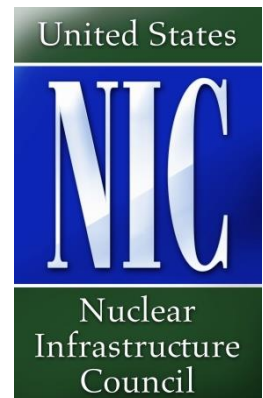


**Ensuring the Future of U.S. Nuclear Energy**  
*Creating a Streamlined and Predictable Licensing  
Pathway to Deployment*

January 23, 2018



## **Vision for the Future of Nuclear Energy**

With a modernized NRC licensing process, the reviews of advanced reactors will become more efficient and timely, while continuing to protect public health, safety and security. This updated licensing process will enable the development, licensing and deployment of more innovative, cost-competitive and safer nuclear reactor technologies. NRC reviews will become more safety-focused and predictable, and technology developers will be able to use a variety of licensing pathways to obtain NRC design approvals and achieve project milestones. Utilities and users of the industrial heat and energy produced by these technologies will choose advanced nuclear energy for its versatility and competitive economics. This will result in part from regulatory changes that recognize their enhanced safety and security. Regulators and developers will incorporate lessons from early deployments to streamline the licensing and construction of advanced technology projects.

## **The Regulatory Environment for Advanced Reactors and the Need for Change**

The U.S. nuclear industry is at a tipping point. The U.S. led the world into the age of nuclear energy and continues to be the global leader in technology innovation. The U.S. nuclear reactor fleet is the largest in the world, and the U.S. Nuclear Regulatory Commission rules are viewed as the world standard for ensuring nuclear plant safety and security. U.S. companies have developed and licensed large, modern, light water reactor nuclear plant designs that offer improved efficiency and safety. New advanced reactor technologies—many of which are being developed with support from the Department of Energy—are among the designs setting a new standard for nuclear innovation.

However, this technology leadership is at risk without licensing modernization. To mitigate that risk and ensure continued U.S. leadership in global nuclear markets, the U.S. government should act promptly to create a streamlined and predictable licensing pathway for advanced reactors, thereby supporting innovation, commercialization and deployment of new nuclear technologies. To ensure that advanced reactors are licensed and built in the U.S., near-term regulatory changes are needed.

These changes should focus on achieving the following near-term objectives:

- Reversing a trend of increasing regulatory costs and unnecessarily long reviews;
- Aligning the regulatory framework for advanced reactors with their inherent enhanced safety and simplified design bases;
- Defining licensing options clearly, including options for staged application and approval; and
- Providing additional flexibility for changes during construction.

## **Current Environment**

The U.S. nuclear power industry has a history of commitment to safety and continuous improvement in design, operations and maintenance. Building on lessons learned by operating plants over the past several decades, the industry has developed new designs that offer marked

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improvements in safety, ease of maintenance and operations. These efforts have grown, with numerous designs at various stages of development for small modular light water reactors (LWRs) and non-light water reactors (non-LWRs).

New reactor designs, including those certified, under review and planned for submittal, are consistent with the NRC's advanced reactor policy in that they "will provide enhanced margins of safety and/or use simplified, inherent, passive, or other innovative means to accomplish their safety and security functions." The Commission policy also notes that "incorporating the above attributes may promote more efficient and effective design reviews."

The latest round of reactor licensing efforts for traditional LWRs has illuminated the need for flexibility in building them, but it also suggests the same need for upcoming small modular LWRs and advanced non-LWR designs. To date, however, the NRC reactor license review process has remained largely unchanged. While the NRC staff has been engaged in an active dialogue with interested stakeholders, as yet there is little evidence of improved efficiencies in the reviews of advanced LWR designs. Over-regulation and protracted reviews by the NRC are driving some U.S. companies out of the domestic market altogether, shifting their focus to the international market, where they hope regulators are able to make a finding of sufficient safety faster and at a lower cost than the NRC.

While in theory the standard of "adequate protection" has not changed for decades, as a practical matter it has, because the NRC now requires more effort from applicants to demonstrate that a design satisfies that standard. Applications for designs with improved safety features require ever greater detail, adding time and expense without enhancing safety. In some cases information is requested from the applicant that would normally not be available until a system is actually built. Licensing reactors is becoming more time-consuming and less certain even as the designs are becoming inherently safer. The industry has contributed to this situation by acquiescing to the escalation in the Agency's requests for unnecessary, burdensome detail. For its part, the NRC should also acknowledge its contribution to this situation, and urgently refocus its licensing reviews on issues that are safety significant.

Another challenge to U.S. innovation regarding advanced technologies is the need for clearly defined pathways for a staged license application. Pre-application NRC-applicant interactions have at times been ineffective in accelerating or simplifying NRC approvals of plans for addressing issues prior to the review of an application for a complete reactor design. The industry needs a clearly defined yet flexible process for license application approval that provides the option of licensing one portion of the design at a time. A staged, incremental, license application review and approval process would reduce licensing risk and enable developers to win investment and customer support incrementally. This approach will be valuable to some applicants and should be an available option. Although licensing options exist today, they need to be documented and further developed before applicants can apply them with confidence that they are viable, and will avoid significant disputes and costly delays. While the NRC staff has made useful progress in becoming familiar with the need for these pathways over the past two years, continued progress in this area should be a top priority.

Flexibility to make changes during construction also is essential to the deployment of new technologies and “first-of-a-kind” designs. Recent construction experience demonstrates the need for greater flexibility to modify the licensing basis during construction. A requirement for prior regulatory approval of such changes can delay multi-year construction projects with, in most cases, no safety benefit. The result is significant increase in costs and project risk with associated difficulties financing nuclear projects. The problem could be reduced if license applications were less detailed and more safety focused on performance outcomes. To resolve this issue fully, industry self-discipline, NRC process revisions, and possibly rulemaking to revise 10 CFR Part 52 may be required.

There is significant demand for new, advanced LWRs and non-LWRs. However, the promise of advanced technologies and the future of U.S. commercial nuclear power are coupled with the development of a more effective safety-focused and efficient regulatory review. With such improvements, the regulator can operate more effectively and U.S. builders can more efficiently license, deploy, and export advanced reactors to meet the need for clean, reliable energy for electricity generation and other uses.

Details of actions needed to achieve these objectives are discussed below.

### **Reversing Increasing Regulatory Costs and Excessively Long Reviews**

Applicants need a process that gives them confidence the NRC can and will review designs and license applications in a timely, predictable and cost-effective manner and without imposing unnecessary regulatory burden. To improve near-term pre-application and licensing activities, NRC must exercise greater regulatory discipline by conducting appropriately safety-focused reviews, combined with guidance and process improvements identified through 10 CFR Part 52 lessons-learned activities.

One major contributor to the current inefficiency is the increasing level of detail the NRC requires in the docketed license application to support the agency’s finding of reasonable assurance of adequate protection of public health and safety. Over time, the amount of information the NRC has required for licensing reviews of similar plant designs has expanded. This expansion in scope has extended NRC project review schedules and increased the level of effort required by both the industry and the NRC. Much of this detail is unnecessary for the NRC to make and document its safety findings and meet the adequate protection standard. Inconsistent NRC management engagement and decision-making have also contributed to a staff culture where it is acceptable to demand more details in licensing submittals, without a direct nexus to safety.

This “regulatory creep” lengthens NRC review time, increases the information licensees must maintain over the life of the plant, and inflates the scope of details that cannot be changed without NRC approval. NRC must focus its review to consider only the information needed for determining reasonable assurance of adequate protection of public health and safety. An important element of the industry effort is to focus NRC licensing reviews on areas that are safety significant and change NRC practices for required level of detail in applications. (In most

cases this should be accomplished through revisions to regulatory review guidance.) Active involvement and close oversight by the Chairman and Commissioners of the NRC is needed to achieve these outcomes and ultimately evolve the culture at the NRC to ensure the principles of good regulation are met.

In the near-term the industry is highlighting the need to improve timeliness and efficiency during 10 CFR Part 50 and 10 CFR Part 52 regulatory reviews and has placed a high priority on effecting change in this process.

### **Aligning the Regulatory Framework for Advanced Reactors with their Enhanced Safety**

The current regulatory framework was developed for and is based on LWR designs. Since most of the advanced reactors under development are cooled by fluids other than water (e.g., gases, liquid metals and molten salts) and are not susceptible to the same types of accidents, the NRC should tailor its guidance and regulations to appropriately address these advanced designs. Many advanced reactor designs are inherently safe even with the loss of both AC and DC power, feature even larger safety margins, and allow for longer times of accident progression. New designs also are less complex, with passive safety features and far fewer systems than large LWRs, significantly reducing the likelihood and magnitude of offsite releases. As a result, radiological releases are expected to have no impact on public health and safety even with smaller emergency planning zones. Accordingly, the NRC should scale emergency planning requirements and reviews to be commensurate with the accident source term, fission product release, and associated dose characteristics. The NRC has initiated rulemaking that has the potential to address this issue. The Commission should focus on promptly resolving this issue. Additionally, designers are incorporating engineered physical security systems, hardware and other features into the reactor design, making physical security less reliant on armed responders. These enhanced features justify regulatory changes to reduce the number of armed guards and consider eliminating onsite response forces altogether. Re-examination of security and emergency planning requirements is needed to remove unnecessary licensing burdens and reduce licensing and operating costs for advanced technologies. These changes would make the rules appropriate to the characteristics of the new reactors, rather than to traditional large LWRs, and thus improve the economic viability of new technologies. NRC consideration of these features is needed to make use of their security and economic benefits. The NRC staff is developing a recommendation on whether to move forward with rulemaking to change security requirements. The Commission should ensure that any new rulemaking appropriately aligns the security requirements for advanced reactors commensurate with their risk.

The NRC also should modernize its process for setting design requirements for advanced reactors to be more systematic, predictable and repeatable, thus ensuring that consistent requirements are established for different technologies. The modernized process should account for the unique characteristics of the advanced non-LWRs and enhanced safety features of these reactors. This effort is expected to result in a more technology-inclusive, performance-based and safety-focused regulatory process needed to restore stakeholder confidence. The effort relies on revisions to the regulatory review guidance under Parts 50 and 52. It builds upon NRC, DOE and industry work over the last decade to develop the technical basis for an efficient, modernized

regulatory process that is safety-focused and is applicable to all plant designs. This work was documented in a series of papers that provide the starting point for the ongoing work on the utility-led Licensing Modernization Project.

The result will provide processes for determining the important safety significant attributes of an advanced reactor design. NEI is working in collaboration with the industry and DOE to develop guidance for integrating these processes with existing regulations, for NRC review and endorsement. The guidance will outline the application of these concepts under 10 CFR Parts 50 and 52 and identify where exemptions are necessary. Judging from the pace of progress over the last decade, it will take more than five years to develop and implement an entirely new regulatory framework for advanced non-LWRs. However, the industry's near-term efforts, with NRC engagement, will define the principles for establishing a new regulatory framework in the long-term and address recognized challenges in a manner that enables near-term advanced reactor development.

### **Defining Licensing Options Clearly, including Staged Application and Approval**

The industry has recognized that for some non-LWRs, it needs a clearly defined, flexible process for license application approval that provides an optional mechanism for licensing one portion of the design at a time. In principle, NRC regulations allow for a staged, incremental, license application review and approval process for licensing one portion of the design at a time. These provisions are not well-defined and have not been recently used. Thus, applicants are uncertain about their viability to address specific development risks much earlier in the licensing process.

The industry is collaborating with the NRC to develop regulatory engagement planning guidance that better defines the different licensing pathways that could be used by designers, based in part on a Nuclear Innovation Alliance report that clarifies options to consider in defining "major portions" for a Standard Design Approval. The goal is to reduce designers' uncertainty about NRC review and acceptance of certain aspects of the design, even before they have the final design completed for the entire facility. This effort is also intended to clarify pre-application interactions with NRC and desired outcomes. These interactions need to become more effective in identifying key safety issues and acceptable methods for resolving them. This is important for further reduction of regulatory review time and costs. Addressing these concerns will help to remove unnecessary barriers to innovation.

### **Providing Additional Flexibility for Changes during Construction**

Utilities and other end-users that will build future reactors need the ability to make changes during construction, without unduly slowing construction. The need for prior NRC approvals of the changes, no matter how minor, has increased costs, both by causing construction delays or by maintaining the engineering and licensing organization on standby, ready to quickly develop and submit license amendments. These issues, in part, will be addressed by reducing the level of detail in the licensing basis and thereby reducing the need for license amendments. Ensuring Tier 1 obligations are focused on safety significant features and eliminating the NRC's use of the Tier 2\* designation will also help provide flexibility. However, additional process improvements are

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needed for situations which require license amendments, to allow construction to proceed without delays. To fully accomplish this objective, new or revised guidance will be needed and revisions to Part 52 may be needed.

In summary, the industry and the NRC have a longstanding shared commitment to safety. As we move forward with advanced reactor technologies we will continue to place the highest priority on the shared fundamental tenet of protecting public health and safety while recognizing that the new designs need an updated licensing process with improved execution. The changes outlined in this paper are needed to enable the use of new and innovative advanced reactor technologies and are essential to achieving the goal of ensuring the future of nuclear technology in the United States and the nation's role as a leader in technology innovation.

