Written Testimony of
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Before the Subcommittee on Clean Air and Nuclear Safety
Committee on Environment & Public Works
U.S. Senate

Enabling Advanced Reactors

April 21, 2016

Summary of Testimony

Chairman Capito, Ranking Member Carper, and distinguished members of this subcommittee, thank you for holding this hearing and for giving me the opportunity to testify. My name is Ashley Finan, and I am Policy Director for the Nuclear Innovation Alliance (NIA), a non-profit organization dedicated to leading advanced nuclear energy innovation.

The NIA was established by a cross-cutting group of innovators, academics, environmental organizations, industry groups, and other experts and stakeholders who believe that advanced nuclear energy is needed to ensure a better future. The world will double or triple its energy demand in 30 years, driven by an emerging middle class in the developing world and the need to bring electricity to 1.4 billion people who lack it today. At the same time, many analyses point to the pressing need to reduce global carbon emissions by 80 percent or more by 2050 if we are to avoid the worst impacts of climate change.

A more rapid expansion of nuclear power is an essential part of the solution. In the United States and elsewhere, dozens of innovative start-up companies and other stakeholders are pioneering designs that promise to lower risk and cost, and reduce deployment barriers. But the transition from design to commercialization and deployment—both in the US and globally—has been slow.

Current NRC regulation confronts the licensing of advanced technologies with two major challenges. First, NRC design certification or approval calls for enormous front-loaded investment during a protracted development and licensing phase—without a staged structure to provide applicants with clear, early feedback on an agreed schedule. Second, current regulation primarily evolved to oversee light water reactor (LWR) technologies. It must be adapted to the features and performance characteristics of advanced reactors, which rely on substantially different fuels, cooling systems, and safety strategies, and require novel operating strategies.

Over the past two years, the NIA has been developing strategies to facilitate the efficient, cost-effective, and predictable licensing of advanced nuclear power plants in the United States. These strategies are based on consultations with nuclear innovators, safety experts, former NRC staff and commissioners, members of the financial community, and other nuclear industry stakeholders. We compiled the results of our work into a report called "Enabling Nuclear Innovation: Strategies for Advanced Reactor Licensing," which was issued on April 12th. The report has been provided to the Committee, and is available to the public on the NIA website. It discusses in much greater detail the points that I am touching on today.

To address the LWR-centric nature of the current regulations, a more technology-inclusive approach is needed. A risk-informed, performance-based licensing approach will allow the NRC to review a diverse set of advanced reactor technologies. This would incorporate both modern methods of risk assessment and traditional deterministic approaches to provide an exhaustive safety review. S.2795 provides for the NRC to do work in this area without impacting the costs incurred to the existing plants.

To illustrate the investment challenge, I'd like to turn to Figure 1. This shows schematically the risk/investment profile of nuclear energy projects relative to the licensing process today, and the large monetary and temporal hurdle of obtaining design approval.

Figure 1: Current Project Risk/Investment Profile Relative to Licensing

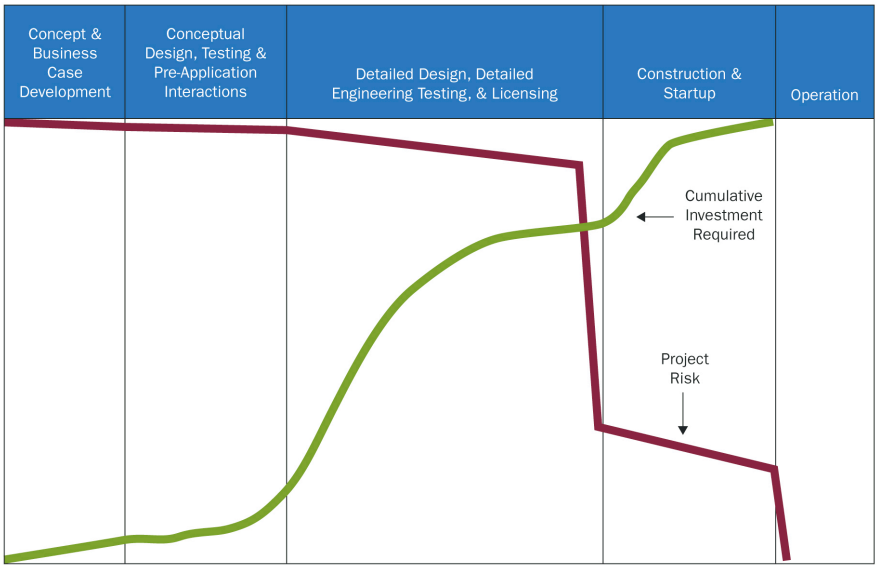
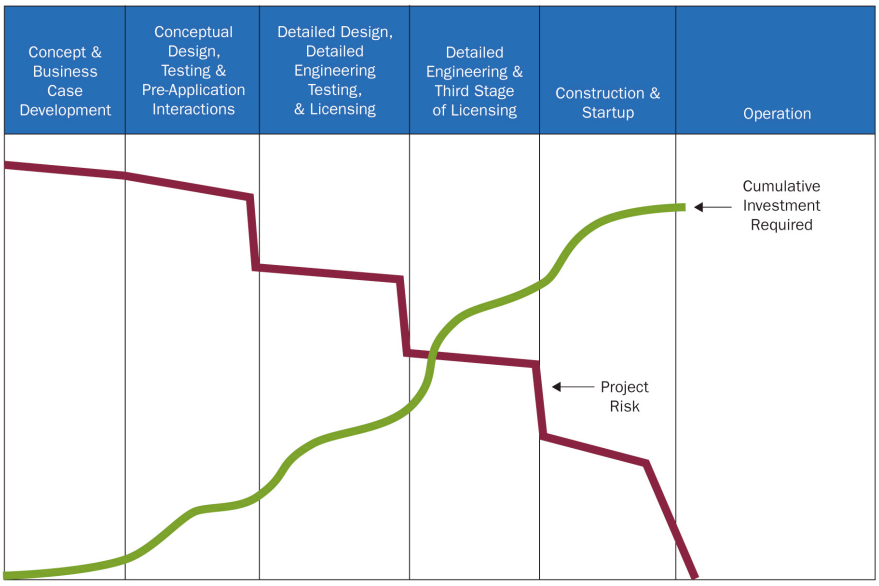


Figure 2 illustrates a staged approach – one that would update the current process to be more aligned with private sector development of innovative technology using a licensing project plan, topical reports, and other mechanisms; and one that would provide clear and early feedback to investors and developers through a statement of licensing feasibility process. This approach maintains the rigor and high standards of the NRC, and facilitates

the development of safer nuclear technology that produces less waste, or even consumes it.

Figure 2: Desirable Project Risk/Investment Profile Relative to Licensing



S.2795 authorizes the NRC to do the crucial work to develop and implement this staged licensing process with dedicated funding. This is an important bill that will enable the NRC to develop the rigorous, technology-inclusive regulatory infrastructure to support the review of advanced nuclear energy technologies without diluting funds used to regulate operating plants. It also allows for immediate adjustments that will provide a more efficient, predictable, and effective process. S.2795 is needed to enable progress in advanced nuclear energy.

Thank you for this opportunity to testify. I would be pleased to respond to any questions you might have, today or in the future.

Full Written Testimony

Chairman Capito, Ranking Member Carper, and distinguished members of this subcommittee, thank you for holding this hearing and for giving me the opportunity to testify. My name is Ashley Finan, and I am Policy Director for the Nuclear Innovation Alliance (NIA), a non-profit organization dedicated to leading advanced nuclear energy innovation.

The NIA was established by a cross-cutting group of innovators, academics, environmental organizations, industry groups, and other experts and stakeholders who believe that advanced nuclear energy is needed to ensure a better future.[1] The world will double or triple its energy demand in 30 years, driven by an emerging middle class in the developing world and the need to bring electricity to 1.4 billion people who lack it today. At the same time, many analyses point to the pressing need to reduce global carbon emissions by 80 percent or more by 2050 if we are to avoid the worst impacts of climate change.

A more rapid expansion of nuclear power, though an essential part of the solution, faces stiff challenges. Accidents raise public fears about safety; large cost overruns and protracted schedules deter investors and owners; and concern over spent nuclear fuel disposal and weapons proliferation continues to block expansion in some parts of the world.

Innovation will be necessary if these challenges are to be addressed. In the US and elsewhere, dozens of innovative start-up companies and other stakeholders are pioneering new designs that promise to lower risk and cost, and reduce deployment barriers. But, despite the American talent for developing advanced nuclear reactor technologies, the transition from design to commercialization and deployment—both in the US and globally—has been slow. Two of the most critical barriers are the lack of a clear and efficient pathway for a first demonstration project, and continuing doubt that the Nuclear Regulatory Commission (NRC) will be able to issue a license for a non-light water reactor in a time frame compatible with private-sector needs. *These obstacles **must** be addressed before we can realize the benefits of the next generation of nuclear technology*.

Many other hurdles exist, including technology challenges, supply chain limitations, a difficult market environment, inaction on nuclear waste management, and restrictions on international cooperation. In addition, clean air policy must be updated to recognize the benefits of nuclear power. Progress on all of these fronts is urgently required.

[1] A list of NIA Policy Committee and Advisory Committee members is included after this written statement.

The analysis here focuses on a key initial obstacle—a nuclear regulatory process badly in need of an update. It is important to keep in mind that addressing this challenge is a necessary first step; other steps will be required.

Current NRC regulation confronts the licensing of advanced technologies with two major challenges. First, NRC design certification or approval calls for enormous front-loaded investment during a protracted development and licensing phase—without a staged structure to provide applicants with clear, early feedback on an agreed schedule. Second, current regulation primarily evolved to oversee light water reactor (LWR) technologies. It must be adapted to the features and performance characteristics of advanced reactors, which rely on substantially different fuels, cooling systems, and safety strategies, and require novel operating strategies.

Over the past two years, the NIA has been developing strategies to facilitate the efficient, cost-effective, and predictable licensing of advanced nuclear power plants in the United States. These strategies are based on consultations with nuclear innovators, safety experts, former NRC staff and Commissioners, members of the financial community, and other nuclear industry stakeholders. The NIA also examined nuclear reactor licensing systems in the United Kingdom and Canada, and scrutinized analogous regulatory systems administered in the United States by the Federal Aviation Administration and the Food and Drug Administration. We compiled the results of our work into a report called "Enabling Nuclear Innovation: Strategies for Advanced Reactor Licensing," which was issued on April 12th. The report has been provided to the Committee, and is available to the public on the NIA website. It discusses in much greater detail the points that I am touching on today.

Based on this research and analysis, the NIA offers the following recommendations:

A. Regulatory Recommendations

(1) To structure a staged review of advanced reactors and support long-range resource planning by the agency and the applicant, the NRC and industry should develop and employ guidelines for a licensing project plan (LPP). The LPP would be a living document that serves as a roadmap for the entire process, defining—in as much detail as possible—project schedules, testing requirements, deliverables, and NRC review budgets. The most effective approach will be for the applicant and the NRC to design a licensing project plan that establishes milestones corresponding to meaningful stage-gates along a given project's development pathway and that take full advantage of the NRC's readiness to review specific aspects of the design. To provide the foundation for open communication and effective project management, we recommend that, as soon as a potential applicant initiates interaction with the NRC, the agency produce an initial LPP establishing guidelines that define the working relationship among the parties. This should help to ensure rapid resolution of conflicts and efficient progress. The NRC and potential applicants should discuss the appropriate contents of an LPP during this initial engagement period, and the LPP should be built up with additional detail as the project progresses and it is

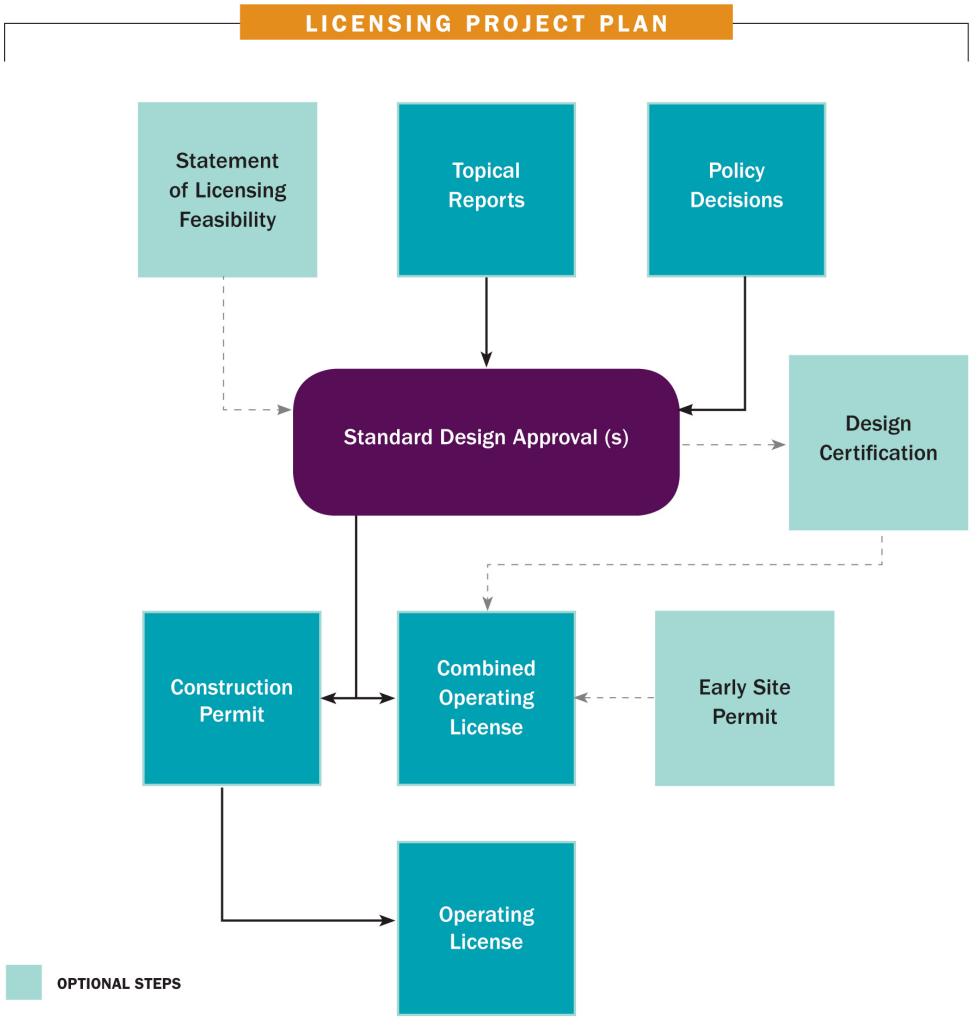
possible to foresee upcoming interactions. Much of the responsibility for designing an effective LPP lies with the applicant; the applicant will need to understand a project's design, development, deployment, and investment milestones in order to propose corresponding licensing milestones. At the same time, NRC expectations for the level of design detail must correspond to the particular milestone, and be clearly communicated to potential developers.

(2) The NRC should promote and applicants should use topical reports and the standard design approval as tools to introduce stages into the advanced reactor licensing process, while emphasizing the need to achieve a level of finality that supports staged decision making. These tools can be employed under current regulations, if the proper staff guidance and policies are put in place, and if dedicated funding can be authorized and appropriated; the proposed licensing project plan could structure their use.

(3) The NRC should develop and employ an optional statement of licensing feasibility process with time frames and budgets to be agreed upon in the licensing project plan. This would permit it to more easily assess whether an applicant's design intent was conceptually aligned and consistent with established regulatory requirements. Doing so would offer important benefits: (i) it would standardize a review phase that, because of its limited cost and duration, could be used by stakeholders to compare available design options; (ii) it would provide early feedback to the applicant, allowing timely alterations in approach to better meet regulatory obligations; and (iii) it would provide useful structure to pre-application engagement.

Figure 3 depicts the elements that could be used to support the staged licensing of an advanced reactor, structured by an LPP.

Figure 3: Elements of a Staged Licensing Process



(4) The Commission and license applicants should cooperate to adapt the agency's light water reactor (LWR)-centric requirements so that they are better suited to advanced reactors seeking licenses in the near term, while, wherever appropriate, increasing the use of risk-informed and performance based techniques. For new technologies, alternative approaches to the exemption process should be considered. Advanced reactor designers from both traditional industrial organizations and small start-ups are concerned with the cost and schedule uncertainty associated with the exemption process (as well as potential negative perception that applicants are trying to avoid stringent safety regulation). A means should be available earlier in the process for the NRC and the applicant to reach agreement on alternative compliance strategies for specific requirements that are only partially applicable or are not applicable at all. The LPP would be a natural place to do this, once the NRC and stakeholders have identified promising approaches. This will increase efficiency and effectiveness in the design and regulation of advanced

technologies without sacrificing safety or security.

(5) The NRC and DOE should continue to move forward with the DOE/NRC Advanced Reactor Licensing Initiative.[2] This will help to establish and clarify acceptable approaches for creating the underlying design criteria associated with these concepts, thereby removing a portion of the regulatory uncertainty associated with advanced non-LWRs.

(6) Given the substantial investments that have already been made by industry and DOE in pre-application reports and proposals for advanced reactors (including the Next Generation Nuclear Plant), and by NRC staff in evaluating them, the NIA recommends that (i) the NRC complete its evaluation and the Commission issue its decisions or opinions at this stage of the application, and (ii) generic issues raised by DOE and NRC be resolved through the issuance of guidance for advanced reactor applicants.

(7) At the same time that the NRC pursues the above initiatives, the NRC should designate a special technical team to develop and implement a technology inclusive licensing and regulatory framework for advanced reactors based on risk-informed and performance-based principles. The technical team should propose a roadmap for putting the new framework into practice by 2025 (supported by a rulemaking completed in 2023), and then be given the administrative flexibility and resources to succeed. Because this framework will not be ready immediately, it should remain optional (similar to the Part 52 licensing processes as an alternative to the Part 50 process)—at least until it is fully demonstrated. That way, its development will not delay current projects. The authorization and appropriation of dedicated funding will be necessary to enable this work.

(8) To provide a clear and achievable regulatory pathway for developing and deploying advanced demonstration reactors, the NRC should:
   (i) In collaboration with stakeholders, clarify terminology and resolve discrepancies and gaps in statutes, regulations, and practice;
   (ii) Using terminology revised pursuant to (i) above, clarify responsibility for reviewing potential applications;
   (iii) Develop guidelines for advanced reactor demonstrations to support the review process; and
   (iv) Provide or develop guidelines for prototype plant regulation (as defined in 10 CFR 50.2 and 10 CFR 52.1) and conversion to commercial operation.

(9) The NRC should continue development and execution of advanced reactor technology knowledge management and training opportunities for NRC staff. Mid- and upper-level managers should be included in these programs. Funding will be needed to support this.

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[2] This was recently described in the following report: US Department of Energy, Office of Nuclear Energy, *Guidance for Developing Principal Design Criteria for Advanced (Non-Light Water) Reactors*, December, 2014. http://pbadupws.nrc.gov/docs/ML1435/ML14353A246.pdf.

B. Policy

(1) Congress should revise the NRC's budget structure so that, instead of a 90% fee-based, 10% public funding model, licensees and applicants reimburse the NRC for activities related to their regulation, with Congress funding other agency-related activities—including the development of new regulations for advanced technologies, R&D, international programs, and other initiatives not related to a specific licensee. The nuclear fleet operating today was licensed by an NRC that had been fully funded by Congress, before the advent of current fee-recovery rules. Unlike that earlier generation of reactors, licensing of the AP1000s now under construction has been supported by substantial cost-shared funding from DOE. To prepare for the licensing of advanced reactors, the NRC faces a greater challenge that will require consistent public funding.

(2) Congress should authorize and appropriate funds for the NRC to prepare for advanced reactor licensing, including but not limited to:

- Development and implementation of strategies to stage and expedite the advanced reactor licensing process;
- Development and implementation of a risk-informed, performance-based licensing framework for advanced non-light water reactors;
- Efforts to prepare the process of licensing advanced demonstration reactors; and
- Staff training or the hiring of experts.

(3) To expand available financial resources for advanced reactor companies, Congress should continue to fund DOE to competitively award grants for early efforts to license advanced reactor companies, including but not limited to:

- Pre-application engagement with the NRC;
- Developing a licensing project plan; and
- Applying for a statement of licensing feasibility or similar early-stage design review.

The DOE Gateway for Accelerated Innovation in Nuclear (GAIN) initiative's small business voucher program is one possible mechanism for this.

C. Industry Action

Industry has an important role to play as a constructive participant in all of the above recommendations, but also has primary responsibility for several actions:

(1) Industry stakeholders should cooperate to deliver a coordinated message to the NRC regarding technology-inclusive advanced reactor priorities.

(2) Prospective applicants should proactively address the NRC's need for information about future projects by informing the agency as early as possible of their intent to

request NRC review. By capturing this information in regulatory issue summaries, the NRC will have a stronger basis to support research, as well as budgetary estimates and requests.

(3) Industry should take a more active role in communicating with the NRC, DOE, and other stakeholders on the challenges and opportunities associated with various advanced reactor designs, including R&D priorities.

(4) Working with appropriate research and standards organizations, industry should pursue the development of codes, standards, and conventions for advanced nuclear power.

S.2795 authorizes the NRC to do the crucial work to develop and implement a staged licensing process with dedicated funding. This is an important bill that will enable the NRC to develop the rigorous, technology-inclusive regulatory infrastructure to support the review of advanced nuclear energy technologies without diluting funds used to regulate operating plants. It also allows for immediate adjustments that will provide a more efficient, predictable, and effective process.

Thank you for this opportunity to testify. I would be pleased to respond to any questions you might have, today or in the future.

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Biography

Dr. Ashley Finan serves as Policy Director for the NIA. Ashley earned her Ph.D. in Nuclear Science and Engineering at the Massachusetts Institute of Technology. Her doctoral work focused on energy innovation investment and policy optimization, both in nuclear and renewable energy technologies. She has played a key role in studies of the use of advanced nuclear energy to reduce greenhouse gas emissions in several applications, including hydrogen production, coal to liquids processes, and oil production methods. Ashley has worked as a strategy and engineering consultant, primarily on nuclear energy applications. She also contributed to an analysis of the techno-economic potential of energy efficiency improvements in the residential and commercial sectors and several related topics. Ashley holds an SB degree in Physics as well as SB and SM degrees in Nuclear Science and Engineering from MIT.