

White Paper
Alternative Risk-Informed, Technology-Inclusive Approaches to Advanced Reactor Regulation
December 2024

NRC Staff Prepared White Paper
“Alternative Risk-Informed, Technology-Inclusive Approaches to Advanced Reactor Regulation”
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SUBJECT: ALTERNATIVE RISK-INFORMED, TECHNOLOGY-INCLUSIVE APPROACHES TO ADVANCED REACTOR REGULATION

PURPOSE:

The purpose of this paper is to offer alternatives to the proposed Part 53, “Risk-Informed, Technology-Inclusive Regulatory Framework for Commercial Nuclear Plants,” as directed by the Commission in the staff requirements memorandum (SRM) for SECY-23-0021¹. The proposed alternatives would provide an approach to advanced reactor licensing where risk analyses are used in a supporting or confirmatory role during the licensing process.

BACKGROUND:

On January 14, 2019, the President signed the Nuclear Energy Innovation and Modernization Act (NEIMA) into law (Public Law 115-439). NEIMA requires the NRC to prepare the regulatory infrastructure to support the development and commercialization of advanced nuclear reactors. Specifically, NEIMA section 103(a)(4) directs the NRC to “complete a rulemaking to establish a technology-inclusive, regulatory framework for optional use by commercial advanced nuclear reactor applicants for new reactor license applications” by December 31, 2027.

In response to NEIMA, the Commission directed the NRC staff in SRM-SECY-20-0032² to prepare and release preliminary proposed rule language, engage in public outreach and

¹ SRM-SECY-23-0021, “Staff Requirements – SECY-23-0021 – Proposed Rule: Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors,” dated March 4, 2024 (ML24064A039).

² SRM-20-0032, “Staff Requirements – SECY-20-0032 - Rulemaking Plan on ‘Risk-Informed, Technology Inclusive Regulatory Framework for Advanced Reactors (RIN-3150-AK31; NRC-2019-0062)’” (ML20276A293).

dialogue, and then further revise the language to establish the rudiments of the proposed rule for Commission consideration. On November 6, 2020, the NRC published a notification in the *Federal Register* (85 FR 71002) describing plans for the periodic release of preliminary proposed rule language, meetings with stakeholders, and the ability of stakeholders to provide input during the development of this proposed rule. The NRC staff conducted extensive public outreach on early versions of the preliminary proposed rule text as sections became available.

Based on stakeholder feedback, the NRC staff updated preliminary proposed rule language to consist of two distinct frameworks, known as Framework A and Framework B. The proposed Framework A reflected the NRC staff's initial vision for the rulemaking, relying on a probabilistic risk assessment (PRA) to identify enhanced safety margins that could be used to justify operational flexibilities. The proposed Framework B leveraged the licensing approaches in Title 10 of the *Code of Federal Regulations* (10 CFR) 10 CFR Parts 50 and 52 with modifications to be technology inclusive. While the proposed Framework B included consideration of insights from risk assessments, it did not rely on a PRA to the extent in the proposed Framework A. Instead, the proposed Framework B would have used risk insights from a PRA or alternative evaluation for risk insights (AERI) in a confirmatory role to support a largely deterministic safety analysis, and as a tool to identify safety margins to justify operational flexibilities. This approach is consistent with how 10 CFR Part 52 currently uses risk insights.

The NRC staff developed Framework B as an alternative to the PRA-led approach in Framework A because some stakeholders expressed a preference for a technology-inclusive alternative to the existing requirements developed for large light water reactors (LWRs) that would coincide with existing international standards for designing and licensing advanced reactors. Such an approach could have been better suited to support designs of a simplified scope or business plans contemplating marketing designs in countries that would require a more deterministic safety analysis. The NRC staff discussed its proposed Framework B approach during three public meetings and two Advisory Committee on Reactor Safeguards meetings in 2022, as well as at a July 2022 Commission briefing.

On March 1, 2023, the NRC staff delivered the proposed rule to the Commission in SECY-23-0021, "Proposed Rule: Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors" (ML21162A093). The proposed rule consisted of Frameworks A and B as part of what would be a new Part 53 in 10 CFR to establish technology-inclusive regulatory frameworks for commercial nuclear plants. In the subsequent SRM-SECY-23-0021, the Commission disapproved the inclusion of Framework B in the Part 53 proposed rule and directed the NRC staff to develop alternative options for the use of the concepts contained in Framework B outside of the Part 53 rulemaking. The Commission directed that the options should include, at a minimum:

- a. An option to update 10 CFR Parts 50 and 52 to include technology-inclusive improvements;
- b. An option to use a separate part in 10 CFR for Framework B; and

- c. An option to create a less prescriptive regulation where methods of compliance, similar to Framework B, could be located in guidance.

DISCUSSION:

In addition to the three rulemaking options, SRM-SECY-23-0021 directed staff to address the following:

Alternative Evaluation for Risk Insights

Initially, Framework B would have required all commercial nuclear plant applicants using the framework to develop PRAs for use in a confirmatory role as part of their risk evaluation. In response to stakeholder views that a PRA may not be necessary for all designs (particularly very small reactors), the NRC staff developed the AERI methodology as an alternative approach. Using the AERI approach would have allowed applicants to demonstrate that specified entry conditions were met, thereby ensuring that postulated bounding events would result in limited offsite consequences. By meeting the entry conditions and demonstrating that a postulated event for a proposed design would result in limited radiological consequences, an applicant would meet the Commission's safety goals without the need to estimate the likelihood of individual event sequences. The proposed AERI entry conditions would not have been safety or siting criteria but rather would only have been used to determine which applicants could develop an AERI in lieu of a PRA.

The Part 53 proposed rule defines a role for PRAs to inform various parts of the licensing basis for commercial nuclear plants and to ensure that applicants assess the risks associated with any plant that would be licensed under that part using comprehensive risk metrics and associated risk performance objectives. As such, the proposed Part 53 rule and associated guidance do not include provisions for alternatives to PRAs, such as AERI.

The NRC staff could include an AERI approach, as described in Enclosure 4, "Alternative Approaches Considered for Selected Topics During the Development of 10 CFR Part 53" (ML22244A001) to SECY-23-0021, in any of the alternative options for Framework B described below. However, due to the differences in the implementation of each option, the NRC staff would develop specific rule language and tailored guidance once the Commission provides direction on how to proceed.

Risk-Informed Seismic Designs

Another concept presented in Framework B of the proposed Part 53, Subpart R, "Licenses, Certifications, and Approvals," was based on provisions for developing ground motion response spectra that would enable the use of an alternative, risk-informed, performance-based, approach to seismic design. Instead of utilizing the seismic design requirements in 10 CFR Part 50, Appendix S, this approach would allow applicants and licensees with sufficient risk insights to grade the assumptions and inputs necessary for the seismic analyses and classification of structures, systems, and components (SSCs) important to safety, which must be able to withstand the effects of earthquakes, commensurate with their safety significance,

without loss of capability to perform their safety functions. The risk-informed alternatives for SSC classification parallel the existing alternatives under 10 CFR 50.69, “Risk-informed categorization and treatment of structures, systems and components for nuclear power reactors.” The seismic design alternatives are similar to the flexibilities proposed in Part 53 for permitting the use of multiple design-basis ground motions in lieu of the current requirements for a single safe-shutdown earthquake ground motion and minimum peak ground acceleration.

The NRC staff could include this risk-informed, performance-based approach to seismic design in any of the alternative options for Framework B described below. However, due to the differences in the implementation of each option, the NRC staff would develop specific rule language and tailored guidance once the Commission provides direction on how to proceed.

Leveraging Part 53 Experience

To support the implementation of any of the rulemaking options below, the NRC staff will leverage its experience developing Part 53. In particular, the NRC staff would adapt the draft proposed rule language and associated preamble discussions for Framework B as presented to the Commission in SECY-23-0021 to fit the proposed options below. For example, if the NRC staff is to create a new part in 10 CFR, it may be possible to directly reproduce much of the text previously prepared for Framework B. If the NRC staff is to develop a framework that relies more heavily on guidance or is incorporated into existing parts of 10 CFR, greater revisions to the original Framework B text are likely. In addition, the Part 53 rulemaking will provide a roadmap for where conforming changes would be needed throughout the CFR.

The NRC staff will also consider comments received on the Part 53 proposed rule. The comment period for the proposed rule closes on February 28, 2025. The NRC staff will consider how relevant comments resulting in changes to Part 53 impact the development of any of the rulemaking options presented below, or development of additional options. Examples of relevant areas in the Part 53 proposed rule include approaches to the use of risk information in developing a safety case, the use of generally licensed reactor operators, factory reactor fuel loading, and factory testing of certain reactors.

Following the example set during the development of Part 53, the NRC staff will continue to engage stakeholders throughout the development of any of the rulemaking options below to ensure that the rulemaking would provide reasonable assurance of adequate protection of public health and safety and meet the needs of developers. Examples of ways the NRC staff can engage with stakeholders prior to a formal proposed rule comment period include the use of white papers and periodic releases of preliminary proposed rule text to receive early feedback and public meetings, which can serve as forums for the open exchange of information.

10 CFR Parts 50 and 52 Licensing Lessons Learned

The NRC staff is conducting advanced reactor licensing reviews under 10 CFR Parts 50 and 52. The lessons learned from these reviews will inform technical and administrative areas of focus during the development of rule language to support technology-inclusive and efficient licensing of commercial nuclear plants. The NRC staff documents best practices and lessons learned

from ongoing and completed advanced reactor reviews and applies them to subsequent reviews. For example, in March 2022, the NRC staff issued “Lessons Learned from the U.S. Nuclear Regulatory Commission Staff’s Review of the NuScale Design Certification Application” ([ML22088A161](#)). This report highlights best practices from the NuScale review process including the applicant’s engagement in preapplication activities to familiarize the NRC staff with the design, development of a list of highly challenging issues, and staff efforts to streamline the safety evaluation report. Recently, the NRC staff issued an interim lessons-learned report on the ongoing review of the NuScale standard design approval application ([ML23345A079](#)). In this report, the NRC staff identified licensing review enhancements that will be implemented during the remainder of the standard design application review as the agency continues to adapt and modernize its advanced reactor licensing approaches.

In advance of the rulemaking efforts described below, the advanced reactor review teams will continue to directly apply lessons learned from one review to the next. For example, staff familiarity with the Kairos Hermes design and 14-month review of the Hermes 1 construction permit application facilitated establishing a shorter review schedule for the Hermes 2 construction permit application, which the NRC staff recently completed the safety review of in just over 10 months. Current technical areas of engagement in advanced reactor licensing reviews that could provide insights during any future rule development include methods for addressing seismic hazards and methods for determining emergency planning zones.

International Safety Standards

During public meetings on the Part 53 preliminary proposed language, discussions with stakeholders indicated that future reactor designers were interested in the use of international safety standards, potentially including the use of common terminology, that may not yet be endorsed by the NRC. The Part 53 proposed rule would allow for the use of international codes and standards not previously used in NRC licensing. However, the proposed rule recognizes that the use of any consensus code or standard would ultimately need to be found acceptable by the NRC either through generic efforts to endorse a code or standard or on an application-specific basis during an individual licensing review.

As discussed above, Framework B would have required applicants to use risk insights from a PRA, or an AERI, in a confirmatory role to support the largely deterministic safety analysis and as a possible tool to identify safety margins to justify operational flexibilities. This approach to licensing in Framework B, which would have required applicants to develop and use principal design criteria similar to those in Appendix A in 10 CFR Part 50, aligns with existing international standards for designing and licensing advanced reactors.

Framework B would have also built on international guidance (e.g., International Atomic Energy Agency guidance) for nuclear reactor licensing. For example, Framework B would have contained requirements for analysis and evaluation of initiating events derived from 10 CFR 50.34(a)(4) (similar requirements exist for 10 CFR Part 52 applications). This would have provided an additional level of detail with respect to the categorization of events and the associated acceptance criteria and analysis requirements. These requirements would have

been generally consistent with existing regulations, historical practice, and international standards for these classes of events.

The NRC staff will consider international frameworks, including the use of international safety standards and common terminology, for designing and licensing advanced reactors in the development of any of the rulemaking options below.

Rulemaking Impact and Timelines

While development of any of the rulemaking options presented in this paper would occur separately from the ongoing Part 53 rulemaking effort, the NRC staff would consider any relevant comments provided on the Part 53 rulemaking package. Because the Part 53 rulemaking does not depend on any of the concepts or requirements from the originally proposed Framework B, there are not expected to be any conflicts or impacts that might cause a delay to the finalization of the Part 53 rulemaking. Similarly, ongoing advanced reactor licensing activities conducted under 10 CFR Parts 50 and 52 are established and the NRC staff will continue to ensure licensing reviews move forward without delay from any of the rulemaking options proposed in this paper.

Each of the rulemaking options below would follow the NRC's rulemaking process to include the development and publication of both a proposed and final rule. The NRC staff will develop a specific implementation timeline as part of a formal rulemaking plan for the option selected by the Commission.

Option Development

The NRC staff has developed three options as alternatives to the Framework B initially proposed in Part 53. Each option supports a technology-inclusive approach to advanced reactor licensing where risk analyses are used in a supporting or confirmatory role during the licensing process. The options are as follows:

- Option 1 would update 10 CFR Parts 50 and 52 to include technology-inclusive provisions for advanced reactors.
- Option 2 would incorporate the Framework B language into a standalone Part 56, including technical and administrative requirements.
- Option 3 would also create a new standalone part; however, the regulatory requirements would be written more generally, leaving more detailed methods of compliance would be located in guidance.

ALTERNATIVE OPTIONS TO PART 53 FRAMEWORK B:

The NRC staff applied the principles of good regulation in its assessment of each option's relative enhancements and drawbacks in the following areas:

- *Reliability*: The NRC staff considered the extent that each option would provide a stable and predictable regulatory framework for commercial nuclear plants and take into account the diversity of designs and regulatory activities to maintain risks at an acceptably low level. Each option was also evaluated for its basis on the best available knowledge from research and operational experience.
- *Efficiency*: The NRC staff considered the extent that each option would accommodate diversity in potential designs, promote the use of risk-informed regulation consistent with the risk profile of the facility, minimize the use of resources for development and implementation, and consider the latest experiences to promote effective licensing reviews.
- *Clarity*: The NRC staff considered the extent that each option would support the coherent, logical, and practical organization of regulatory requirements. The NRC staff also considered whether the regulatory options would be readily understood and easily applied.

The NRC staff also examined legal, technical and practical implementation considerations for each option.

Option 1 – Update 10 CFR Parts 50 and 52 to Include Technology-inclusive Improvements

In SRM-SECY-23-0021, the Commission directed the NRC staff to consider an option to update 10 CFR Parts 50 and 52 to include technology-inclusive improvements. Under this option, the proposed Framework B language from SECY-23-0021 would be incorporated into the existing 10 CFR Parts 50 and 52, as appropriate, to provide technology-inclusive regulations for commercial nuclear plants. This would be accomplished by translating the proposed Framework B subparts into appendices in 10 CFR Parts 50 and 52. To minimize impacts on existing requirements for large LWRs and non-power production and utilization facilities (NPUFs), the NRC staff would develop entry criteria for each part to indicate the applicability of new and existing requirements. As appropriate, for any non-technical requirements (i.e., recordkeeping), the NRC staff would utilize the current regulations in 10 CFR Parts 50 and 52 instead of replicating these requirements in the new appendices. Below is the NRC staff's evaluation of this option against the NRC's relevant principles of good regulation.

Reliability

This option would rely on the NRC's existing regulatory frameworks in 10 CFR Parts 50 and 52 as a foundation. Because both NRC staff and stakeholders are familiar with the structure and use of risk information in 10 CFR Parts 50 and 52, this approach promotes regulatory stability and predictability. However, by inserting the previously proposed Framework B language into 10 CFR Parts 50 and 52, there would be a potential to introduce conflicting regulations, which could impact the preparation and review of license applications as well as future rulemaking efforts.

It would also be more difficult to ensure consistency with international standards and guidance because 10 CFR Parts 50 and 52 already contain incompatible definitions and requirements. This could decrease stakeholders' ability to develop designs and license applications that can be easily used in both the United States and abroad.

In weighing the factors above, the NRC staff concludes that the reliability of this option would overall offer ***moderate enhancements*** over the NRC's existing regulatory frameworks in 10 CFR Parts 50 and 52 and the previously proposed Framework B approach.

Efficiency

This option would minimize the need to replicate requirements that are not technical in nature (i.e., record keeping, etc.), which would increase the efficiency of developing new regulations. However, because the new appendices would need to reference these existing regulations throughout 10 CFR Parts 50 and 52, it could contribute to less efficient preparation and review of applications to ensure all requirements are met³.

This framework would also provide applicants with a licensing pathway that provides more flexibility in using risk insights to support the design and licensing of plants. Consistent with the existing regulatory frameworks, this option would support the use of risk insights from a PRA or AERI in a confirmatory role to support a largely deterministic safety analysis, and as a tool to identify safety margins to justify operational flexibilities.

The technology-inclusive nature of this option would also reduce the need for exemptions from the LWR-specific requirements in 10 CFR Part 50 and 10 CFR Part 52. However, this option has the potential to complicate ongoing and future rulemaking efforts impacting Parts 50 and/or 52. To avoid introducing unintended impacts, the NRC staff would need to remain diligent in its awareness of changes to 10 CFR Parts 50 and 52, considering the impact of such changes to LWRs, NPUFs, and advanced reactors licensed as commercial nuclear plants under the new technology-inclusive framework. Finally, as discussed under the resource considerations below, implementing this option would require significant staff resources.

In weighing the factors above, the NRC staff concludes that the efficiency of this option would overall offer ***minimal enhancements*** over the NRC's existing regulatory frameworks in 10 CFR Parts 50 and 52 and the previously proposed Framework B approach.

Clarity

This option would incorporate previously developed Framework B language into 10 CFR Parts 50 and 52 as appendices. Although this language would need to be evaluated and adjusted for inclusion in 10 CFR Parts 50 and 52, the use of appendices to contain previously developed subparts for Framework B would promote coherent and easily understood requirements for advanced reactors licensed as commercial nuclear plants. However, the use of

³ Alternatively, the NRC staff could include cross-references from the new part to relevant administrative portions of 10 CFR Parts 50 and 52.

entry criteria into the technology-inclusive portions of the updated 10 CFR Parts 50 and 52 could make it less clear which requirements would be applicable to a particular technology.

In weighing the factors above, the NRC staff concludes that the clarity of this option would overall offer **minimal enhancements** over the NRC's existing regulatory frameworks in 10 CFR Parts 50 and 52 and the previously proposed Framework B approach.

Legal, Technical, and Resource Considerations

Whenever regulations are updated, there is the potential to create requirements that conflict or unintentionally impact the operating fleet of LWRs and NPUFs. The NRC staff would need to ensure no backfit issues are introduced from this option. In addition to backfit requirements, significant coordination with ongoing rulemakings would be necessary to ensure regulatory consistency and prevent unintended impacts.

Technical requirements for this option would be contained within dedicated appendices in 10 CFR Parts 50 and 52. However, significant effort would be needed to identify the requirements in 10 CFR Parts 50 and 52 that would be modified and to ensure those modifications were technology inclusive. Under this option, significant additional effort would be needed to ensure no impact on existing Part 50 and Part 52 licensees.

From a resource perspective, the coordination and analysis efforts to prevent backfit issues and other unintended impacts associated with this rule could increase the amount of time needed to implement this option relative to the other options in this paper.

In weighing the factors above, the NRC staff concludes that this option would have moderate legal complexity and would require significant staff resources and time to complete.

Option 2 – Create a New “Part 56” in 10 CFR

In SRM-SECY-23-0021, the Commission directed the NRC staff to consider an option to update 10 CFR to include a new part of the regulations. Under this option, the proposed technical and administrative requirements of Framework B, as presented in SECY-23-0021, would be incorporated into a standalone part, nominally referred to as “Part 56.” This new part would include the language from the subparts that were exclusive to Framework B as well as the requirements and references to other regulations that were previously common to both Frameworks A and B in SECY-23-0021. For example, Subparts A, “General Provisions,” and X, “Enforcement” would be ported over from Part 53 into the new part. The result would be a complete set of technology-inclusive regulations for commercial nuclear plants contained within a new part of the regulations that would be separate and distinct from 10 CFR Parts 50, 52, and 53. Below is the NRC staff's evaluation of this option against the NRC's relevant principles of good regulation.

Reliability

This option would provide a technology-inclusive version of the NRC's regulatory frameworks in 10 CFR Parts 50 and 52. Because both NRC staff and stakeholders are familiar with the structure and use of risk information in 10 CFR Parts 50 and 52, a new part that using a similar approach to licensing promotes regulatory stability and predictability. Because this standalone part would not be impacted by changes to the existing 10 CFR Parts 50 and 52, there would be a lower potential for the introduction of unintended impacts in this option. However, the NRC staff would need to remain cognizant of common updates affecting Parts 50, 52, and 53 to ensure consistency, as appropriate, across frameworks.

Because this option would not be reliant upon 10 CFR Parts 50, 52, and 53, there would be greater flexibility in developing definitions and requirements that would be more compatible with the use of international standards. Compatibility with international standards could also improve the clarity of what information may be leveraged to support designs licensed in multiple countries.

In weighing the factors above, the NRC staff concludes that the reliability of this option would overall offer **substantive enhancements** over the NRC's existing regulatory frameworks in 10 CFR Parts 50 and 52 and the previously proposed Framework B approach.

Efficiency

While this option would leverage much of the previously developed Framework B language into a new part in the regulations, the NRC staff would also need to replicate applicable non-technical requirements (i.e., record keeping, etc.) from 10 CFR Parts 50 and 52, which would decrease the efficiency of developing this new part. Additionally, this framework would provide applicants with a licensing pathway that provides more flexibility in using risk insights to support the design and licensing of plants. Consistent with the existing regulatory frameworks, this option would support the use of risk insights from a PRA or AERI in a confirmatory role to support a largely deterministic safety analysis, and as a tool to identify safety margins to justify operational flexibilities.

The technology-inclusive nature of this option would also reduce the need for exemptions from the LWR-specific requirements in 10 CFR Parts 50 and 52. However, as discussed above, while this standalone part would not be impacted by changes to the existing 10 CFR Parts 50 and 52, the NRC staff would need to remain cognizant of common updates affecting 10 CFR Parts 50, 52, and 53 to ensure consistency, as appropriate, across frameworks. Finally, as discussed under the resource considerations below, implementing this option would require moderate staff resources.

In weighing the factors above, the NRC staff concludes that the efficiency of this option would require fewer resources to implement than option 1 and overall offer **minimal enhancements** over the NRC's existing regulatory frameworks in 10 CFR Parts 50 and 52 and the previously proposed Framework B approach.

Clarity

This option would incorporate previously developed Framework B language and common administrative requirements into a new self-contained part within 10 CFR. This approach would minimize the number of cross-references to 10 CFR Parts 50, 52, and 53 and avoid introducing potentially conflicting or difficult to follow requirements, both of which would promote coherent and easily understood requirements.

In weighing the factors above, the NRC staff concludes that the clarity of this option would overall offer **substantive enhancements** over the NRC's existing regulatory frameworks in 10 CFR Parts 50 and 52 and the previously proposed Framework B approach.

Legal, Technical, and Resource Considerations

Because all technical and administrative requirements would be contained within a single part of the regulations, there would be less potential for introducing requirements through this effort or in the future that would conflict or unintentionally impact the operating fleet of LWRs and NPUFs. There would also not be a risk of introducing backfit issues with this option.

Technical requirements for this option would largely replicate the existing language from the proposed Framework B, simplifying the development of the new rule.

From a resource perspective, while additional time and resources would be needed to port the necessary administrative requirements from 10 CFR Parts 50 and 52 into the new part, this would be outweighed by the significant time and resource savings from reusing much of the previously developed proposed Framework B language.

In weighing the factors above, the NRC staff concludes that this option would have low legal complexity and would require moderate staff resources and less time than option 1 to complete.

Option 3 – Create a New “Part 56” in 10 CFR that Relies More Heavily on Guidance

In SRM-SECY-23-0021, the Commission directed the NRC staff to consider an option to create a less prescriptive regulation where methods of compliance, similar to Framework B, could be located in guidance. Similar to Option 2, under this option the proposed technical and administrative requirements of Framework B, as presented in SECY-23-0021, would be incorporated into a standalone part. However, in contrast to Option 2, this option would rework the previously developed Framework B rule language to provide less detail and specific direction on how regulatory requirements would be met. The bulk of the concepts and approaches described in the proposed Framework B would be converted into implementation guidance. The result would be a complete set of general technology-inclusive regulations supported by detailed implementation guidance. This new part of the regulations and supporting guidance would be separate and distinct from the regulations and guidance for 10 CFR Parts 50, 52, and 53. Below is the NRC staff's evaluation of this option against the NRC's relevant principles of good regulation.

Reliability

This option would provide a more general technology-inclusive version of the NRC's regulatory frameworks in 10 CFR Parts 50 and 52 that would rely heavily on guidance to support implementation. While such an approach would overall offer greater flexibility to developers in proposing means of satisfying the NRC's regulations, it could also introduce regulatory uncertainty, contributing to less regulatory stability and predictability. Because most of the implementation details in this approach would be contained in non-binding guidance, there would be greater potential for reduced predictability during a licensing review to support the NRC staff in making safety findings on design-specific information. This could contribute to a more complicated regulatory process with less certainty on needed time and resources to complete licensing reviews.

Because this standalone part would not be impacted by changes to the existing 10 CFR Parts 50 and 52, there would be a lower potential for the introduction of unintended impacts in this option. However, due to the more general requirements in this approach, it would be more difficult for NRC staff to translate common updates affecting 10 CFR Parts 50, 52, and 53 into this part. Differences in language for similar requirements across parts of the NRC's regulations could introduce inconsistencies across frameworks and reduce certainty on the information necessary to satisfy regulations.

Because this option would not be reliant upon 10 CFR Parts 50, 52, and 53, there would be greater flexibility in developing definitions and requirements that would be more compatible with the use of international standards. Compatibility with international standards could also improve the clarity of what information may be leveraged to support designs licensed in multiple countries.

In weighing the factors above, the NRC staff concludes that the reliability of this option would overall offer **drawbacks** over the NRC's existing regulatory frameworks in 10 CFR Parts 50 and 52 and the previously proposed Framework B approach.

Efficiency

While this option would draw from the previously developed Framework B language, the NRC staff would need additional time and resources to rework this language into more general regulatory requirements that provide reasonable assurance of adequate protection of public health and safety of commercial nuclear plants licensed under this new part. The NRC would also need to replicate and potentially revise for consistency applicable non-technical requirements (i.e., record keeping, etc.) from 10 CFR Parts 50 and 52, which would decrease the efficiency of developing this new part. This option would also require the development of extensive technical guidance to support implementation.

As with the previous options, this framework would provide applicants with a licensing pathway that provides more flexibility in using risk insights to support the design and licensing of plants. Consistent with the existing regulatory frameworks, this option would support the use of risk insights from a PRA or AERI in a confirmatory role to support a largely deterministic safety

analysis, and as a tool to identify safety margins to justify operational flexibilities. Additionally, this option would offer an opportunity to develop a performance-based part of the regulations that is less prescriptive than 10 CFR Parts 50 and 52. The technology-inclusive nature of this option would also reduce the need for exemptions from the LWR-specific requirements in 10 CFR Parts 50 and 52. However, as discussed above, translating common updates affecting 10 CFR Parts 50, 52, and 53 into this part should be examined closely to avoid introducing inconsistencies across frameworks. Additionally, the greater flexibility provided in meeting general regulatory requirements could result in more case-by-case licensing reviews, reducing the predictability and efficiency of licensing advanced reactors. As discussed under the resource considerations below, implementing this option would require significant staff resources.

In weighing the factors above, the NRC staff concludes that the efficiency of this option would overall offer **drawbacks** over the NRC's existing regulatory frameworks in 10 CFR Parts 50 and 52 and the previously proposed Framework B approach.

Clarity

This option would minimize the number of cross-references to 10 CFR Parts 50, 52, and 53 and avoid introducing potentially conflicting or difficult to follow requirements, both of which would promote more coherent and easily understood requirements. However, the clarity on the information necessary to meet the more general regulatory requirements would be reduced.

In weighing the factors above, the NRC staff concludes that the clarity of this option would overall offer **moderate enhancements** over the NRC's existing regulatory frameworks in 10 CFR Parts 50 and 52 and the previously proposed Framework B approach.

Legal, Technical, and Resource Considerations

Because all technical and administrative requirements would be contained within a single part of the regulations, there would be less potential for introducing requirements through this effort or in the future that would conflict or unintentionally impact the operating fleet of LWRs and NPUFs. There would also not be a risk of introducing backfit issues with this option.

Since this option relies on more general rule language, there could be lengthier and more complex legal adjudications of challenges to applications filed under this regulatory framework.

Technical requirements would need to be adapted and reworked into more general regulations compared to the previously proposed Framework B requirements, complicating development of the new rule. Additionally, the combination of anticipated unique designs and general regulations could create a challenging environment for standardized reviews.

From a resource perspective, significant time and resources would be necessary to prepare a new set of general regulatory requirements and detailed regulatory guidance. This option could also increase the length and cost of licensing reviews because of the greater potential for case-by-case reviews due to the limited details in the requirements.

In weighing the factors above, the NRC staff concludes that this option could have high legal complexity and would require significant staff resources and time to complete.