

**NRC Staff Prepared White Paper
“Nth-of-a-Kind Micro-Reactor Licensing and Deployment Considerations”
September 2024 Draft – Released to Support ACRS Interaction**

THIS NRC STAFF WHITE PAPER HAS BEEN PREPARED AND IS BEING RELEASED TO SUPPORT INTERACTIONS WITH THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS (ACRS). THIS PAPER HAS NOT BEEN SUBJECT TO NRC MANAGEMENT AND LEGAL REVIEWS AND APPROVALS, AND ITS CONTENTS SHOULD NOT BE INTERPRETED AS OFFICIAL AGENCY POSITIONS. A PROSPECTIVE APPLICANT SHOULD NOT USE THE CONTENTS OF THIS PAPER OR RELY ON ITS CONTENTS IN PREPARING AN APPLICATION.

SUBJECT: Nth-of-a-Kind Micro-Reactor Licensing and Deployment Considerations

PURPOSE:

The purpose of this paper is to support upcoming interactions with the Advisory Committee on Reactor Safeguard (ACRS) on the U.S. Nuclear Regulatory Commission (NRC) staff’s strategy for efficient licensing of “nth-of-a-kind” (NOAK) micro-reactors, including options for NRC staff review of standardized operational programs in connection with review of a standard design and options for alternative environmental reviews associated with combined license (COL) and construction permit (CP) and subsequent operating license (OL) applications for NOAK micro-reactors.

BACKGROUND:

Stakeholders have expressed growing interest in the widespread deployment of micro-reactors within the United States to support decarbonization goals, provide integrated power sources for industrial applications, deliver reliable electricity in remote locations, and potentially for other applications. Micro-reactor developers are particularly interested in the NRC’s providing enhanced clarity about efficient regulatory processes that would govern licensing of such facilities.¹ The NRC staff is currently in preapplication engagements with several micro-reactor developers that are considering fabrication of numerous micro-reactors of a standard design for rapid deployment.

The micro-reactors considered in this paper are commercial power reactors licensed under section 103, “Commercial Licenses,” of the Atomic Energy Act of 1954, as amended (AEA). While the NRC staff is not proposing a regulatory definition of “micro-reactor” in this paper, in SECY-20-0093, “Policy and Licensing Considerations Related to Micro-Reactors,” dated October 6, 2020 (Agencywide Documents Access and Management System Accession No. ML20129J985), the NRC staff described the anticipated attributes of micro-reactors. The NRC staff anticipates that micro-reactors will have thermal power levels on the order of several megawatts to a few tens of megawatts and will have small site footprints. They will likely have radionuclide inventories that would be about one percent or less of those for typical large light-water reactors and, in the unlikely event of an accident, are anticipated to have significantly

¹ See, for example, the letter from T. Williams of Shepherd Power to Robert Taylor dated February 14, 2024 (ML24068A021) and the Nuclear Energy Institute (NEI) proposal paper, “Regulations of Rapid High-Volume Deployable Reactors in Remote Applications (RHDR) and Other Advanced Reactors” (ML24213A337) dated July 31, 2024.

lower potential radiological consequences with a correspondingly lower impact on public health and safety. Micro-reactors may also rely on passive systems and inherent characteristics to control reactor power and heat removal.

The NRC staff has taken a technology-inclusive approach and not constrained the applicability of options in this paper by proposing any specific limitations, such as reactor power level, on the meaning of the term “micro-reactor,” as used in those options. However, practical matters, such as the extent to which reactors can be fabricated away from the site of permanent deployment, small reactor site footprints, few or no radioactive effluents, low reliance on site-specific reactor design features, minimal interfaces between the reactor and the site, and simplified operations, will tend to limit the options to micro-reactors with attributes such as those described in SECY-20-0093.

For the purposes of this paper, the term “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 (DC), manufacturing license (ML), or a first-of-a-kind (FOAK) COL or CP/OL proceeding. The term “NOAK licensing” refers to licensing micro-reactors of a standard common design for operation as power reactors at fixed sites. It is possible for a CP/OL or COL applicant to reference a design previously approved in a DC or ML and construct and operate the reactor without departures from the approved design, but experience has shown that construction and operation of a FOAK reactor has involved departures. Departures from the approved design in subsequent COL or CP/OL licensing applications would not necessarily negate the NOAK designation, but they would likely decrease the efficiency of NOAK licensing by requiring additional NRC staff review. For this reason, maximal design standardization (as described in Enclosure 3) might not be achieved until after a FOAK reactor has been constructed and placed into operation and the DC or ML updated (following the applicable change control processes) to incorporate the design changes necessitated by the departures. This may also be true for design aspects that factor into the options for alternative environmental reviews described later in this paper.

The deployment models for micro-reactors considered in this paper are consistent with the generic factory-fabricated micro-reactor deployment model described in SECY-24-0008, “Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory,” dated January 24, 2024 (ML23207A252).² Based on feedback from micro-reactor developers and other stakeholders, the NRC staff anticipates that DCs or MLs or both will be employed for standardizing the designs of micro-reactors that would be mostly or entirely fabricated in a factory. As described in SECY-24-0008, micro-reactor designs will likely be one of two types. The first type is a “self-contained” micro-reactor that would incorporate the reactor and balance of plant in one or several transportable containers and require minimal site preparation or construction activities at the deployment site. The second type is a design that may consist of a “core module” that comprises the core, reactor vessel, control elements, and other systems and components, that would be 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.

² SECY-24-0008, currently under consideration by the Commission, provided options related to fuel loading and operational testing at a factory. While the current Commission options paper is consistent with the generic deployment model described in SECY-24-0008, i.e., fabrication of reactors in a factory, transportation to deployment sites, and operation as power reactors at deployment sites, the options in this paper do not assume any particular Commission direction on the options presented in SECY-24-0008.

DISCUSSION:

The NRC staff is prioritizing development of strategies to provide for the predictable and efficient licensing and regulation of micro-reactors, and the identification and resolution of policy issues associated with their widespread deployment. As part of these efforts, the NRC staff has developed options for addressing two related policy topics: (1) the approval of standardized operational programs in connection with review of a standard design (i.e., a standard design proposed in an application for a DC or ML) and (2) alternative environmental review options for COL and CP/OL applications for NOAK micro-reactors.³ The options presented in this paper include approaches that could be implemented under the existing regulations and approaches that would require rulemaking.

The NRC staff is cognizant that some topics and policy issues in this paper and its enclosures could be more broadly relevant to the deployment of other reactor technologies, such as small modular reactors and larger reactors. Although this paper does not explicitly address such situations, the NRC staff will account for them, as appropriate.

This paper includes two enclosures. Enclosure 1 includes supplemental information related to standardization of operational programs. Enclosure 3 provides information on additional topics related to NOAK licensing and strategies to address these topics, the implementation of which could involve further Commission engagement, as appropriate. The NRC staff plans to issue an additional enclosure (to become Enclosure 2) that will provide supplemental information related to alternative environmental review options.

Legislative and Regulatory Considerations

The NRC staff assessed the current regulatory framework in Title 10, “Energy,” of the Code of Federal Regulations (10 CFR), Chapter I, “Nuclear Regulatory Commission”; the AEA; and the National Environmental Policy Act of 1969, as amended (NEPA). The NRC staff specifically considered the regulations in 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities”; 10 CFR Part 51, “Environmental Protection Regulations for Domestic Licensing and Related Regulatory Functions”; 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants”; and other related regulations. The options presented in this paper provide potential regulatory approaches to licensing reactors of a standard design that do not involve changes to legislation, although changes to the regulations and guidance development are considered. In addition, the draft proposed rule package for 10 CFR Part 53, “Risk Informed, Technology-Inclusive Regulatory Framework for Advanced Reactors,” dated March 6, 2023 (ML21162A093), discusses and requests comments on micro-reactor licensing and regulation and may result in rulemaking that addresses policy issues for micro-reactors.

The NRC staff also considered Congressional direction in the Fiscal Responsibility Act of 2023 (FRA) and the Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy Act of 2024 (ADVANCE Act) in the development of this paper. The FRA requires specific changes to Federal agencies’ NEPA practices. Implementation of the FRA could result in a more

³ In developing the strategies in this paper for standardization of the reactor design and operational programs, the NRC staff also considered the regulations in 10 CFR Part 52 Subpart E, “Standard Design Approvals.” However, compared to a DC or ML, a standard design approval does not provide the same degree of finality and corresponding efficiency gains for NOAK licensing.

streamlined NEPA process than under current NRC regulations in 10 CFR Part 51. For example, in SECY-24-0046, “Implementation of the Fiscal Responsibility Act of 2023 National Environmental Policy Act Amendments,” dated June 13, 2024 (ML24078A013), staff recommended revising the NRC regulations in 10 CFR Part 51 to explore eliminating 10 CFR 51.20(b), except where an Environmental Impact Statement (EIS) is otherwise required by statute. Removing the list of actions in 10 CFR 51.20(b) that automatically require an EIS, except where an EIS is required by statute, would provide greater flexibility to consider and implement streamlined environmental review approaches, where appropriate, without the need for an exemption. If this recommendation is approved and subsequent rulemaking amends 10 CFR 51.20(b), the NRC staff may be able to develop an environmental assessment (EA) with a finding of no significant impact (FONSI) for actions, such as micro-reactor licensing actions, that would have required preparation of an EIS under 10 CFR 51.20(b) or an exemption from that requirement. Prior to receiving Commission direction, the NRC staff will, as stated in SECY-24-0046, continue to implement the requirements of 10 CFR 51.20, “Criteria for and identification of licensing and regulatory actions requiring environmental impact statements,” including preparation of EISs for the actions listed in 10 CFR 51.20(b), and will also consider exemptions from 10 CFR 51.20(b) on a case-by-case basis with appropriate communication to the Commission.

Section 208, “Regulatory Requirements for Micro-Reactors,” of the ADVANCE Act requires the NRC to develop and implement “risk-informed and performance-based strategies and guidance” in eight areas, specified in subparagraphs 208(a)(1)(A)–(H), for the licensing and regulation of micro-reactors. Throughout development and implementation of these strategies and guidance, the NRC must consider “the unique characteristics of micro-reactors,” including physical size, design simplicity, and source term; opportunities to incorporate specific improvements related to streamlining the review process; and other policy and licensing issues. Section 506, “Modernization of Nuclear Reactor Environmental Reviews,” of the ADVANCE Act requires the NRC to submit a report to the appropriate committees of Congress, by January 5, 2025, on the NRC’s efforts to “facilitate efficient, timely, and predictable environmental reviews” for nuclear reactor applications for a license under AEA section 103, “including through expanded use of categorical exclusions, environmental assessments, and generic environmental impact statements.” This options paper and its enclosures address, at least partially, several aspects of these sections of the ADVANCE Act, including strategies for inspections, security, emergency preparedness, environmental reviews, and opportunities to reduce redundancies and enhance efficiency. Consistent with the ADVANCE Act, the NRC staff proposes implementing the strategies and options presented in this paper via a combination of guidance under the existing regulatory framework, the 10 CFR Part 53 rulemaking, and pending or new rulemaking.

Section 208 of the ADVANCE Act also directs the Commission to develop and implement strategies and guidance for micro-reactor licensing and regulation in other areas not explicitly covered in this paper. These include staffing and operations, oversight, risk analysis methods, decommissioning funding assurance, the transportation of fueled micro-reactors, and siting in relation to population density criteria and licensing mobile deployment [of micro-reactors]. Other ongoing (or planned) NRC staff activities address these aspects, and the NRC staff will engage with the Commission, as appropriate.

This paper focuses on the aspects of licensing for which applicants and the NRC are wholly or mostly responsible and the associated opportunities for public involvement afforded under NRC regulations. There are additional legal and regulatory aspects of licensing commercial nuclear

power reactors that involve other stakeholders, such as State Governments, other Federal Agencies, and Tribal Nations. The timeframes for the associated processes are not entirely under the control of applicants or the NRC. For example, the Energy Policy Act of 2005 requires the NRC to consult with the Department of Homeland Security concerning the potential vulnerabilities of the location of a proposed facility to terrorist attack before issuing a license. Another example is Section 106 of the National Historic Preservation Act that requires the NRC to provide the Advisory Council on Historic Preservation a reasonable opportunity to comment on the effects of projects the NRC licenses on historic properties. These processes (and others not directly under NRC control) have historically taken several to many months to complete. The NRC staff is engaging with such other stakeholders to consider whether these processes can be tailored for micro-reactor reviews considering that the characteristics of micro-reactor projects are significantly different than commercial nuclear power projects licensed by the NRC in the past.

Licensing Strategy for NOAK Micro-Reactors

The NRC staff has developed an approach by which a robust upfront approval of a standard design enables efficient, predictable licensing of NOAK micro-reactors. It involves two main phases that would enable safe, rapid deployment of micro-reactors of a standard design.

Phase 1, upfront approval of the standard plant, encompasses the following:

- Approval of a maximally standardized design in a DC, ML, COL, or CP/OL (see Enclosure 3)⁴
- Approval of standardized operational programs, to the extent practicable (see Topic 1, below, and Enclosure 1)
- Completion of a generic environmental review, to the extent practicable (see Topic 2, below)
- Completion of hearings covering the standard design and environmental review (see Enclosure 3)

The timeframes associated with the upfront approval of the standard plant vary based on the particular licensing pathway (i.e., DC, ML, COL, or CP/OL) and are bounded by the generic milestone schedules established by the NRC in response to direction in the Nuclear Energy Innovation and Modernization Act of 2019 (NEIMA).⁵ These typically range from 30-42 months; however, recent NRC reviews of advanced reactor applications have achieved significantly shorter schedules than the published milestone schedules, especially when an applicant has had robust preapplication engagement with the NRC staff.⁶ Given that the focus of this paper is

⁴ A maximally standardized design has the following attributes and characteristics (see Enclosure 3 for a more detailed description):

- The design is a standard design as defined in the regulations in 10 CFR 52.1, “Definitions”;
- The complete plant design is approved in a DC or ML or combination of the two;
- The design uses bounding site parameters;
- The design minimizes site-specific design features; and
- The design of an individual reactor does not include departures from the approved design.

⁵ See “Generic Milestone Schedules of Requested Activities of the Commission,” at <https://www.nrc.gov/about-nrc/generic-schedules.html>.

⁶ See Appendix A, “Pre-Application Engagement Guidance,” of Interim Staff Guidance DANU-ISG-2022-01, “Review of Risk-Informed, Technology-Inclusive Advanced Reactor Applications—Roadmap,” dated March 2024 (ML23277A139).

on the timeframes for the NOAK licensing phase (described below), timeframes for the various pathways for the upfront approval are not discussed in detail. However, as described in Enclosure 3, the licensing pathway chosen for the upfront approval (i.e., DC, ML, COL, or CP/OL) and the degree of finality afforded by the proceeding for that pathway may affect the timeframe for NOAK licensing. For example, upfront approval of the design in a ML will tend to provide a greater degree of finality and likely result in shorter NOAK licensing timeframes compared to upfront approval of the design in a FOAK COL.

Phase 2, NOAK licensing, leverages the upfront approval in Phase 1 to enable efficient, predictable licensing of NOAK micro-reactors and includes:

- Streamlined administrative processes for submission of applications, preparation of NRC licensing documents, and NRC staff reviews (see Enclosure 3)
- Staff safety and security reviews, focusing on confirmation of site suitability for the standard design (see Enclosure 3)
- Staff site-specific environmental review that applies the generic environmental review, as appropriate (see Topic 2, below)
- Confirmatory inspections at the place of fabrication (factory or manufacturing facility) and deployment site, as appropriate (see Enclosure 3)
- Verification of completion of inspections, tests, analyses and acceptance criteria (ITAAC) for a COL or confirmation of compliance with license conditions for a CP/OL and readiness for operation inspection (see Enclosure 3)
- Completion of site-specific hearings⁷

Licenses for NOAK micro-reactors may be issued in accordance with the regulations in 10 CFR Part 50 or 10 CFR Part 52.⁸ Both licensing pathways have common elements, such as NRC staff safety and security reviews, environmental reviews, reviews by the ACRS, mandatory hearings, opportunities for contested hearings, requirements to obtain a license before beginning construction, inspections during construction, and requirements that must be satisfied before commencing facility operation. There are also differences between the licensing pathways that could affect the overall timeframe for deployment of a micro-reactor of a particular design. These include the two-step CP/OL licensing process under 10 CFR Part 50, the scope of contested hearings, and the processes for the NRC to issue an operating license under 10 CFR Part 50 or find that the acceptance criteria in the ITAAC are met under 10 CFR Part 52.

Table 1 and Table 2, below, show the steps involved in NOAK licensing under 10 CFR Part 50 and 10 CFR Part 52, respectively, and presume that the design has already been approved in another proceeding. The NOAK licensing timeframe begins with submission of a COL or CP

⁷ See Topic 1, “Timeframe for Authorization to Operate at the Deployment Site,” in the enclosure to SECY-24-0008 (ML23207A251) for a detailed discussion of the timeframes for contested hearings under 10 CFR Part 50 and 10 CFR Part 52 licensing. See SECY-24-0032, “Revisiting the Mandatory Hearing Process at the U.S. Nuclear Regulatory Commission,” dated April 12, 2024 (ML24103A089), and the associated Staff Requirements Memorandum, “Staff Requirements – SECY-24-0032 – Revisiting the Mandatory Hearing Process at the U.S. Nuclear Regulatory Commission,” dated July 18, 2024 (ML24200A044), for the current Commission policy related to the timeframe for mandatory hearings.

⁸ The regulations in 10 CFR Part 53 will provide an additional licensing pathway for NOAK micro-reactors, but the NRC staff is not providing a detailed discussion of that topic here because the regulations are under development. However, the NRC staff anticipates that the NOAK licensing approach would provide efficiencies for licensing under 10 CFR Part 53 that would be similar to those described in this paper for licensing under 10 CFR Part 50 or 10 CFR Part 52.

application and ends with an NRC decision on whether to issue an OL or find under 10 CFR 52.103(g) that the acceptance criteria in the ITAAC of a COL are met. Each step depicted in the tables accounts for the activities and processes under the control of the applicant and the NRC and the opportunities for public involvement afforded by the relevant regulations. Tables 1 and 2 include estimated timeframes for each step for illustrative purposes that will vary based on the particular circumstances of each licensing review and are not to be taken as commitments by the NRC staff to complete NOAK licensing reviews within those timeframes.

Table 1: NOAK Licensing under 10 CFR Part 50

| NOAK Licensing under 10 CFR Part 50 | | |
|---|--|-------------------|
| Licensing Process Step | Nominal Timeframe(s) and Notes | Total Days |
| Construction Permit Review Stage | | |
| - Preapplication engagement - Site characterization | Dependent on the applicant’s licensing strategy and necessary site characterization activities (considering the information in Enclosure 3) | N/A |
| - Submission of the CP application | Beginning of the timeframe for NOAK licensing | 0 |
| - Acceptance review, docketing, and notice of availability of the application in the <i>Federal Register</i> (FR) - Notice of mandatory hearing in the FR | 5 days (considering the streamlined processing of applications and NRC licensing documents described in Enclosure 3) At least 60 days prior to the hearing (this fits within the timeframe for the next step) | 5 |
| - NRC staff safety evaluation - NRC staff environmental review | 60 to 120 days 60 to 180 days | 65 to 185 |
| - Mandatory hearing | 56 days (see SECY-24-0032) | 121 to 241 |
| - Issuance of the CP and notice in the FR | 10 days | 131 to 251 |
| - Construction begins - Construction inspection begins | 0 days (dependent on the CP holder) Performed during construction, consistent with the status of construction activities | 131 to 251 |
| Operating License Review Stage | | |
| - Submission of the OL application | 0 days (this timeframe assumes submission of the OL application after issuance of the CP. However, the OL application may be submitted prior to the issuance of the CP, and even at the same time as submission of the CP, at the risk of the applicant) | 131-251 |
| - Acceptance review, docketing, and notice of availability of the application in the FR - Notice of opportunity for a contested hearing in the FR - Notices required by AEA Sec. 182c in the FR | 5 days (considering the streamlined processing of applications and NRC licensing documents described in Enclosure 3) At least 60 days prior to the hearing (this fits within the timeframe for the next step) Beginning at least 56 days before OL issuance (this fits within the timeframe for the next step) | 136-256 |
| - NRC staff safety evaluation - NRC staff supplemental environmental review | 60 to 120 days 60 to 120 days | 196 to 376 |
| - Contested hearing | 0 to 180 days | 196 to 556 |
| - Verification of substantial completion of construction | 0 days (dependent on the CP holder completing construction and the NRC performing this verification in parallel with the previous steps in the OL review stage) ⁹ | 196 to 556 |
| - Issuance of the OL and notice in the FR | 10 days End of the NOAK licensing timeframe | 206 to 566 |

⁹ The timeframe for this step is dependent on whether the construction permit holder completes construction during the previous steps in the operating license review phase (i.e., within the timeframe between issuance of the CP and completion of the contested hearing) with some margin for the NRC to complete the necessary inspections.

Table 2: NOAK Licensing under 10 CFR Part 52

| NOAK Licensing under 10 CFR Part 52 | | |
|--|--|-------------------|
| Licensing Process Step | Nominal Timeframe(s) and Notes | Total Days |
| Combined License Review Stage | | |
| - Preapplication engagement - Site characterization | Dependent on the applicant’s licensing strategy and necessary site characterization activities (considering the information in Enclosure 3) | N/A |
| - Submission of the COL application | Beginning of the timeframe for NOAK licensing | 0 |
| - Acceptance review, docketing, and notice of availability of the application in the FR - Notice of mandatory hearing in the FR - Notices required by AEA Sec. 182c in the FR | 5 days (considering the streamlined processing of applications and NRC licensing documents described in Enclosure 3) At least 60 days prior to the hearing (this fits within the timeframe for the next step) Beginning at least 56 days before OL issuance (this fits within the timeframe for the next step) | 5 |
| - NRC staff safety evaluation - NRC staff environmental review | 60 to 120 days 60 to 180 days | 65 to 185 |
| - Mandatory hearing | 56 days (see SECY-24-0032) | 121 to 241 |
| - Issuance of the COL and notice in the FR | 10 days | 131 to 251 |
| - Construction begins - Construction inspection begins | 0 days (dependent on the CP holder) Performed during construction, as supported by the construction activities | 131 to 251 |
| Post-COL Review Stage | | |
| - Submission of scheduled date for initial fuel load (10 CFR 52.103(a)) - Submission of ITAAC closure notification or uncompleted ITAAC notification (10 CFR 52.99(c)) - Publication of the notice of intended operation and opportunity to request a contested hearing in the FR (10 CFR 52.103(a)) | 0 days (the applicant may submit this notification upon receipt of the COL) 0 days (the applicant may submit this notification upon receipt of the COL) 75 days (15 days after receipt of the above notices from the COL holder and providing at least 60 days to request the hearing) | 206-326 |
| - Contested hearing | 0 to 180 days | 206 to 506 |
| - Complete construction - Provide notification that all ITAAC are complete (10 CFR 52.99(c)) - NRC inspection that prescribed ITAAC are performed | 0 days (dependent on the COL holder completing construction and ITAAC during the previous steps in the post-COL stage) | 206 to 506 |
| - Issuance of the 10 CFR 52.103(g) finding and notice in the FR | 5 days End of the timeframe for NOAK licensing | 211 to 511 |

The NRC staff safety evaluation and environmental review, contested hearings, and construction timelines account for the greatest uncertainty and variability in the overall NOAK licensing timeframe and will be affected by factors that include:

- The deployment model and licensing pathway for the standard design (see Enclosure 3)
- Departures from the maximally standardized design, including the approved site parameter envelope, in the COL or CP/OL application (see Enclosure 3)
- The extent to which the COL or CP/OL application references pre-approved standardized operational programs (see Vote Topic 1, below)

- The scope and complexity of site characterization by the applicant and site-specific confirmations by the NRC staff (see Enclosure 3)
- The extent to which the environmental review for a particular design can be completed on a generic basis prior to submission of a CP/OL or COL application and the type and scope of the site-specific environmental review necessary to be performed in connection with CP/OL or COL proceedings for deployment of a reactor of that particular design (see Vote Topic 2, below)
- Whether the Commission receives requests for contested hearings, whether the Commission grants requests for contested hearings, and the duration of contested hearings (see Topic 1 in the enclosure to SECY-24-0008)
- The time needed by the licensee to substantially complete construction (for an OL) and complete ITAAC (for a COL) (see Enclosure 3)

The NRC staff notes that the shorter timeframes provided in the estimated ranges for the NRC staff safety reviews in Tables 1 and 2 may not be achievable if an applicant takes departures from the standard design and unless an online system for processing license applications is in place. Similarly, the shorter timeframes for environmental reviews may not be achievable without categorical exclusions, as described in Option E4, below. The NRC staff anticipates that the timeframes will likely decrease (to an extent) as the number of licensing proceedings for a reactor of a particular design increases. However, more complex facility designs or deployment models that include significant on-site construction might not support the lower estimates of the ranges provided in the tables.

The NRC staff also notes that gains in regulatory efficiency and cumulative resource savings will depend on the amount of any extra costs associated with the upfront approval in Phase 1 of the approach described in this paper and the number of reactors of a common standard design subject to NOAK licensing. For example, NRC staff review of standardized operational programs in connection with the review of a standard design (under Option O2, below) would increase the upfront review costs. These costs might not be offset if only a few CP/OL or COL license applications reference the standardized operational programs. Similar considerations exist related to the potential alternative approaches for environmental reviews, such as the cost associated with rulemaking to establish a categorical exclusion under Option E4, below.

The NRC staff will consider the need to develop guidance for applicants and the NRC staff to implement the two-phased licensing approach described in this paper. As applicants and the NRC staff gain experience with this approach and related oversight, it may be possible to reduce NOAK licensing timeframes and further enhance efficiency through additional guidance, rulemaking, or other Commission engagement. Examples include changes to the Commission's procedures for contested hearings and rulemaking to amend the minimum 60-day opportunity to request a hearing specified in 10 CFR 2.309(b)(3).

Options for Standardization of Operational Programs and Alternative Environmental Reviews

The NRC staff identified standardization of operational programs and alternative environmental reviews as near-term policy issues that need to be addressed to support NOAK licensing and enhance clarity, reliability, and efficiency. Stakeholders are currently engaged in preapplication discussions with the NRC staff on these issues and have requested clarity on the available options as they develop deployment models and licensing documents over the next several years to support widespread deployment in the 2030 timeframe.

The options described in this paper support the NRC's Principles of Good Regulation and are intended to enhance regulatory efficiency, clarity, and reliability. The NRC staff notes that these options would provide for the effective management of licensing and deployment activities for NOAK micro-reactors by affording the NRC staff greater flexibility to tailor its future reviews to the anticipated wide variety of micro-reactor designs, operational characteristics, and deployment models. Additionally, the NRC staff seeks to provide stakeholders with clear agency positions on reviewing operational programs and approaches for environmental reviews that use alternate processes, both of which maintain a continued focus on safety, security, and the environment and are aimed at enhancing the efficiency of CP/OL and COL licensing. In providing the clear agency positions, the NRC staff will also consider updating guidance or regulations as needed to ensure reliability of licensing processes for NOAK micro-reactors to support micro-reactor developers' operational and planning processes. The NRC staff's descriptions of several information topics in Enclosure 3 to this paper aim to provide additional clarity on licensing and deployment considerations for NOAK micro-reactors.

Topic 1: Standardization of Operational Programs

The NRC staff has developed strategies for the review of measures proposed to satisfy operational requirements (e.g., technical specifications and operational programs) before submission of an OL or COL application. Currently, the NRC staff may review and approve measures proposed to satisfy operational programs through topical reports and COL or CP/OL applicants can reference these topical reports in their applications. Applicants can also reference operational programs approved in another COL or CP/OL review, and the NRC staff may review and approve such programs using the design-centered review approach, as appropriate.¹⁰ This paper presents an alternative that would afford applicants the option to submit measures to satisfy operational requirements as part of a DC or ML application.

Under the current framework, operational programs are generally reviewed and approved during the COL or CP/OL licensing phase. Several DC and ML regulations require portions of operational programs to be provided in order to evaluate the proposed design, but generally full programs are not required at that stage. Furthermore, current Commission policy does not allow for approval of an operational requirement in the context of DC or ML applications unless the adequacy of that operational requirement is material to the adequacy of the design.

The final design certification rule for the Advanced Boiling Water Reactor (Volume 62 of the FR, page 25806 (62 FR 25806)) discusses that the operational requirements were not accorded finality because the operational matters were not comprehensively reviewed and finalized for the DC. The degree to which the Commission would afford finality or enhanced regulatory stability to approved operational requirements should the Commission decide to allow approval of all such requirements is a matter for Commission consideration if Option O2 is approved. For

¹⁰ For the design-centered review approach, the staff would review measures to satisfy operational requirements for the first micro-reactor application of a particular design and the review would be applied to subsequent micro-reactor applications of the same design that use the same approach as proposed in the first application. The NRC staff previously applied the design-centered review approach to design matters in combined license applications referencing the same certified design where review of a lead or "reference" combined operating license application (RCOLA) was applied to a subsequent combined operating license application (SCOLA). See Regulatory Issue Summary 2006-06, "New Reactor Standardization Needed to Support the Design-Centered Licensing Review Approach," dated May 31, 2006 (ML053540251).

instance, for a NOAK applicant or licensee who references the DC appendix, the Commission could direct that those matters associated with operational requirements reviewed and approved be resolved within the meaning of 10 CFR 52.63(a)(5). Alternatively, the Commission could direct that operational requirements not material to the design that are reviewed and approved in the DC rulemaking are governed by the requirements in 10 CFR 50.109. Should the Commission approve a strategy for expanded resolution of operational matters during DC or ML review, OL or COL applicants referencing the DC or ML would not be bound to an approved method for satisfying an operational requirement; rather, such an applicant would be free to employ its own program for satisfying the requirement, e.g., a fleetwide program for an entity seeking operation of several reactors.

In SECY-05-0197, “Review of Operational Programs in a Combined License Application and General Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria [ITAAC],” dated October 28, 2005 (ML052770257), the NRC staff defined operational programs for new nuclear power plants as programs that are required by regulation, are reviewed by the NRC staff for acceptability with the results documented in the safety evaluation report, and will be verified for implementation by NRC inspectors. In SECY-05-0197, the NRC staff provided a list of operational programs required by regulation. Examples of these operational programs include those for testing and inspection, radiation protection, the maintenance rule, quality assurance, security, and emergency preparedness. The Commission endorsed the NRC staff recommendations on operational programs in SRM-SECY-05-0197, dated February 22, 2006 (ML060530316). These programs were subsequently described for light-water reactors in NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition,” (SRP) Section 13.4, “Operational Programs,” dated April 2019 (ML18344A032).¹¹

For the purposes of this options paper, the NRC staff used the guidance in SRP Section 13.4 to inform the list of operational programs considered in Enclosure 1. The enclosure provides additional background and details for the staff rationale. The NRC staff notes that the list of operational programs discussed in Enclosure 1 may not be all-inclusive or applicable to every micro-reactor or advanced reactor design. The Advanced Reactor Content of Applications Project (ARCAP) guidance (ML23277A105) was developed to support near-term advanced reactor applicants and includes DANU-ISG-2022-01, “ARCAP Roadmap Interim Staff Guidance,” issued March 2024 (ML23277A139), which, in Appendix B of the document, describes the regulations that are generally applicable to non-LWR applications for CPs and OLs under 10 CFR Part 50 and DCs, COLs, and standard design approvals under 10 CFR Part 52. The applicant should identify which operational programs are applicable to its design and deployment models, and preapplication engagement with the NRC staff can help to facilitate a common understanding in this regard.

Option O1—Status quo

Under this option, the NRC staff would apply the Commission’s historical position to review and approve only those operational requirements material to the finding on the adequacy of design

¹¹ NUREG-0800 is available on the NRC’s public webpage at <https://www.nrc.gov/reading-rm/doc-collections/nuregs/staff/sr0800/index.html>.

as part of a DC or ML proceeding and thus afford some measure of finality only to those programs. The NRC staff would not review or approve any other operational requirements.

Under the current process, a DC or ML applicant could, at its option, submit an operational program topical report for NRC staff review and approval, and a CP/OL or COL applicant could then incorporate it by reference in its application. The NRC staff would not revisit its evaluation of the topical report except if the staff identified new information material to the conclusions on the adequacy of the program or other good cause. Approval of a topical report, however, is not a licensing action and does not resolve issues for purposes of a proceeding on an application, i.e., an intervenor could challenge the adequacy of the program approved in the topical report and neither the Atomic Safety and Licensing Board nor the Commission would be bound by the safety evaluation on the topical report. Alternatively, an applicant could pursue a design-centered review approach and reference an operational program, or programs previously approved by the NRC.

Staff is currently using and will continue to use the tools discussed under Option O1 to provide for more efficient reviews but believes that the additional review efficiency afforded under Option O2 would better facilitate the high-volume licensing and deployment plans of micro-reactor developers.

Implementation

This option would not necessarily require NRC staff action to implement. However, due to the wide range of potential deployment models, the staff acknowledges that there is a possibility that guidance may need to be updated. An applicant should identify and the NRC staff should verify the operational requirements that are applicable, e.g., requirements that may be material to the manufacture of reactors under an ML. The NRC staff notes the importance of early DC and ML preapplication engagement.

Advantages

- Under this option the NRC staff would continue to use current established processes for reviewing operational programs via topical reports or a design-centered review approach.
- Under this option changes to operational programs may more easily be made by an applicant or licensee using existing change control processes (versus changes to DCs or MLs).
- Under this option, a topical report could be submitted at any time (versus at the time of submission of the DC or ML application under Option O2, below).

Disadvantage

- This option would not provide for optimal review efficiency to support streamlined micro-reactor NOAK deployment models as finality to operational programs referenced in a COL or CP/OL would not be accorded (except to the extent that an operational requirement is completely reviewed and approved and governed by the change requirements in 10 CFR 50.109). COL or CP/OL applicants would have to reference numerous topical reports, and the NRC staff would need to verify the applicability and appropriateness of each in its safety evaluations.

Option O2—Review and approval of operational programs proposed in a DC or ML application

Under this option, an applicant would have the option to provide proposed measures to satisfy operational requirements or complete operational programs as part of a DC or ML application. The NRC staff would review these proposed measures or programs and could approve them, as appropriate, as part of the DC or ML to afford finality. Assuming the proposed measures constituted an essentially complete program such that staff could make a safety finding, and that the staff comprehensively reviewed the proposed measures, this would provide additional regulatory stability for those programs when referenced by COL or CP/OL applicants in NOAK licensing. The NRC staff acknowledges that there are many possibilities for micro-reactor deployment models and that the information to describe an operational program in sufficient detail may not be known at the design stage for a DC or ML for all programs. However, this option would allow NRC staff the flexibility to review proposed measures to satisfy operational requirements in connection with a DC or ML application and make a finding on the program, provided that it is described in sufficient detail. This would facilitate efficient NOAK licensing for COL and CP/OL applicants referencing those approved standardized operational programs.

Implementation

The NRC staff would implement this option via rulemaking (either as part of the DC rulemaking or through amending the regulations for an ML), or other appropriate regulatory vehicles to afford DC or ML applicants an option to submit proposed measures to satisfy operational requirements or complete operational programs as part of DC and ML applications and to allow the NRC staff to review and approve them. For a DC, the design certification rulemaking would provide a pathway for the applicant to provide information on operational programs and for the NRC staff to review and approve the programs. For an ML, the NRC staff would consider a generic rulemaking and other regulatory vehicles, such as a rule of particular applicability or a plant-specific hearing order, to establish requirements for operational programs. A rule of particular applicability would allow for a set of operational requirements and programs to be tailored to a specific ML application, including consideration of the type of technology employed, and could be referenced in a COL or CP/OL application for NOAK licensing. Such a rule would be particularly useful to define definitions unique to a particular design and to treat issues common to several programs. A hearing order would define the applicable license review standards and any special standards or instructions. A hearing order could provide a focused regulatory structure and offer perhaps the most flexibility, but it would require substantial time and interaction between the applicant and the staff before submittal and acceptance of an application, and approval of the approach (including issuance of a hearing order) by the Commission. This approach also carries a risk of future litigation in regard to the standards

applied to each program to the extent the programs or standards differ from those in current NRC rules. A rule of particular applicability carries a lower risk of litigation because it provides for the public notice-and-comment process associated with a rulemaking. Potential drawbacks include substantial upfront time cost from both the staff and the applicant, as the rule would need to be promulgated before the application is submitted. The NRC staff would also evaluate the potential for rulemaking to amend the regulations in Subpart F, “Manufacturing Licenses,” of 10 CFR Part 52 in addition to or in lieu of the rule of particular applicability or hearing order.

Additionally, the NRC staff will consider including flexibility in whichever regulatory vehicle is used to allow the NRC staff to exclude review and approval of a specific program if it would unnecessarily delay the entire design certification rule or issuance of the ML. The NRC staff will also consider flexibilities for COL and CP/OL applicants who do not wish to reference all of the standardized programs approved in a DC or ML but would rather use a combination of standardized programs and custom programs (either specified in the COL or CP/OL application directly or incorporated by reference using the approaches in Option O1). However, the use of custom programs specified directly in a COL or CP/OL application would likely extend the timeframe for the NRC staff to complete its safety evaluations during NOAK licensing.¹²

In implementing this option, the NRC staff would consider the need to update existing staff guidance or develop new guidance for reviewing operational programs during a DC or ML review. This would include guidance related to appropriate regulatory vehicles by which the NRC staff could review the information in a DC or ML proceeding and document safety findings. Also, similar to Option O1, due to the range of potential deployment models and micro-reactor technologies, it is likely that guidance for development of operational programs for micro-reactors will need to be updated, and that applicants would identify, and the NRC staff would verify the adequacy of, any operational requirements that may be applicable for various milestones.

The NRC staff would also explore whether additional guidance would be needed to describe how an applicant or licensee could make changes to an operational program once it is approved in a DC or ML. For example, the DC rule could include provisions specifying the change process, similar to the provisions included in Section VIII of the current DC rules. Holders of COLs or OLs who have already adopted the standard operational programs would follow the existing requirements in 10 CFR Part 50 and 10 CFR Part 52 for changes. The NRC staff also notes that the DC or ML applicant should ensure that any changes to the design during the DC or ML review are considered and reflected in the operational programs, as appropriate.

Advantages

- This option would provide for optimal NOAK licensing review efficiency and reliability because COL or CP/OL applicants would reference the programs approved and afforded finality in the DC or ML, which would minimize the required resources needed for COL or CP/OL application reviews. This option allows the COL or OL/CP applicant the flexibility to also reference topical reports as the operational programs provided in the DC or ML are optional.

¹² If an existing licensee applied for a new license and proposed to implement a well-established fleet-wide program, that would not likely extend the review schedule.

- This option could potentially provide for a more efficient review of multiple operational programs at once as part of the DC or ML proceeding, as opposed to individual topical reports.
- This option provides the NRC staff the flexibility to comprehensively review these programs early, assuming the program descriptions are essentially complete; however, the NRC staff could decline to make a finding if the program description information is incomplete or inadequate. Specifically, NRC staff could grant the DC or ML but deny approval of a particular program if a safety finding cannot be made and the program is not material to the safety of the design. Staff would provide guidance to enhance clarity of the staff's regulatory approach and ensure consistency between COL and CP/OL reviews.

Disadvantages

- Under this option, the NRC staff would have to pursue rulemaking or use another appropriate regulatory vehicle to review operational programs under an ML.
- Under this option, any changes made to operational programs accorded backfit protection under 10 CFR 50.109 or finality under 10 CFR 52.63 after approval through a DC or ML could potentially be subject to more resource intensive change control compared to changes to a topical report.
- Under this option, contentions related to operational programs could impact the estimated timeline for issuance of an ML.

Topic 2: Alternative Environmental Reviews

The staff developed the following options for adapting the NRC environmental review process to the circumstances associated with micro-reactors. The options are not mutually exclusive, and staff may be able to eventually adapt elements of multiple options to best meet emerging conditions as micro-reactor developments (e.g., design finalization, creation of a supply chain, manufacturing plans) progress. The staff may discover that certain options might be best suited to specific micro-reactor designs or for a large number of micro-reactor designs (e.g., generic) due to common features (e.g., size and power levels). Furthermore, the staff notes that it may be beneficial to implement elements of multiple options sequentially or to adjust the approach when more information becomes available over time as the agency gains experience reviewing micro-reactor applications and has resources to conduct rulemaking or to take other appropriate actions. This would involve the systematic implementation of Option E2a along with the parallel development of Option E3 followed by Option E4. This systematic approach would allow for the flexibility of design changes and the necessary data collection and time needed for the creation of an online portal under Option E3 and the development of categorical exclusion rulemaking, if justified for a particular micro-reactor design, under Option E4.

In keeping with NEPA, each of the environmental options would have some level of public participation. The EIS and Generic Environmental Impact Statement (GEIS) process, relied upon in Options E1 and E2, represents the most in-depth levels of environmental review and public participation with providing a scoping period and a public comment period on the Draft EIS. An EA under Options E2 or E3 could have reduced public participation because the public

would only have an opportunity to comment on a draft FONSI. Option E4 would have limited to no public participation after the initial rulemaking for incorporation into the regulations for categorical exclusions in 10 CFR 51.22(c).

Some of the environmental options presented below may apply the concepts of plant parameter envelope (PPE) and site parameter envelope (SPE) as defined and developed in the draft New Reactor Generic Environmental Impact Statement (NR GEIS) (NUREG-2249). The PPE consists of parameters for specific reactor design features independent of the site. Examples include the footprint of disturbance, building height, water use, air emissions, employment levels, and noise generation levels. For each PPE parameter, the NR GEIS presents a set of bounding values and assumptions underlying the associated analysis of environmental impacts. The NR GEIS introduces SPE as a set of site-related parameters such as site size, size of water bodies supplying water to the reactor, and regional demographics. As for PPE, the NR GEIS presents a set of bounding values and assumptions for each SPE parameter that underlies the associated analysis of environmental impacts.

Option E1—No additional action

Under this option, the NRC staff would not seek additional Commission direction on policy matters specifically related to environmental reviews for NOAK micro-reactors. The NRC is presently in compliance with the immediately effective provisions of the NEPA amendments in the FRA. The NRC staff will fully implement the FRA in accordance with the Commission's direction on SECY-24-0046. Until then, the staff would follow the existing NEPA process of 10 CFR Part 51 in place at the time of an application for a NOAK micro-reactor license (currently an EIS or an EA, if viable, and if an exemption from an EIS is justified) and incorporate by reference analysis from the NR GEIS.

Implementation

Implementation would consist of continuing existing environmental review practices, while continuing to take steps to comply with the FRA and accomplish other environmental review streamlining objectives.

Advantages

- Under this option, the staff would use the existing practices, which are well-established and would not warrant rulemaking or a substantial change in staff processes.
- EISs provide a high level of public involvement and transparency, thereby reducing the potential for stakeholder intervention.
- This option would not typically involve higher effort level at the FOAK stage, and FRA implementation should improve upon the existing process.

Disadvantage

- The environmental review process would be repeated for each NOAK application, resulting in redundancy, schedule impacts, and greater long-term costs.

Option E2a—Design-specific GEIS

The staff would develop a design-specific GEIS for a micro-reactor of a standard design to generically analyze additional environmental resources/topics beyond those analyzed in the NR GEIS. The environmental review associated with licensing a NOAK micro-reactor at a specific site would follow the existing NEPA process of 10 CFR Part 51 and analyze those issues that were not considered in the design-specific GEIS. Rulemaking could be pursued to codify the design-specific GEIS. Another option would be “tiering” off the GEIS as is a standard practice under Council on Environmental Quality (CEQ) regulations, which could also be done with rulemaking to enhance regulatory certainty.

Implementation

Implementation would consist of developing a design-specific GEIS (or other generic NEPA documentation) upon receipt of a FOAK license application referencing a specific design. The staff would tier the design-specific GEIS from the NR GEIS. The design-specific GEIS would allow staff to address more issues generically than would use of the NR GEIS alone. The value of the design-specific GEIS would depend on the number of NOAK applications received using that design. The long-term efficiencies gained for a given design may not offset the additional upfront costs unless a large number of NOAK applications are ultimately received. Otherwise, it might be more efficient to follow Option E1.

Advantages

- A design-specific GEIS created at the FOAK stage would afford the ability to address more issues generically (beyond just those addressed in the NR GEIS), so that at the NOAK stage, for that specific design, the environmental documentation could be more focused with increased regulatory certainty.
- A design-specific GEIS at the FOAK stage could substantially reduce time and costs at the NOAK stage.
- Option E2a may make possible the use of checklists allowing applicants to submit information at the NOAK stage more efficiently, thereby reducing application preparation costs and easing staff review effort. A checklist could consist of a list of assumptions used in a design-specific GEIS and space next to each for the applicant to explain how its project meets the assumption.
- A license applicant could tailor its site selection to conform to assumptions underlying analyses in the design-specific GEIS and thereby avoid the need for application-specific evaluations.

Disadvantages

- Development of the expanded generic environmental analysis at the FOAK stage would involve additional resources and time.
- It is unclear whether the NRC could charge service fees to the vendor under 10 CFR Part 170, “Fees for Facilities, Materials, Import and Export Licenses, and Other

Regulatory Services Under the Atomic Energy Act of 1954, as Amended,” for development of the design-specific GEIS.

- There would only be an advantage to Option E2a if a large number of NOAK applications are received for one or more designs.

Option E2b—Environmental reviews associated with designs approved in a DC or ML

Under this option, the staff would undertake rulemaking (or potentially use exemptions, hearing orders, or rules of particular applicability) to include a new subsection in 10 CFR 51.30 to provide an option for an applicant for a DC or an ML to submit a separate request for evaluation of a GEIS specific to the design described in the DC or ML application. Such a request would include information related to potential environmental impacts and an environmental effects site parameter envelope. The NRC would perform a generic environmental review in parallel with its review of the DC or ML application. This environmental review would result in a checklist of unresolved environmental topics/resources for the design, given a postulated environmental effects site parameter envelope, for which the GEIS would evaluate impacts. The environmental review associated with licensing a micro-reactor of a standard design at a specific site would likely be a simple EA based on the checklist or through tiering (e.g., NR GEIS, FOAK EIS, or FOAK EA).

Implementation

Implementation would be as for Option E2a except that the design-specific generic NEPA documentation would be produced only upon receipt of a DC or ML application using a new design.

Advantages

- This option affords similar advantages as Option E2a for DCs or MLs.

Disadvantages

- This option has similar disadvantages as Option E2a for DCs or MLs.
- Additionally, providing for a generic environmental analysis parallel to the DC or ML application review would require rulemaking (or other appropriate regulatory vehicles) involving additional resources and time.

Option E3—Generic micro-reactor portal; Streamlined EA process leveraging tiering

This environmental option represents a streamlined approach that largely utilizes the current NEPA review process. Unique aspects of this option are modeled after the “general permit” process that is used by several regulatory agencies, such as the U.S. Army Corps of Engineers. General Permits are permits that may be issued nationwide or regionally for a category or categories of activities that are either similar in nature and cause only minimal individual and cumulative adverse impacts. General Permits include terms and conditions for compliance and require notification of the issuing agency for coverage.

Implementation

Initial steps of this option would involve identifying “bounding micro-reactor PPE and SPE values,” a subset of the broader PPE and SPE values in the NR GEIS that would broadly envelope potential micro-reactor designs, and development of an online “NRC Environmental Review Portal.” The bounding micro-reactor PPE and SPE values could be developed in coordination with industry stakeholders (e.g., through the American Nuclear Society (ANS) standards process). The main difference between Option E2a and E3 is that the bounding micro-reactor PPE and SPE values would not be tied to a specific design, and, therefore, development of the bounding PPE and SPE values could begin immediately without having to wait for an applicant to submit an application for a specific design.

Once the bounding micro-reactor PPE and SPE values are established, the staff would then develop guidance to allow the applicant to document, and the NRC to verify, that the site falls within the established bounds (e.g., an environmental screening worksheet). The NRC staff would also develop the online portal for submitting the required environmental screening information on a license application docket, which could include a screening process to help expedite Endangered Species Act (ESA) Section 7 and National Historic Preservation Act (NHPA) Section 106 consultations. This could be similar to the process now used by the Environmental Protection Agency. After review and verification of information submitted via the portal, the NRC staff could then develop a streamlined EA which could be used for each license applicant, i.e., referencing a design for which the bounding parameter values, PPE and SPE are met such that the “Generic Micro-Reactor EA Template” would satisfy each bounding application. This approach would not effectively streamline the environmental review of a NOAK application unless the NRC staff receives a complete high-quality application, and the project falls within the bounding micro-reactor PPE and SPE values. Applicants would be encouraged to initially have preapplication meetings with the NRC staff.

Advantages

- This option could potentially afford significant time savings over the current EA/FONSI timeline. Using an online permitting portal, it is anticipated that an EA, supporting a FONSI, could be issued in under six months for a micro-reactor application meeting the bounding conditions in the environmental screening worksheet.
- The upfront work required for developing the “bounding micro-reactor PPE and SPE values” (based on the expected characteristics of micro-reactors and currently available design information), the associated guidance document, NHPA Section 106 and ESA Section 7 screening guidance, and the online portal could commence immediately.
- The bounding sets of micro-reactor PPE and SPE values would be developed to encompass the environmental impacts related to all or most micro-reactor designs (with cooperation from multiple micro-reactor developers potentially through an ANS standards committee working group).
- The bounding micro-reactor PPE and SPE values established for the portal could be used by applicants in their site selection processes.

- The online portal would be in alignment with CEQ goals and the direction in the ADVANCE Act for timelines and efficiency and could be used as a blueprint for other environmental review streamlining efforts.

Disadvantages

- Substantial resources would be required upfront to develop the bounding micro-reactor PPE and SPE values, associated guidance document, NHPA Section 106 and ESA Section 7 screening tools, and the online portal.
- This effort would require the allocation of resources outside of the current budget process and require coordination with stakeholders to develop aspects of these options outside of a fee-based licensing action.

Option E4—Design-Specific categorical exclusions

Under this option, the NRC staff would develop categorical exclusions, on a case-by-case basis, for standard micro-reactor designs through rulemaking. The regulatory basis for the categorical exclusion would be a comprehensive environmental review of the micro-reactor design and SPE. The basis for the categorical exclusion would include assumptions related to the SPE and the categorical exclusion would include as conditions a checklist based on site conditions. The environmental review associated with licensing a NOAK micro-reactor at a specific site would be verification that the deployment site satisfies the checklist and therefore meets the conditions for the categorical exclusion.

Implementation

The NRC staff would implement this option by building upon the experiences of FOAK micro-reactor environmental reviews. The first occurrence for a standard micro-reactor design would have a complete environmental evaluation under the current NEPA process. From this, an environmental checklist would be developed based on staff guidance utilizing the experiences from establishing PPE/SPE values in the NR GEIS. Rulemaking for either a specific standard micro-reactor design or a generic set of conditions via an environmental checklist would be codified in 10 CFR 51.22(c), if it could be shown that a specific standard micro-reactor design or the bounding micro-reactor PPE/SPE values established for the online portal do not individually or cumulatively have a significant effect on the human environment. NOAK licensing would then rely on a categorical exclusion finding if properly verified by the NRC staff through application of the environmental checklist for a specific site.

Advantages

- The staff would establish an efficient NOAK environmental review process (i.e., review completion within a small number of months) with an environmental finding of a categorical exclusion once the rulemaking to 10 CFR 51.22(c) has been completed.
- Categorical exclusions would provide regulatory stability and enhanced reliability once the process is established.

- One implementation process for a generic set of conditions representative and bounding of multiple micro-reactor designs would result in just one rulemaking rather than multiple design-specific rulemakings for greater regulatory efficiency.
- The environmental checklist can be used by potential applicants as a site selection tool.

Disadvantages

- It may take several years to perform the necessary FOAK environmental evaluation, develop the environmental checklist, and complete subsequent rulemaking to codify a design-specific categorical exclusion.
- The regulatory process would not be efficient if each standard micro-reactor design must have its own separate rulemaking process with timeline challenges if multiple micro-reactor designs are being considered at the same time.
- Most public participation would be at the time of establishing the categorical exclusion by rulemaking rather than at the NOAK deployment stage where there would be minimal public engagement.

Considerations with Respect to Other Environmental Requirements and Consultations

In addition to NEPA, Federal agency actions are subject to additional environmental requirements and Federal agencies must engage in consultations that can impact review timelines. These requirements and consultations would need to be addressed under any of the above environmental options and may require additional data from the applicant and more focused outreach to other Federal and State agencies and Tribes than that required for NEPA reviews, especially when staff prepare EAs or categorical exclusions. Currently, the NRC uses the NEPA process to perform these consultations and satisfy these requirements. The staff will need to develop alternative processes for satisfying these requirements. The time needed to complete consultations, such as the identification of historic properties or endangered species, assessment of effects, and consultations with affected parties could vary greatly from a few to many months depending on the complexity of the project, level of effort, and other challenges in consultation. Such time challenges could occur for even simple projects with limited land disturbance.

STAKEHOLDER ENGAGEMENT:

The NRC staff engaged with stakeholders on the topics in this paper through the periodic advanced reactor stakeholder meetings in March and July 2024. During the March meeting, the NRC staff presented topics it was considering including in the paper and received verbal feedback on the scope of the paper. During the July meeting, the NRC staff confirmed the topics to be included in the paper and provided preliminary information about the options the NRC staff was considering. Stakeholders provided oral feedback at these meetings, which the NRC staff considered during development of the paper. The NRC staff also coordinated with several other Federal agencies, such as the Department of Energy, on the topics covered in this paper and its enclosures to ensure that the paper accurately represents their involvement in micro-reactor deployment.

The staff have also engaged with various micro-reactor developers and other stakeholders through preapplication interactions and public meetings to understand the technology needs and planned business models. These interactions have enabled the staff to further refine the planned enhancements to support NOAK licensing and the policy options outlined in this paper. The NRC staff continues to be receptive to stakeholder feedback and considers it in its activities to address policy topics. For instance, staff is considering the discussion provided in the NEI proposal paper regarding rapid deployment of micro-reactors to inform this paper.

Enclosures:

1. Standardization of Operational Programs
for Nth-of-a-Kind Micro-Reactors
2. Environmental Reviews for Nth-of-a-Kind
Micro-Reactors (to be issued at a
later date)
3. Technical, Licensing, and Policy Considerations
for Nth-of-a-Kind Micro-Reactors