reactor conditions. The University of Illinois is in the planning phase of a KRONOS microreactor that will provide necessary training and facilities for operation of high temperature gas cooled reactor systems. Abilene Christian University's proposed molten salt test reactor seeks to generate valuable NRC licensing data for liquid-fueled MSRs. The Texas A&M RELLIS facility is built around the concept of what is effectively a nuclear science park that enables vendors to construct, test, and operate reactors through commercial deployment and connection to the energy grid. Penn State, Tennessee, and Purdue University are also pursuing advanced reactor concepts in collaboration with nuclear energy stakeholders. All of these university led efforts emphasize the unique opportunities that this infrastructure will provide students, scientists, engineers, regulators and the public as the design, construction, licensing, and operation of the next generation of reactors move forward. The university-led reactors emphasize the importance of their proposed facilities in demonstrating operation of unique reactors that are built around well established advanced reactor concepts. All of these efforts have strong industry and laboratory support and partnership, highlighting the growing synergy between academic, laboratory, and industry stakeholders. All of these university-led efforts seek not to compete with industry to develop commercial reactor concepts, but instead provide the experimental, validation, and integration infrastructure that many reactor vendors, industry, and national laboratories need. Finally, the technical and workforce training potential of these reactors can be a well timed infrastructure investment to accelerate deployment of these reactors in the coming years.

Workforce needs

The nuclear industry has always had high expectations, and therefore long lead times, for the training and qualification of the workforce required to design, construct, operate, maintain, and decommission nuclear power facilities. At this moment, the demand for a trained nuclear workforce is also seeing significant growth. At a recent nuclear workforce development workshop hosted at NC State University on 20 August 2026, the reality that the need for talented trades, engineers, and scientists is greatly outpacing the rate of training in the nuclear field was reinforced multiple times by utilities, vendors, and contractors. For decades, the nuclear workforce has been experiencing significant shifts based on aging, cost reductions, and generational/cultural differences. These challenges are now compounded by an extraordinary demand for skilled workers as the commercialization and deployment of nuclear technology accelerates. To support the future fleet of advanced reactors, this workforce development network will need to expand not only in numbers but also in new knowledge, skills, and behaviors, given the unique and evolving requirements spanning the entire commercialization ecosystem from construction, operations, design, and maintenance associated with advanced reactors. The Department of Energy has heard the call. Earlier this year, ten workforce development awards totalling $49 million were granted to U.S. academic institutions, including two regional consortia led by the University of Toledo (the Great Lakes Partnership) and North Carolina State University (Consortium for Reactor Safety Training). A common strategy across these workforce development efforts integrate four critical educational pathways: universities, community colleges, trade schools/apprenticeships, and industry/national labs internships. These regional workforce hubs are a promising strategy to establish workforce ecosystems around planned reactor deployments and should continue to be part of the DOE university support portfolio. It is worth noting that the workforce development need and the need for these activities was also recognized by the nuclear industry, who are providing a generous level of matching financial support for these efforts, further emphasizing the broad acknowledgement that the nuclear workforce needs to grow, and it needs to grow now.

Universities, and the continued support and modernization of their training and research facilities, are especially important because the development of the advanced reactor workforce cannot rely exclusively on classroom education, particularly when it is recognized that these workforce needs span a broad spectrum of essential contributors including trades, construction, heavy manufacturing, engineering, research, operations, and cybersecurity. The training model needs to span the spectrum of learning environments and modalities from the classroom to the simulator to the laboratory to the research and test reactor, engineering test facility, and finally the industry experience. This path to qualification and training should seek to find parallel pathways on this model and not a strictly serial path from one learning environment to the next. For example, classroom and simulator training could be carried out in parallel with the industry experience through on-line instruction. Engineering test facilities can be used for apprenticeship training of the trades en route to full scale reactor production. The anticipated accelerated need for talent will demand pathways for accelerated workforce deployment such as these.

In order to address the safety and economic expectations for the next generation deployment of nuclear reactors, designs have employed technologies that deviate from the traditional light water moderator design of the existing commercial and military reactor fleet. These are well established technologies, but have not been broadly deployed in the United States and therefore present a knowledge gap for existing workforce more accustomed to traditional light water based systems. The nuclear workforce that is needed in this country today and in the future must gain hands-on experience with operations, measurements, irradiation experiments, thermal-hydraulic loops, non-light-water cooling loops including molten-salt or sodium systems, instrumentation, digital twins, safety analysis, and regulatory processes for the next generation of commercial reactors. Along with technology advancement needs, this is one of the strongest arguments for establishing advanced university-based research and test reactor infrastructure. The next generation of advanced reactors are of sufficiently different form and type from the previous light water reactors that many of the existing nuclear industry workforce as well as new workers will need training and education on how these reactors operate. For advanced reactors in the United States, the new workforce needs are considerably broader than those of the traditional nuclear engineering workforce. The deployment challenge requires the simultaneous expansion of engineering, skilled trades, manufacturing, construction, licensing, fuel cycle, operations, research, and digital capabilities. Safely operating and maintaining hundreds or even thousands of SMRs pose a very different set of operational, maintenance, and security challenges than the current fleet of large, geographically concentrated light water power reactors now in service. Congress and the Department of Energy must invest more in the facilities and programs that will enable this new workforce to receive the skill training necessary to support the deployment of these new reactors

DOE role in supporting these technologies

Across the technology landscape, universities and their research support mechanisms have largely centered on pre-competitive technology development. Support in this space needs to continue; this has historically been the technology readiness level (TRL) space where universities have made their most substantive contributions to technology advancement in the United States, and other technology domains have continued to benefit from pre-competitive discovery at the university level long after their industry sectors have moved into a predominantly competitive landscape. As advanced nuclear technology transitions to commercialization and deployment, the Department of Energy as the primary steward for nuclear energy research should seek pathways to increase university engagement at these higher TRL levels. There are several established funding models that enable this including the STTR/SBIR models employed by multiple funding agencies, the NSF I/UCRC and IUDP programs, the recent DOE Genesis call, and DOE Fusion Energy Science INFUSE programs are all excellent examples of connecting universities, laboratories, and industries in productive collaborations in the competitive deployment technology phase. DOE's nuclear energy programs should consider these models as advanced reactor commercialization moves the field further from the pre-competitive phase.

Within the federal funding ecosystem, the DOE must also continue to engage with other agencies supporting the development and deployment of advanced nuclear, particularly the Nuclear Regulatory Commission (NRC) and Department of Defense (DOD). DOE has traditionally been the steward for nuclear reactor technology; NRC has traditionally been the steward for deployment and regulation of the commercial fleet; DOD will deploy the initial fleet of advanced microreactors in the near future across five bases nationwide. Common goals and objectives for commercialization and deployment should be maintained across all three agencies to streamline eventual commercial deployment. Continued engagement and alignment between these federal stakeholders will ensure a more rapid, seamless transition to the commercial sector.

Finally, the role of universities in reactor design and deployment, combined with the historic growth in workforce needs in the nuclear sector, needs to be part of the equation in allocation of support for university effort in this area. Until recently, Nuclear Engineering programs have been in steady decline in the United States. From their peak of almost 50 programs in 1980, there are now approximately 20 stand alone nuclear engineering programs at U.S. universities. That attrition is not a surprise when compared to the stagnation and decline of the industry over that same period of time. Looking forward, the forecast deployment of advanced nuclear technology to support United States energy needs over the coming decades is potentially three times the amount deployed prior to 2020. This rapid increase in the nuclear power industry needs to be matched with increased support for the programs that will deploy advanced technology, support the infrastructure that will accelerate commercialization, and train the workforce that will build and operate this greatly expanded domestic nuclear power industry. As the demand for professionals with nuclear training increases, the need for more faculty and facilities will roughly track. Academic success hinges heavily on research productivity and, by proxy, funding. To support the growth of these departments and continue to provide a high level of training, supporting faculty on the academic career path is important. Expansion of academic facilities and increasing the number of faculty, especially recruiting young talent to replace senior faculty expected to retire in the next decade, must track with growing enrollment to ensure high quality education that will reclaim the nation's leadership position in nuclear technologies. Inadequate support in quantity and quality risks failure of this endeavor that is of crucial importance to our nation's national security and prosperity.

Reactor criticality demonstrations

Recently, several companies have demonstrated zero-power critical operation on advanced micro-reactor concepts. These milestones are the first of many subsequent steps to get from where we are today to commercial deployment. Similar to the Artemis program's goal of returning Americans to the moon, where multiple intermediate milestones ensure program success, the commercialization of advanced nuclear also demands measured results-based milestones to build up capacity towards commercialization and deployment.

These milestones, first and foremost, serve as a roadmap and a schedule to advance nuclear technology. These initial milestone tests, followed by the announcement last week that five microreactors will be deployed on US Army bases across the U.S., turned my campus building and classrooms into a metaphorical beehive. I probably received a dozen emails from freshmen engineering students wanting to find out more about our program. These milestone tests, these announcements of deployment that emphasize the pathway to commercialization, demonstrate an industry that is growing, moving forward, and preparing for further innovation, growth, and societal impact. They build excitement, they build enthusiasm, and in doing that they energize young engineers, scientists, and tradespeople to invest their careers in nuclear energy. In doing this, these milestones indirectly strengthen the adjacent pillars needed to move concepts to commercialization.

Closing remarks

When I received my bachelor's degree in nuclear engineering from the University of Michigan in 1995, my graduating class totalled nine nuclear engineers, the majority of whom started careers in other areas than nuclear power production. Today, I oversee a nuclear engineering program at North Carolina State University that welcomed over 100 second year engineering students into our introductory nuclear engineering class, more than a two-fold increase from only three years ago, most of whom look to energy production through nuclear technology as their career path. The potential of this field is staggering and exciting. The pace that we need to grow is staggering and exciting. I know I speak for my entire nuclear engineering community when I say we welcome the challenge, and look forward to working with our stakeholders in academia, the national laboratory network, and industry to build the energy infrastructure of the future.

Thank you for the opportunity to testify before you today. I will do my best to answer any questions you may have.