Responses to Requests for Information
The Honorable Thomas R. Carper
Letter dated March 24, 2016

1. Please explain how NRC will work with DOE and any other entities to understand and navigate the regulatory process for licensing new reactor technology in accordance with President Obama's GAIN initiative.

Under the GAIN initiative, the NRC is tasked to provide the U.S. Department of Energy (DOE) with accurate, current information about the NRC's regulations and licensing processes, which is consistent with its role as an independent safety and security regulator. The NRC staff has been working with the DOE Office of Nuclear Energy staff to develop a process for providing this information, with the objective of providing timely, accurate, and "on-the-record" responses. We are currently developing a Memorandum of Understanding with DOE that will formalize and implement the information sharing process. We anticipate completing that Memorandum of Understanding by the end of this calendar year.

2. In 2015 congressional testimony, you explained that there may be challenges and knowledge gaps within NRC and the prospective applicants if NRC were to receive an advanced reactor application within the next five years. Please describe the challenges related to research and modeling work in both the technical issues and code development for non-light-water reactor designs.

To date, advanced non-light-water reactor (LWR) research has not been a high priority for the NRC because the current fleet consists solely of light water reactor design plants and there has been limited industry activity on non-LWR designs. Thus, only a limited amount of regulatory research has been performed in this area. Recognizing that because certain codes and methodologies that were developed for the analysis of light water reactors may not be generally applicable to advanced non-LWR reactors, targeted regulatory research might be warranted to adapt those codes and methodologies to particular advanced designs. Modeling the physical phenomena in advanced non-LWR accidents, including unique initiators such as fire for sodium-based designs, is a challenge due to the limited number of experimental facilities worldwide. These facilities would be needed by both the staff and the technology developers to test safety system performance that would likely be necessary for code development and licensing.

The determination of what research should be performed for advanced non-LWRs is complicated by the number and wide variety of designs under consideration. Advanced non-LWR designs have been proposed that utilize several types of working fluids – liquid metals, molten salts, and high temperature gas – each with a unique set of safety related considerations.

The NRC will approach the code development and modelling challenges by tailoring the efforts to be commensurate with the complexity and potential risks to public health and safety of the various technologies. These activities will build, to the extent practical, on the efforts of DOE, the advanced reactor community (via efforts by the Electric Power Research Institute), and the international community. The NRC will continue to interact with these entities to gain access to the relevant codes, modelling, and supporting experimental data.

ENCLOSURE

3. In the guidance for Developing Principal Design Criteria for Advanced Reactors, DOE indicated six different advanced reactor technologies to consider for creating regulations for licensing innovative technologies. Please describe whether there is a critical skills gap at NRC to address the non-light-water reactor design research and modeling work in order to be able to consider an application for an advanced nuclear reactor.

Because of our historical focus on LWR licensing activities, the NRC has a relatively limited number of experienced nuclear engineers and other technical experts who are knowledgeable of some of the more advanced designs for non-LWR technologies being pursued today.

Of the six types of reactors indicated in the DOE report, the NRC has the most experience with the modular high temperature gas reactor design and sodium fast reactor design, which is a subset of the general class of liquid metal reactors. The NRC has performed pre-application reviews on reactor designs in these two categories. For the remaining four reactor categories, no vendor has engaged the NRC recently. As a result, the NRC does not have significant experience with those designs. Thus, a skill gap exists for some technical disciplines in the areas of research and regulatory support.

The NRC does have access to the significant capabilities of the national laboratories, which can provide additional technical expertise and research capabilities. These capabilities include both confirmatory experimental research and analytical capabilities, such as code development. It is important to note that, as the DOE labs continue to form development relationships with the non-LWR industry, there is a greater potential for conflicts of interest to emerge that might limit NRC access to lab expertise. The NRC is working with DOE to develop mitigation measures to manage this potential conflict of interest issue.

NRC recognizes the need to enhance our technical capabilities and to establish relationships with the national laboratories and other contractors with the requisite knowledge and experience. We have already undertaken some training activities, supported by the DOE, and are continuing to make use of training opportunities as they emerge.

However, the constraints in our previous budgets, coupled with the early stage of development of most of the advanced non-LWR reactor technologies, have dictated a very measured approach to training and expanding NRC staff capabilities. As with our other activities, the NRC is currently pacing its training and capability building activities to be consistent with: 1) the pace of technology development, 2) the maturity of the advanced reactor designs being discussed today, and 3) the NRC's budget for advanced reactor activities.

Expanded budget authority and specific off-fee base funding for non-LWR preparation to expand our activities would provide flexibility to maintain pace with industry and accelerate our preparations, especially in long-lead research and development areas.

4. According to the Omnibus Budget Reconciliation Act of 1990, NRC's budget must provide for 90 percent fee recovery less the amounts appropriated for generic homeland security activities and waste incidental to reprocessing activities. Please explain how this impacts NRC's ability to meet staffing and resource priorities for addressing advanced non-light water technology.

The NRC's budget for addressing advanced non-LWR technology is not directly impacted by the Omnibus Budget Reconciliation Act of 1990 (OBRA-90) fee recovery requirement. However, due to the OBRA-90 requirement, increases in NRC budgets for advanced non-LWR technologies result in increases in annual fees charged to current NRC licensees. This raises a fairness and equity concern regarding current NRC licensees' funding activities that are not attributable to them.

Previous and current budget constraints have limited our activities addressing advanced non-LWR technology. By design, our activities have been at a sufficiently low level that they do not represent an appreciable contribution to the operating reactor fee base. This has limited the extent of our preparations and outreach to vendors. Thus far, our activities have been focused on generic enhancements to our regulatory processes and guidance.

5. Does the NRC need any additional authority or funding outside of the OBRA-90 fee recovery requirement to expand its technical staff and make more use of other government affiliated research organization to create new standards for advanced reactors?

Yes. In light of the current budget environment and recent developments indicating an acceleration in the pace of activities by the advanced non-LWR vendor community, additional funding would add significant flexibility to the NRC's preparations for non-LWR licensing reviews. The current budget environment is severely limiting the NRC's preparations. The operating reactor fleet does not benefit from NRC staff training on non-LWR technologies, or from staff resources to develop standards and regulatory guidance for non-LWR technologies. Additional authority and funding outside of OBRA-90 would provide the necessary flexibility to the NRC to direct resources to enhance our regulatory infrastructure for timely and efficient reviews of non-LWR technologies. Further, funding excluded from the OBRA-90 fee requirement would address the fee recovery fairness and equity concern that this work is not attributable to current NRC licensees. There are many items on our list of preparatory activities that are long-lead activities and need to be established in the near-term to be fully prepared when advanced reactor vendors are ready to engage the NRC. Additionally, the NRC recognizes the urgency to support current activities, such as development of American Nuclear Society and American Society of Mechanical Engineers consensus code standards, which are needed today for vendors to design reactors. However, the current budget limits the NRC's ability to participate on some of these committees. The NRC also recognizes the urgency to enhance our own infrastructure now to reduce regulatory uncertainty for vendors and increase our own efficiency.

6. How does the NRC interface with the Department of Energy and industry so the regulatory uncertainties and corresponding business risk associated with commercialization of advanced nuclear energy technologies are reduced?

The first level of interface between and among the NRC, DOE, and the industry comes through frequent and open communication to clarify and explain NRC's processes and requirements as they relate to advanced reactors, and to share plans and activities relevant to resolving both real and perceived regulatory uncertainties. The NRC is actively pursuing and supporting a variety of opportunities to build relationships in order for the NRC and DOE to better understand the

needs of industry, and for industry to better understand the roles and needs of the NRC and DOE.

The NRC is implementing a three-prong strategy to address NRC and industry needs relative to ensuring an efficient process for reviewing advanced reactor technologies. The first element of the strategy is to refine and revise NRC's regulatory framework to provide an efficient review process for advanced reactor technologies and to implement regulatory criteria specific to these technologies that will help reduce regulatory uncertainties. A specific example of this effort is the joint NRC and DOE effort to develop advanced reactor design criteria, based on the existing general design criteria in Appendix A of 10 CFR Part 50, that are specific to non-LWR technologies. DOE worked with representatives from the national laboratories and from the non-LWR community to develop proposed advanced reactor design criteria for these technologies. The NRC reviewed the DOE report and made use of it in preparing draft advanced reactor design criteria that were then made available for informal public comment on April 8, 2016. The NRC will consider comments received in developing formal regulatory guidance that will provide these important advanced reactor design criteria for use by the non-LWR technology developers.

Engagements with non-LWR technology developers and their financial backers have yielded recurring requests for NRC to develop two specific processes: (1) a process for providing a general assessment of a specific nuclear power plant design at a conceptual stage to provide early feedback on any foreseeable regulatory obstacles to the eventual regulatory approval of that design; and (2) a process that provides for regulatory review of portions of a specific reactor or nuclear power plant design that are at a final design stage, which could later be incorporated into the NRC review of the complete application. The NRC staff is currently developing proposals for both of these processes, which will be discussed with the public, including the vendor community, and subsequently provided to the Commission for its approval.

The advanced reactor design criteria activity and the effort to develop these two new processes are examples of where NRC's interface with DOE and the advanced reactor community has led NRC to pursue changes to our regulatory framework to reduce uncertainties and business risks.

The second element of NRC's strategy is technical preparation, to ensure that the staff is adequately familiar with the technologies and has access to the analysis tools and experimental facilities needed to support regulatory reviews of the non-LWR technologies. Aspects of the analysis tools and experimental facilities were addressed earlier in response to your second question.

The NRC has worked with DOE to provide general informational training courses to our staff on high-temperature gas reactor and sodium-cooled fast reactor technology. NRC is pursuing other staff training opportunities on molten salt reactors. The staff also is engaged with U.S. consensus standards bodies and international organizations that have activities supportive of NRC's technical preparation in this area.

The third element of NRC's strategy is outreach to the technical community, DOE, and other interested stakeholders. The NRC staff participates in key conferences and technical meetings to both provide information on NRC activities and processes, and to gain insights into the challenges and concerns of the non-LWR community.

One key aspect of our outreach activities comes from the joint NRC and DOE engagement with the advanced non-LWR community and interested stakeholders through workshops to address advanced non-LWR technologies and licensing related topics. The first workshop was held in September of 2015 and was attended by over 300 people. The second workshop, scheduled for June 7-8, 2016, will address NRC, DOE, and industry visions for how advanced non-LWR technologies and licensing activities may unfold over the next several years, along with a focused discussion on fuels, which have been a topic of intense discussion for regulatory review. This workshop series is planned to be held every 6 months with different focus areas of industry interest.

Another important aspect of our outreach activities is engagement with the technology development community, to ensure that the NRC staff clearly understands the challenges faced by that community and what actions might reduce regulatory uncertainty and associated business risks. The NRC staff and Commission have met with representatives of the technology developers on numerous occasions. During 2015, the NRC staff met with over a dozen developers of various technologies.

In summary, over the last few years, NRC's interface with DOE and the non-LWR community has led the NRC to develop a strategy for readying the NRC to conduct efficient reviews of non-LWR designs as they are submitted. Implementing this strategy is leading to specific changes to regulatory processes, technical development, and outreach activities that are directly related to reducing regulatory uncertainties and business risks.

7. The NRC has taken many steps to improve the effectiveness, efficiency, and agility of NRC by 2020 through Project Aim. The report indicates NRC's internal process for responding to changes by transferring resources makes it difficult to respond quickly to changes. Would the NRC require organizational changes to enable responsiveness to advanced non-light-water design research, technical work, and licensing?

The NRC would not require organizational changes to enable responsiveness to advanced non-LWR design research, technical work, and licensing. The NRC's efforts related to advanced non-LWRs are being led by our Office of New Reactors (NRO), but it is an agency-wide initiative. NRO engages other NRC offices as their areas of expertise and responsibility are needed to address specific issues. Specifically, NRO will reach out to the following offices:

- Office of Nuclear Regulatory Research for all research activities.
- Office of Nuclear Materials, Safety, and Safeguards to address fuel fabrication and transportation related activities.
- Office of Nuclear Security and Incident Response for security and emergency preparedness activities.
- Office of Nuclear Reactor Regulation for research and test reactor related activities.
- Office of the General Counsel to provide overall legal support.

8. In the 2017 budget request, NRC prioritized funding for the development of a regulatory infrastructure for advanced nuclear reactor technologies. Please indicate which offices are responsible for developing the regulatory infrastructure for advanced nuclear technologies and their respective roles.

NRC's activities related to advanced reactors are being planned and implemented as an agency-wide effort.

NRO provides the overall development and leadership for NRC's activities related to advanced non-LWRs. NRO reaches out to other offices with specific areas of expertise, as discussed in response to Question 7. This provides regulatory consistency for the vendors and applicants when dealing with the NRC. The efforts being led by NRO include developing proposals to the Commission to address key policy issues facing both advanced non-LWRs and small modular reactors. These issues include possible changes to emergency preparedness approaches, reactor siting considerations, licensing for multi-module designs, and insurance and liability considerations for these new technologies.

In addition, the Advisory Committee on Reactor Safeguards plays an important role in advising the Commission on the viability and technical sufficiency of staff guidance and reviews.

In short, the efforts to ensure that the NRC is fully prepared to engage in the timely and efficient regulatory review of advanced reactors represent a coordinated agency-wide effort.