INL/MIS-24-77898-Revision-0

Regulatory Framework Modernization Program

May 2024

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Changing the World's Energy Future

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Prepared for the
U.S. Department of Energy
Under DOE Idaho Operations Office
Contract DE-AC07-05ID14517

U.S. DEPARTMENT OF ENERGY | Office of NUCLEAR ENERGY

Regulatory Framework Modernization Program

Advanced Non-Water Technologies

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Overview of Regulatory Development Structure

- Regulatory Development is one part of the DOE's Advanced Reactor Demonstration Program
  - Advanced Reactor Demonstration Projects (funded via DOE's OCED)
  - Risk Reduction for Future Demonstrations
  - National Reactor Innovation Center
  - Regulatory Development
  - Advanced Reactor Safeguards

- Regulatory Development has four major components:
  - Regulatory Framework Modernization
  - Fast Reactor Regulatory Development R&D
  - Molten Salt Reactor Regulatory Development R&D
  - Gas Reactor Regulatory Development R&D

Regulatory Framework Modernization Program Goals and Objectives

- This portion of DOE's Advanced Reactor Demonstration Program (ARDP) directly engages and supports the industry and Nuclear Regulatory Commission (NRC) in addressing and resolving key regulatory framework issues that directly impact the "critical path" to advanced reactor demonstration and deployment
- This area focuses on risk-informing and adapting ("modernizing") the regulatory framework for commercial reactor facilities, including:
  - Developing adaptations of light water reactor (LWR) based regulations for advanced non-LWRs
  - Establishing risk-informed performance-based NRC license application content and review criteria guidance
  - Establishing risk-informed regulatory approaches for key parts of the plant operations phase
- Identified scope also includes the establishment of key licensing technical requirements that have been identified by industry as areas of regulatory uncertainty when pursuing commercial facility deployments
- These program efforts are focused on achieving formal NRC endorsement or approval, where applicable, so that these areas of regulatory uncertainty are clearly resolved
- It's noted that the identification and prioritization of scope considers topics that may be of specific regulatory interest to DOE Advanced Reactor Demonstration Project awardees, and whose resolution would benefit both the awardees and the broader advanced reactor stakeholder community

Connections to DOE-NE Mission

DOE NE Mission: Advance nuclear energy science and technology to meet U.S. energy, environmental, and economic needs

Mission Goal # 2: Enable deployment of advanced nuclear reactors

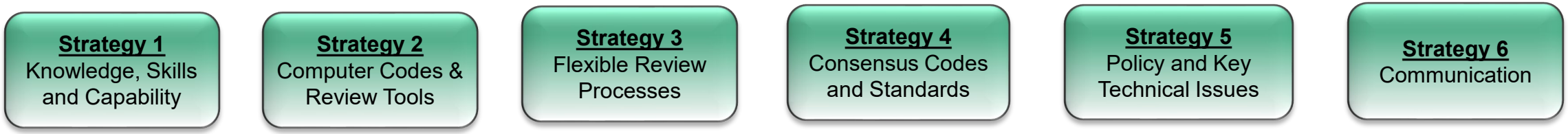
Objectives:

1. Reduce risk and time needed to deploy advanced nuclear technology
2. Develop reactors that expand market opportunities for nuclear energy
3. Support a diversity of designs that improve resource utilization

Note: Every commercial deployment of an advanced reactor will require regulatory engagement by the developer and the facility's owner/operator(s)

NRC's Implementation Action Plan (IAP)

- The IAP is an NRC initiative originated in 2015 to establish a strategy to assure NRC readiness to effectively and efficiently review non-water reactors, including consideration of their fuel cycles and waste forms
  - NRC gathered industry inputs in 2015-2017 to identify and confirm readiness needs
  - The IAP was issued in 2017, with 6 major focus areas identified



- DOE-funded programs are focused on strategy areas 2, 3, 4, & 5, and include for example:
  - 2 NEAMS Program, ART Program, Microreactor Program
  - 3 Non-LWR design criteria, Licensing Modernization Project, TICAP/ARCAP
  - 4 ASME Section III Div. 5, Non-LWR PRA Standard, ANS 20.2
  - 5 Functional Containment, "right-sized" Emergency Planning, Microreactor policy issues

Work Package Overview

- RD-24IN070201: Non-LWR Regulatory Framework Modernization
- This work package supports the following work:
  - Technical Area Lead position (at INL) and program support
  - International collaborations regarding advanced reactor safety design and regulatory frameworks
  - Non-LWR Regulatory Framework Modernization through participation in various industry and NRC interactions influencing advanced non- LWR licensing through the establishment of a defined and predictable regulatory framework
- This work is being performed to support the development of regulatory frameworks to facilitate timely advanced reactor deployments (i.e. Part 50/52 adaptations, Part 53 development, TRISO fuel qualification, graphite qualification, material qualifications)
- This work package supports the industry by providing a path to solve emerging issues associated with the development of a regulatory framework for advanced reactors

Deliverables

- M3RD-24IN0702014
  - “Submit a report with recommendations for R&D needed to establish licensing technical requirements in conjunction with a summary of FY24 regulatory framework development outcomes that have reduced advanced reactor regulatory uncertainties”
  - Due September 27, 2024
- M4RD-24IN0702013
  - “Submit a memo summarizing the progress on FY24 International Collaborations scope”
  - Due September 27, 2024

Regulatory Framework Modernization Program

- The Regulatory Framework Modernization part of the Regulatory Development subprogram coordinates with the industry and Nuclear Regulatory Commission (NRC) to address and resolve key regulatory framework issues that directly impact the “critical path” to advanced reactor demonstration and deployment

- This area focuses on risk-informing and adapting (“modernizing”) the regulatory framework for commercial reactor facilities, including:
  - Commission policy issue resolution,
  - Developing adaptations of light water reactor (LWR) based regulations for advanced non-LWRs
  - Establishing risk-informed performance-based NRC license application content and review criteria guidance
  - Establishing risk-informed regulatory approaches for key parts of the plant operations phase

- These program efforts are focused on achieving formal NRC endorsement or approval, where applicable, so that these areas of regulatory uncertainty are clearly resolved
- It’s noted that the identification and prioritization of scope considers topics that are specific regulatory challenges to ARDP Demonstration Project awardees, and whose resolution would benefit both the awardees and the broader advanced reactor stakeholder community

Examples & Outcomes of Completed Program Efforts

Regulatory Framework Modernization Program efforts have resulted in elimination of regulatory uncertainties in key areas supporting advanced reactor deployments. This involved the development of regulatory proposals, coordinated with industry, that have been formally approved or endorsed by NRC for industry use, such as:

- Licensing Modernization Project (LMP) - NRC endorsed in Regulatory Guide 1.233
  - Established a risk-informed and performance-based approach to advanced reactor design and licensing
- Technology Inclusive Content of Application Project (TICAP) – NRC endorsed in Regulatory Guide 1.253
  - Provides guidance to both industry and NRC staff on LMP-based license application content expectations
  - Being utilized by the two DOE-ARDP awardees (TerraPower & X-energy) for commercial licensing
- Use of historical DOE experimental databases to support NRC licensing
  - NRC Safety Evaluation approving Argonne National Laboratory QA program to qualify certain EBR-II historical data
- Use of DOE R&D program results to support industry fuel qualification efforts
  - NRC Safety Evaluation of EPRI topical report that establishes an accepted foundation for TRISO particle fuel qualification

Examples of Current Framework Modernization Work

- Further Development of Risk-Informed and Performance-Based (RIPB) Approach
  - Developed Technology Inclusive Risk Informed Change Evaluation (TIRICE) guidance for non-LWRs to evaluate changes to the facility that meets the intent of the 10 CFR 50.59 regulation for those licensees that have used the Licensing Modernization Project approach
  - The Technology Inclusive Management of Safety Case (TIMaSC) project is looking at the full picture of the licensing basis for a plant with an LMP-based safety case provide for integration of the various activities associated with the risk-informed change management of a license.
- Risk-Informed and Performance-Based Emergency Planning
  - Developing a consensus technology-inclusive RIPB approach to establishing the plume exposure EPZ and associated emergency plan
  - NRC's Emergency Planning Rulemaking was issued in November 2023
- Generic Environmental Impact Statement (GEIS)
  - Tracking progress and awaiting further work by NRC staff and potential release for public comment
- Physical Security Rulemaking

Examples of Current Framework Modernization Work Cont'd

- Hazards
  - Developing an approach for the assessment of low frequency external events as part of a RIPB licensing approach
- Liquid Fuel Qualification
  - Piloting the MSR-specific NUREG/CR-7299 approach to assess and identify any specific challenges with achieving liquid fuel qualification by addressing the key considerations reflected in NUREG-2246, Fuel Qualification for Advanced Reactors"
- Sodium Fast Reactor Fire Protection – Industry Standard
  - Assist with industry efforts to draft an updated version of ANSI/ANS Standard 54.8 - "Liquid Metal Fire Protection …"
- International Collaborations
  - Continued GIF-RSWG & IAEA participation focused primarily on development of advanced reactor safety design approaches and criteria

Event Participation

- INL staff have attended and participated in numerous events held by NRC, DOE, NEI, and industry
  - Regularly attended NRC public meetings regarding 10CFR Part 53 development
    - Provided progress reports to INL Nuclear Science & Technology Associate Laboratory Director on the status of 10 CFR Part 53 and major industry comments/concerns with the rule
  - Advisory Committee on Reactor Safeguards (ACRS): Participated in the ACRS review of the NRC guidance on risk-informed licensing application content for advanced reactors (TICAP and ARCAP), November 16, 2023 AND December 6, 2023
    - December 6 meeting resulted in an ACRS letter providing very positive feedback and identifying a few remaining open issues for staff to consider.
    - Guidance was later issued to industry for use and will likely be used by the two DOE-ARDP awardees
- ACRS Subcommittee Meeting: Participated in the meeting addressing the transportation of fueled microreactors, November 17, 2023
- Advanced Reactor Stakeholder Meetings
  - Typically held every 6 weeks (October, December, February, March to current in FY24)

Event Participation Cont'd

- INL staff have attended and participated in numerous events held by NRC, DOE, NEI, and industry
  - NEI Advanced Reactor Forum(s), including the in-person event held March 11 in Bethesda, MD
  - NRC Regulatory Information Conference, March 12-14, 2024
  - NEI New Reactor Regulatory Working Group, March 14, 2024
- Staff presented ongoing work in the Regulatory Development Program at the NRC Advanced Reactor Stakeholder Meeting on March 27, 2024
  - Significant industry and government feedback was obtained from these presentations, including ideas and areas of need for FY25 (and beyond) work planning

Regulatory Engagement Considerations

- **DOE program outputs have a number of connections to industry regulatory engagements – close coordination is critical:**
  - Currently ongoing NRC licensing reviews (Kairos-Hermes 2, Abilene Christian-NEXT)
  - Design and commercial license application development is underway (incl. DOE ARDP awardees)
  - NRC pre-application interactions by various industry advanced reactor technology stakeholders is underway

- **General types of regulatory engagement directly supported by DOE NE-5 programs:**
  - Completion of R&D that provides experimental results, data, and validated methods that are reflected in DOE national laboratory reports (OSTI) that can be directly referenced by industry stakeholders in support of their license applications and associated regulatory interactions

  - Completion of R&D and development of associated industry proposals that are submitted to NRC for formal endorsement, and can then be utilized by multiple industry stakeholders without additional “up-front” regulatory approach evaluation

Planning for FY25 and Beyond

Regulatory Development obtains inputs from key stakeholders and reports (DOE, NEI/NEA, Developers, NRC, etc) to prioritize and propose regulatory projects. Examples:

- Participation in NEI New Reactor Regulatory Working Group
- Regulatory topics within EPRI/NEI Advanced Reactor Roadmap – North America
- Participation in DOE advanced reactor technology program reviews

Regulatory development leadership desires additional information to meet the needs of NRIC and NRIC customers

Avenues for stakeholder engagement and input:

- Jim Kinsey, Technical Area Lead, Regulatory Framework Modernization Program
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Questions?