# Discussion on Alternative Risk-informed, Technology-inclusive Approaches to Advanced Reactor Regulation

Public Meeting

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ADVANCED REACTOR READY

https://www.nrc.gov/reactors/new-reactors/advanced.html

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# Agenda

- Meeting Goals
- Background
- Probabilistic Risk Assessment (PRA) Considerations
- Meeting Stakeholder Needs
- Proposed Options
- Guided and Open Discussion
- Next Steps

# Meeting Goals

- Present approaches to advanced reactor licensing where risk analyses could be used in a supporting or confirmatory role during the licensing process
  - See: NRC staff white paper, “Alternative Risk-Informed, Technology-Inclusive Approaches to Advanced Reactor Regulation” (ML24355A087)
- Discuss stakeholder perspectives on proposed options for alternative frameworks
- The options presented in the white paper and discussed today are intended to align with the current proposed framework in Part 53.

# Background

- In 2019, the Nuclear Energy Innovation and Modernization Act (NEIMA) was signed into law and required the NRC to prepare the regulatory infrastructure necessary to support the development and commercialization of advanced nuclear reactors.

- In response, the staff delivered to the Commission in March 2023[1] a draft proposed rule known as "Part 53" for advanced reactor regulation, which consisted of two distinct frameworks, known as “Framework A” and “Framework B.”

[1] See: SECY-23-0021, “Proposed Rule: Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors,” dated March 1, 2023 (ML21162A095).

# Background

- Framework A relied on a PRA to inform the design of a reactor facility and identify enhanced safety margins that could be used to justify operational flexibilities.

- Framework B was developed as an alternative licensing approach in response to feedback that the use of PRA, as proposed in Framework A, could be unduly restrictive.
  - Framework B largely replicated the existing licensing approach in 10 CFR Parts 50 and 52 with technology-inclusive modifications.
  - Framework B would have required applicants to use risk insights from either a PRA or an alternative evaluation for risk insights (AERI) in a confirmatory role to support a largely deterministic safety analysis.

# Background

In SRM-SECY-0021[1], the Commission disapproved the inclusion of the proposed Framework B in Part 53 and directed staff to develop an options paper for Commission consideration for the use of Framework B outside of the Part 53 rulemaking. The options were to include at a minimum:

a. an option to update 10 C.F.R. Parts 50 and 52 to include technology-inclusive improvements;

b. an option to use a separate part in 10 C.F.R. 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.

[1] SRM-SECY-23-0021, "Proposed Rule: Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors," dated March 4, 2024 (ML24064A047)

# Background

The SRM-SECY-23-0021 also directed staff to address the following:

- Experience and insights gained through the Part 53 rulemaking process;
- Innovative concepts such as alternative evaluation for risk insights and risk-informed seismic design;
- Relevant lessons learned from recent and ongoing advanced reactor licensing experience evaluating the applicability of Part 50 and 52 requirements; and
- Compatibility with international safety standards such as use of common terminology in this options paper.

# PRA Requirements in Proposed Part 53

- *Probabilistic risk assessment* means a quantitative assessment of the risk associated with plant operation and maintenance that is measured in terms of event sequence occurrence frequencies and consequences. (Proposed 10 CFR 53.020)

- Proposed analysis requirements for the use of PRA in Part 53 are provided in Section 53.450, which states, in part, that "[a] PRA of each commercial nuclear plant must be performed to identify potential failures, susceptibility to internal and external hazards, and other contributing factors to event sequences that might challenge …safety functions…and to support demonstrating that each commercial nuclear plant meets [established] safety criteria…"

# Use of PRA in 10 CFR Parts 50 and 52

- Consistent with Commission policy, Part 50 and 52 applicants are expected to utilize a PRA to help confirm that a proposed commercial nuclear plant can be constructed and operated without undue risk to the public health and safety. Part 50 and 52 applicants may also utilize a PRA to a greater extent for a variety of risk-informed activities.

- The requirements in these parts are largely specific to light water reactor (LWR) technologies and reflect decades of development and changes to address events discovered through operating experience.

# Use of PRA in Part 53

- The proposed Part 53 would rely on the use of a PRA as a design tool for informing the selection of licensing basis events (LBEs), informing the classification of structures, systems, and components (SSCs), evaluating the adequacy of defense-in-depth measures, and to identify and assess all plant operating states where there is the potential for the uncontrolled release of radioactive material to the environment.

- This systematic process to designing a facility with PRA in a leading role would support flexibility and technology-inclusive considerations, accommodating technologies that, in some cases, lack significant operating experience.

# Flexibility in PRA Analysis in Part 53

- The proposed Section 53.450 would offer some flexibility, stating that the PRA may be used “in combination with other generally accepted approaches for systematically evaluating engineered systems”

- As currently envisioned, this flexibility would be used in limited cases (e.g., seismic analysis) where state of the art knowledge of very low frequency events may not yield useful PRA results.

# Flexibility in PRA Analysis in Part 53

- Areas for flexibility would be identified as part of performing a systematic PRA for the facility, which would be used to justify performing supplemental analyses, as appropriate, consistent with Regulatory Guide 1.247 for Trial Use, “Acceptability of Probabilistic Risk Assessment Results for Non-Light-Water Reactor Risk-Informed Activities” and the non-LWR PRA standard.

- It is not currently envisioned that supplemental analyses would be used without justification and insights gained from performing a PRA that addresses the internal events hazard group for reactors in an at-power plant operating state.

# Considerations for the Use of AERI Methodology

- The purpose of the AERI method was to allow an alternative for gaining an understanding of the risk of a facility, which may have entailed describing a conservative or bounding understanding of the risk for those facilities with very low offsite dose consequences.

- For an applicant that used the AERI methodology, a quantifiable very low risk may have been established by comparing a demonstrably conservative risk estimate using the postulated bounding event with the quantitative health objectives (QHOs), which are derived from the Commission Safety Goal Policy Statement

# Considerations for the Use of AERI Methodology

- The AERI methodology could have been used for performing an accident analysis, if entry conditions were met, in lieu of a PRA for confirming that a proposed plant would satisfy the NRC's safety goals.

- An applicant would have confirmed that the AERI entry conditions were met by estimating dose consequences using a postulated bounding event or events, considering risk insights, searching for severe accident vulnerabilities, and assessing the adequacy of the design in terms of layers of defense in depth.

# Considerations for the Use of AERI Methodology

- As such, the AERI methodology would have been incompatible with the current proposed Part 53, which requires the use of a PRA, with limited exceptions, to inform the design of the facility.
  - The AERI methodology was not designed to provide the risk insights needed to inform the identification of LBEs, inform the safety classification of SSCs, or evaluate the adequacy of defense-in-depth as required by proposed § 53.450(b).

- Under the currently proposed Part 53 framework, without an alternative to implementing the concepts from Framework B, applicants that do not wish to use a PRA to inform the design of their facility would need to use the existing regulatory frameworks in 10 CFR Parts 50 and 52, requesting exemptions, as appropriate, to use alternative accident analysis or risk evaluation methodologies.

# Meeting Stakeholder Needs

- What are the current drivers for seeking alternative licensing approaches to the existing Parts 50 and 52 frameworks or the proposed Part 53 framework?
  - Conformance with international standards
  - Alternative analysis methodologies
  - Suitability of requirements for proposed technologies
  - Flexibility, predictability, and consistency of requirements

# Option Evaluation

The NRC staff examined the proposed options using the following criteria, consistent with the NRC's principles of good regulation:

- **Reliability**
  - Ability of option to account for future changes in technology
- **Efficiency**
  - Consideration of potential costs for both NRC and stakeholders
  - Timeframe for implementation
- **Clarity**
  - Predictability and consistency of reviews
  - Flexibility of approach

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

## Reliability

- Utilizes NRC's existing regulatory frameworks in Parts 50 and 52
- Potential to introduce conflicting regulations
- Offers **moderate** enhancements over the NRC's existing regulatory frameworks

## Efficiency

- Minimizes replication of non-technical requirements
- Supports the use of risk insights from a PRA or AERI
- Reduces need for exemptions from light-water-reactor-specific requirements in Parts 50 and 52
- Could complicate other ongoing rulemakings in Parts 50 and 52
- Offers **minimal** enhancements over the NRC's existing regulatory frameworks

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

Clarity

- Promotes coherent and easily understood requirements for advanced reactors licensed as commercial nuclear plants
- May decrease clarity on which requirements would be applicable to a particular technology
- Offers **minimal** enhancements over the NRC's existing regulatory frameworks

# Option 1 Discussion

# Option 2 – Create a New "Part 56" in 10 CFR

Reliability

- New part that utilizes a similar approach to licensing as Parts 50 and 52, promoting regulatory stability and predictability
- Greater flexibility in developing definitions and requirements that would be more compatible with the use of international standards
- Offers **substantive** enhancements over the NRC's existing regulatory frameworks

Efficiency

- Non-technical requirements from Parts 50 and 52 would need to be replicated
- Supports the use of risk insights from a PRA or AERI
- Reduces the need for exemptions from LWR-specific requirements in Parts 50 and 52
- Requires fewer resources to implement than Option 1 and offers **minimal** enhancements over the NRC's existing regulatory frameworks

# Option 2 – Create a New "Part 56" in 10 CFR

Clarity

- Minimizes the number of cross-references to Parts 50, 52, and 53
- Avoids introducing potentially conflicting or difficult to follow requirements
- Offers **substantive** enhancements over the NRC's existing regulatory frameworks

# Option 2 Discussion

# Option 3 – Create a New "Part 56" in 10 CFR that Relies More on Guidance for Implementation

Reliability

- Relies more on guidance to support implementation
- Greater flexibility in developing definitions and requirements that would be more compatible with the use of international standards
- Offers **drawbacks** over the NRC's existing regulatory frameworks

# Option 3 – Create a New "Part 56" in 10 CFR that Relies More on Guidance for Implementation

Efficiency

- Requires the development of extensive technical guidance to support implementation
- Supports the use of risk insights from a PRA or AERI
- Offers an opportunity to develop a performance-based part of the regulations that is less prescriptive than Parts 50 and 52
- Reduces the need for exemptions from the LWR-specific requirements in Parts 50 and 52
- Greater flexibility provided in meeting general regulatory requirements could result in more case-by-case licensing reviews
- Offers **drawbacks** over the NRC's existing regulatory frameworks

# Option 3 – Create a New "Part 56" in 10 CFR that Relies More on Guidance for Implementation

Clarity

- Minimizes the number of cross-references to Parts 50, 52, and 53
- Avoids introducing potentially conflicting or difficult to follow requirements
- Reduction of clarity on information necessary to meet more general regulatory requirements
- Offers **moderate** enhancements over the NRC's existing regulatory frameworks

# Option 3 Discussion

# ADVANCE Act Section 208, Regulatory Requirements for Microreactors

- Section 208 of the ADVANCE Act directs the NRC to develop and implement risk-informed and performance-based strategies and guidance to license and regulate microreactors in eight topical areas:
  - staffing and operations
  - oversight and inspections
  - safeguards and security
  - emergency preparedness
  - risk analysis methods
  - decommissioning funding assurance
  - transportation of fueled micro-reactors, and
  - siting
- The NRC will address the ADVANCE Act through the existing regulatory framework, the risk-informed and technology-inclusive regulatory framework for advanced reactors (Part 53) proposed under the Nuclear Energy Innovation and Modernization Act of 2019, or other rulemaking, as appropriate.

# Guided and Open Discussion

- Are there other criteria that the NRC staff should consider when evaluating the potential alternatives?
- Are there other alternatives consistent with the current proposed Part 53 framework that the NRC staff should consider?
- Is there other feedback or questions for the NRC staff?

# Next Steps

- Consider stakeholder feedback on options presented today
- Develop a Commission options paper on alternative technology-inclusive, risk-informed approaches for advanced reactors where risk analyses are used in a supporting or complementary role
- Further stakeholder engagement will be sought once staff receive Commission direction on how to proceed