

R H
Y
B
R
I
D **C 2023** U.S. Nuclear Regulatory Commission
35th Annual Regulatory Information Conference



NAVIGATING the NUCLEAR FUTURE

MARCH 14-16, 2023

Bethesda North Marriott Hotel
and Conference Center
Rockville, Maryland



WWW.NRC.GOV

#NRCRIC2023



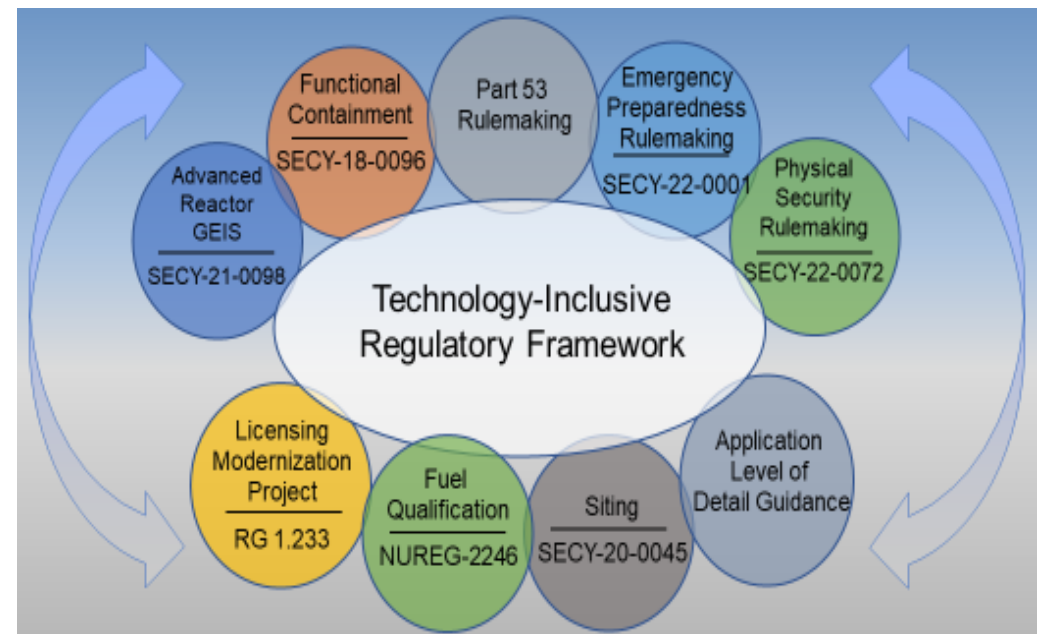
Enabling Deployment of Advanced Reactors Nuclear Reactor Regulation

Vision and Strategy

The NRC staff developed vision, strategy, and implementation action plans to ensure the agency's readiness to review and regulate a new generation of non-light-water reactors. Subsequently, the Nuclear Energy Innovation and Modernization Act (NEIMA) was enacted in 2019 (Public Law 115-439). This legislation, in part, required the NRC to develop a technology-inclusive regulatory framework for advanced reactors, including next-generation light- and non-light-water reactors.

Modernizing the Regulatory Framework

The NRC staff has taken significant steps to establish a modern framework to support the effective, efficient, and predictable review of advanced reactor license applications in accordance with NEIMA. The NRC staff has implemented several risk-informed and performance-based licensing strategies, including endorsement of **codes and standards**, development of **analytical tools**, resolution of key **policy issues**, preparation of several proposed **rulemakings**, and creation of **key guidance documents** to support advanced reactor application development and review.





Streamlining the Licensing Process

Several rulemakings are under development, including the new 10 CFR Part 53, which will provide, if finalized, performance-based, risk-informed, and technology-inclusive regulatory frameworks for optional use by applicants for new commercial advanced reactors.

Other rulemakings under development address physical security, emergency preparedness, and issuance of a generic environmental impact statement for advanced reactors. If finalized, these rulemaking efforts will provide regulatory stability, predictability, and clarity in the licensing of advanced reactors.

Anticipated 10 CFR Part 53 Rulemaking Schedule



The draft proposed 10 CFR Part 53 rule includes two optional frameworks:

- **Framework A**—This is a probabilistic risk assessment (PRA)-led approach for developing portions of the licensing basis. Functional design criteria are established based largely on the results of the PRA to ensure high-level safety and design requirements are satisfied.
- **Framework B**—This includes a traditional use of risk insights, in which principal design criteria are established in the initial stages of design and licensing and subsequent design activities are performed to ensure that these criteria are met. This framework will include an alternative evaluation for risk insights (AERI) approach, which would not require a PRA for less complex and lower consequence facilities.





Resolving Policy Issues to Prepare for the Evolving Advanced Reactor Landscape

Functional Containment

The NRC staff developed a new methodology for establishing design-specific functional containment performance criteria that rely heavily on identification and analyses of licensing-basis events for non-light-water reactors. This approach was approved by the Commission and is described in SECY-18-0096.

Population-Related Siting Considerations

The NRC staff is revising guidance to provide an alternative population-density siting criterion that is directly related to the potential radiological consequences estimated from analyzing a range of possible design-specific events. This approach was approved by the Commission and is described in SECY-20-0045.

Fusion Regulatory Framework

The NRC staff has assessed the characteristics and hazards associated with proposed fusion energy systems and developed options for a regulatory framework based on a byproduct material, utilization facility, or hybrid approach. The NRC staff presented these options to the Commission for consideration in SECY-23-0001.

Micro-reactors

The NRC staff is proactively identifying policy issues to support safety-focused, cost-effective, and timely reviews of micro-reactor technologies. The NRC staff is considering issues associated with factory-fabricated modules, factory fueling, and transportation to present to the Commission for consideration.





Guidance and Oversight

The development of key guidance is underway to support both early advanced reactor applicants that plan to apply under the existing 10 CFR Part 50 and 10 CFR Part 52 frameworks, as well as future applicants that may use 10 CFR Part 53.

Key Guidance

Existing

- Licensing Modernization Project (RG 1.233)
- Siting Criteria (RG 4.7)
- Fuel Qualification Framework (NUREG-2246)
- Developing Principal Design Criteria for Non-LWRs (RG 1.232)
- Non-LWR PRA Standard (RG 1.247)
- High Temperature Materials (RG 1.87)

Under Development

Near Term

- PRA for Initial Licensing ISG
- TICAP/ARCAP (NEI 21-07)
- Reliability and Integrity Management (ASME XI-2)
- MSR Fuel Qualification
- Seismic Design/Isolators
- Emergency Planning
- TIRICE (SNC led)
- QA Alternatives (NEI led)
- Facility Training Programs
- Materials Compatibility ISG

Part 53

- Identification of Licensing Events
- AERI Framework
- Operator Licensing Examination ISG
- Human Factors Engineering ISG
- Flexible Staffing Plan Review ISG
- Part 26, Fitness for Duty
- Part 26, Fatigue Management
- Part 73, Access Authorization
- Part 73, Cyber Security
- Part 73, Security Programs

Future

- Analytical Margin
- Chemical Hazards
- Manufacturing
- Technical Specifications
- Facility Safety Program
- Framework B Content of Applications

ARCAP and TICAP

The Advanced Reactor Content of Application Project (ARCAP) contains application guidance that is technology inclusive, risk informed, and performance based. The ARCAP is broad and encompasses the industry-led Technology-Inclusive Content of Application Project (TICAP). Both projects build on the Licensing Modernization Project to support the establishment of key aspects of the licensing basis. There are nine ARCAP interim staff guidance (ISG) documents and one TICAP draft regulatory guide (RG) that are in development to support near-term applicants under 10 CFR Part 50 or 10 CFR Part 52.

ARCOP

The Advanced Reactor Construction Oversight Project (ARCOP) will contain guidance and oversight methods that embody a risk-informed, technology-inclusive construction oversight program for advanced reactors. With the advanced reactor landscape evolving rapidly, the NRC staff will ensure adequate protection of the safety of nuclear facilities with an oversight program that will be flexible and scalable such that the oversight for each licensee is appropriate and commensurate with the facility's characteristics and structures, systems, and components important to safety.





Analytical Tools and Codes and Standards

Enhancing non-light-water reactor technical and regulatory readiness

Activities are underway to ensure sufficient computer code capability for the NRC staff to perform independent analyses of advanced reactor designs. The NRC uses computer codes and tools to perform confirmatory, sensitivity, and uncertainty analyses to investigate design margins commensurate with the risk and safety significance of the phenomena applicable to specific designs. The NRC staff has identified a suite of tools comprising NRC, U.S. Department of Energy (DOE), and internationally developed codes and is continuing to develop these tools and close any gaps in capability. The NRC staff has developed reference plant models to demonstrate the capabilities of these tools to analyze non-light-water reactor designs.

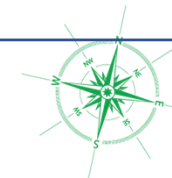
Looking forward

The NRC staff continues to assess the information, experimental data, and analytical tools needed to support non-light-water reactor reviews and to develop its own computer codes while leveraging DOE capabilities.

Endorsement of Codes and Standards

Consensus codes and standards are integral to the regulatory process and promote safe operation of nuclear plants while improving the effectiveness and efficiency of regulatory oversight. The following codes and standards have been endorsed or are under consideration to support advanced reactor licensing:

- Non-light-water reactor probabilistic risk analysis standard
 - Endorsed by the NRC with staff exceptions and clarifications in RG 1.247 for trial use
- ASME Boiler and Pressure Vessel Code, Section III, Division 5, "High-Temperature Reactors"
 - Endorsed by the NRC with exceptions and limitations in RG 1.87, Revision 2
- ASME Boiler and Pressure Vessel Code, Section XI, Division 2, "Requirement for Reliability and Integrity Management"
 - Endorsed by the NRC with conditions in RG 1.246
- Seismic design standards that the NRC staff is currently considering endorsing include the following:
 - ANSI/ANS 2.27-2020
 - ANSI/ANS 2.29-2020
 - ASCE/SEI 43-19





Contact Information

More information on efforts to establish a framework to support the effective and efficient review of advanced reactor license applications can be found at <https://www.nrc.gov/reactors/new-reactors/advanced.html>

For more information or any questions, please contact Amy Cubbage or Scott Tonsfeldt at Amy.Cubbage@nrc.gov or Scott.Tonsfeldt@nrc.gov

