Licensing and Deployment Considerations for Nth-of-a-Kind Micro-Reactors

Advanced Reactor Stakeholders Meeting

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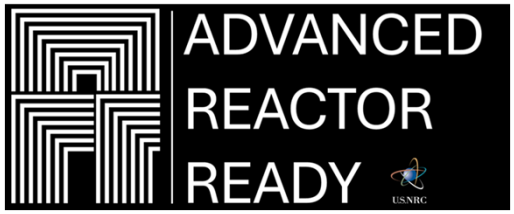

https://www.nrc.gov/reactors/new-reactors/advanced.html

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Goals of this Presentation

- Inform stakeholders about regulatory approaches the NRC staff is developing, for Commission consideration, regarding standardized operational programs and alternative environmental reviews
- Inform stakeholders about other licensing and deployment topics, potential near-term strategies, and next steps the NRC staff is considering.
- Engender a dialogue with stakeholders

Background

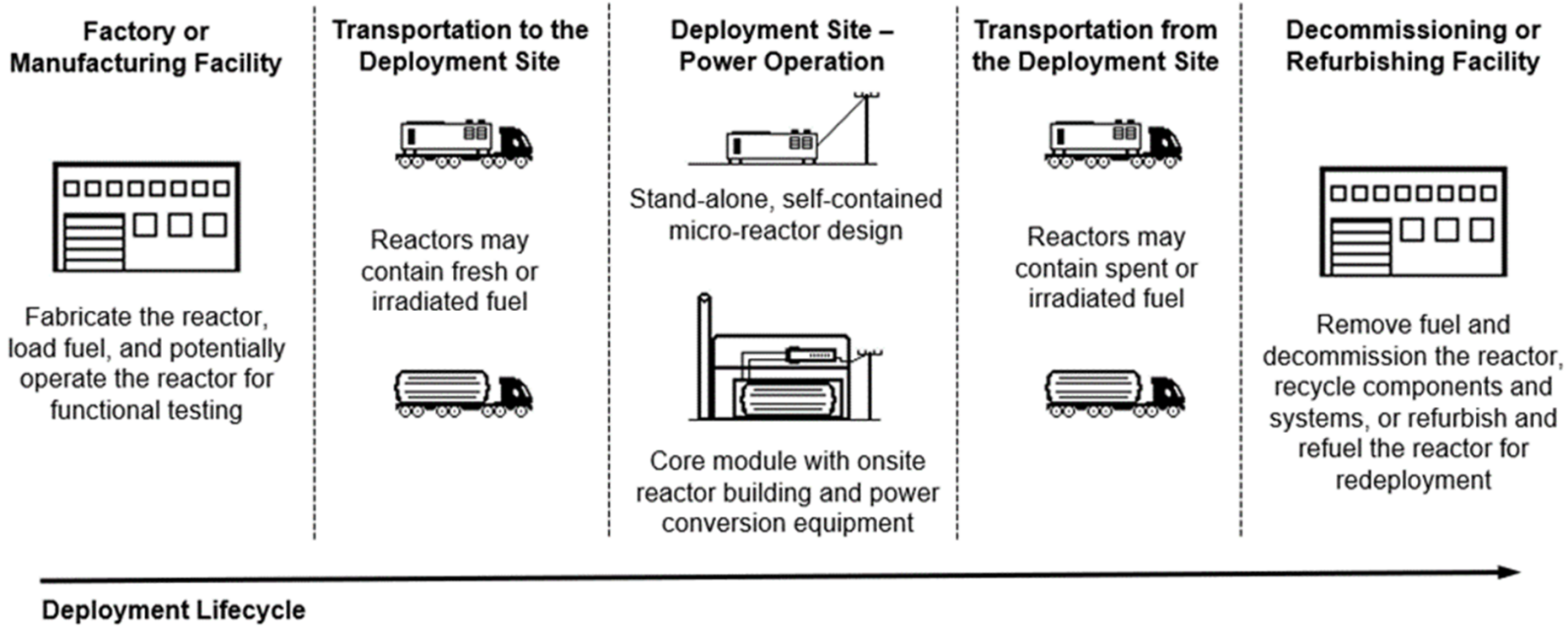
- For licensing purposes, micro-reactors are commercial power reactors licensed under Section 103 of the AEA.
- Micro-reactors typically use non-light-water reactor technologies, are expected to have power levels on the order of tens of megawatts thermal, small site footprints, low potential consequences in terms of radiological releases, and may have increased reliance on passive systems and inherent characteristics to control power and heat removal.
- Factory-fabricated micro-reactors are a subset of micro-reactors that would rely heavily on standardization and mass production to simplify licensing and deployment.*

* See SECY-24-0008, "Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory," dated January 24, 2024 (ML23207A252).

Background

- For the purposes of this presentation, the term “Nth-of-a-Kind” (NOAK) micro-reactor generally means a micro-reactor of a standard common design that has been previously approved by the NRC through, a design certification, manufacturing license, or final safety analysis report for a first-of-a-kind (FOAK) combined license or operating license.
- Nth-of-a-Kind micro-reactor licensing refers to licensing micro-reactors of a standard common design for operation as power reactors at fixed sites.

Conceptual Deployment Model for Factory-Fabricated Transportable Micro-Reactors



An approach by which a robust up-front approval of a standard design enables efficient, predictable licensing of "Nth-of-a-Kind" reactors

Up-Front Approval of the Standard Plant

- Standard design approved in a manufacturing license, design certification, construction permit and operating license, or combined operating license
- Technical issues resolved
- Standardized operational programs
- Generic environmental review (to the extent practicable)
- Hearings covering the standard design and environmental review

Nth-of-a-Kind Licensing

- Streamlined administrative processes
- Confirmation of site suitability for the standard design
- Site-specific environmental review (applying the generic environmental review, as appropriate)
- Closure of ITAAC/license conditions
- Confirmatory site-specific inspection
- Site-specific hearing
- Operating decision

Regulatory Approaches for Standardizing Operational Programs

- The NRC staff is exploring approaches to review operational matters at the design approval stage (ML or DC) for a standard micro-reactor design considering two general groups of operational programs:
  - Group 1: Design-related (e.g., technical specifications (TS), design quality assurance, and portions of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME BPV) in-service inspection and in-service testing programs)
  - Group 2: Site specific/operational (e.g., operator training, security programs, emergency preparedness, etc.) developed in the operating license or combined license under current processes

Regulatory Approaches for Environmental Reviews

- The current regulatory process is to perform an environmental impact statement (EIS) for nuclear power reactors*
- The NRC staff is considering alternative approaches for environmental reviews for micro-reactors of a common design
- Any EIS, generic environmental impact statement (GEIS), or environmental assessment (EA) under any alternative may be tiered from the New Reactor GEIS

Alternative	Environmental Review for First-of-a-Kind	Environmental Review for Nth-of-a-Kind
Design-Specific GEIS	• GEIS or • Generic EA w/ Exemptions	• Supplemental EA tiered from FOAK GEIS or EA
Environmental reviews associated with a design approved in a ML or DC	• EIS or • EA with Exemptions	• Supplemental EA tiered from FOAK EIS or EA
Micro-Reactor Online Environmental Review Portal	• EIS or • EA with Exemptions • Develop Design-Specific Portal	• Applicant supplies site-specific data into Portal • NRC develops EA tiered from First-of-a-kind EIS/EA or from New Reactor GEIS based on applicant submission on Portal
Design-Specific Categorical Exclusions (CATEX)	• EIS or • EA with Exemptions • Develop CATEX and Checklist	• Applicant supplies site-specific data using Checklist • NRC determines if CATEX applies

* See SECY-24-0046, "Implementation of the Fiscal Responsibility Act of 2023 National Environmental Policy Act Amendments" (https://www.nrc.gov/docs/ML2407/ML24078A013.html), for discussion of the current process for environmental reviews and potential changes related to the Fiscal Responsibility Act of 2023.

Other Licensing and Deployment Topics

Maximal design standardization

- The regulations in 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” provide several regulatory pathways for design standardization, including manufacturing licenses, design certifications, and standard design approvals, under which most safety issues would be resolved.
- Maximal standardization would involve approval of a standardized micro-reactor design and subsequent deployment under a combined license or construction permit and operating license without any significant deviations or departures from the standardized design.
- Maximal design standardization could allow micro-reactors of a common design to be deployed to most sites in the U.S. with minimal need for site-specific features or the associated additional NRC reviews and approvals.

Other Licensing and Deployment Topics

Grading the level of site characterization

- A standardized design for a micro-reactor could establish bounding parameters for site characteristics that are important to the safety review so that micro-reactors of the standard design could be deployed at suitable sites throughout the U.S.
- The NRC staff is considering approaches for grading the level of site characterization for NOAK micro-reactors of a standard design based on the applicable hazards for the specific micro-reactor design, the amount of margin included in the design for each bounding site parameter, and the amount of margin to appropriate dose reference values.
- A graded approach could focus on how a construction permit or combined license applicant can provide the required site characterization information and demonstrate that the bounding parameters are met for the candidate site.

Other Licensing and Deployment Topics

Deployment site security

- The existing requirements for security apply to licensing micro-reactors of a common design, including various regulations in 10 CFR Part 73, “Physical Protection of Plants and Materials.”
- The NRC has ongoing activities that would apply to micro-reactors, such as those associated with SECY-22-0072, “Proposed Rule: Alternative Physical Security Requirements for Advanced Reactors” (https://www.nrc.gov/docs/ML2133/ML21334A003.html), and SECY-23-0021, “Proposed Rule: Risk-Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors” (https://www.nrc.gov/docs/ML2116/ML21162A093.html).
- The NRC staff is considering additional approaches for streamlining the review of security for licensing “Nth-of-a-Kind” micro-reactors, including the possibility to standardize operational aspects of security, to the extent practical.

Other Licensing and Deployment Topics

Deployment site emergency preparedness

- The existing regulations for emergency preparedness in 10 CFR Part 50, “Domestic licensing of production and utilization facilities,” apply to licensing micro-reactors of a common design.
- The NRC staff is exploring approaches for streamlining the review of emergency preparedness for licensing NOAK micro-reactors based on considerations such as the possibility that potential accidents would result in low doses at the site boundary and, under certain circumstances, might not require extensive off-site response.

Other Licensing and Deployment Topics

Streamlined processing of license applications and licensing documents

- Licensing applications referencing an approved micro-reactor design that leverages maximal design standardization will likely be nearly identical, with some possible minor variations related to licensee-specific or site-specific information.
- NRC-generated licensing documents, such as the NRC staff safety evaluation, environmental review, license, and required Federal Register notices, will likely be very similar for licensing each individual micro-reactor of a common design.
- The NRC staff is considering approaches for using electronic licensing forms, licensing document templates, and automation to streamline processing and review of micro-reactor applications to reduce the timeframes for acceptance review, docketing, safety review, environmental review, concurrence, license issuance, and other steps.

Other Licensing and Deployment Topics

Construction inspection

- Micro-reactors of a common design might be “self-contained” in that they would be almost entirely fabricated at a factory and require minimal site preparation or construction activities at the deployment site, or they might consist of a “core module” that is fabricated in a factory and then incorporated into or connected to permanent structures and systems constructed at the deployment site, such as a reactor building and power conversion equipment.
- In either case, it will be necessary for the NRC staff to verify completion of ITAAC in support of a finding for authorization to operate under 10 CFR 52.103(g) or to verify substantial completion of construction for issuance of an operating license under 10 CFR 50.56 and 50.57(a)(1).
- As discussed in SECY-23-0048*, the NRC staff is considering approaches for risk-informed and performance-based inspections at both the fabrication facility and deployment site that can be completed within the expected timeframes for licensing and deployment of Nth-of-a-Kind micro-reactors.

*SECY-23-0048, "Vision for the Nuclear Regulatory Commission's Advanced Reactor Construction Oversight Program" (ML23061A086)

Next Steps

- Publish a draft white paper, expected in Fall 2024, to further stakeholder engagement
- Develop a Commission paper on licensing and deployment considerations for Nth-of-a-kind micro-reactors:
  - Request Commission direction on regulatory approaches for standardizing operational programs and alternate environmental reviews
  - Provide information on other topics, including the NRC staff's related near-term strategies and potential next steps

Discussion Items

- Are there other approaches that the NRC staff should consider for NOAK micro-reactor licensing and deployment?
- Are there additional strategies the NRC staff should consider for the other identified topics?
- Other feedback or questions for the NRC staff?