POLICY ISSUE
(Notation Vote)

June 18, 2025 SECY-25-0052

FOR: The Commissioners

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SUBJECT: NTH-OF-A-KIND MICROREACTOR LICENSING AND DEPLOYMENT CONSIDERATIONS

PURPOSE:

This paper seeks Commission approval for the U.S. Nuclear Regulatory Commission (NRC) to afford finality to standard operational programs or requirements submitted by applicants and reviewed and approved by the NRC staff in connection with a design certification (DC) or manufacturing license (ML) application. Current Commission policy only allows for approval of an operational requirement in the context of a DC or ML application if the adequacy of that operational requirement is material to the adequacy of the design. This paper also describes the NRC staff's strategy for licensing of nth-of-a-kind (NOAK) microreactors to enable the safe and secure deployment of these reactors on optimized timeframes.[1] The enclosures to this paper inform the Commission about the staff's plan to pursue alternative approaches to environmental reviews associated with license applications for NOAK microreactors and describe strategies related to other regulatory and licensing topics that directly support NOAK licensing. This paper also responds in part to SRM-SECY-24-0008, "Microreactor Licensing and Deployment Considerations: Fuel Loading and Operating Testing at a Factory".

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[1] As explained in more detail below, the staff uses the term "NOAK microreactor" to refer to a microreactor of a standard design which the NRC has already approved in a rulemaking certifying a standard design or in a licensing proceeding.

SUMMARY:

Stakeholders have expressed growing interest in the widespread deployment of microreactors within the United States to support decarbonization goals, provide integrated power sources for industrial applications, and deliver reliable electricity in remote locations, among other potential applications. Several microreactor developers indicated the need for additional certainty about the regulatory processes that would govern the licensing of such facilities.[2] The NRC staff is currently in preapplication discussions with several microreactor developers that are considering fabrication of numerous microreactors of a standard design for rapid deployment.

The NRC staff is developing strategies to provide for the predictable and efficient licensing and regulation of microreactors, and to identify and resolve policy issues associated with their widespread deployment. The strategies in this paper have the potential to significantly reduce the timeframe for licensing and deployment of NOAK microreactors by modifying the NRC staff's review processes without affecting the needed rigor of the NRC staff's safety, security, and environmental reviews.

The NRC staff has identified options for the approval of standardized operational programs in connection with the review of a standard design (i.e., a standard design proposed in an application for a DC or ML).[3] The NRC staff recommends that the Commission approve Option 2, which would provide the staff the ability to provide finality for standardized operational programs, or parts thereof, if the use of such programs is requested, described, and justified in a DC or ML application. Enclosure 1 provides supplemental information on the options and considerations related to standardization of individual operational programs for microreactors.

Information is also included on alternative approaches for environmental reviews for combined license (COL), construction permit (CP), and operating license (OL) applications for NOAK microreactors, along with other regulatory and licensing topics that the NRC staff is exploring. Specifically, the NRC staff is informing the Commission in enclosure 2 of the NRC staff's plan to implement a systematic, time-phased approach to NOAK licensing environmental reviews by applying a combination of alternatives. Such an approach for environmental reviews would allow the NRC staff to implement flexible and tailored environmental review strategies for specific microreactor designs and deployment models. Enclosure 3 to this paper provides information on additional topics related to NOAK licensing and on strategies to address these topics, the implementation of which may involve further Commission engagement in the future. Enclosure 4 shows the steps involved in NOAK licensing and estimated timeframes.

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2 See, for example, the letter from T. Williams of Shepherd Power to R. Taylor dated February 14, 2024 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML24068A021), and the Nuclear Energy Institute (NEI) proposal paper "Regulations of Rapid High-Volume Deployable Reactors in Remote Applications (RHDRA) and Other Advanced Reactors," dated July 31, 2024 (ML24213A337).

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 Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," Subpart E, "Standard Design Approvals." However, compared to a DC or ML, use of a standard design approval for this purpose would provide less finality and correspondingly lower efficiency gains for NOAK licensing.

BACKGROUND:

The microreactors 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 "microreactor" in this paper, the staff previously described the anticipated attributes of microreactors in SECY-20-0093, "Policy and Licensing Considerations Related to Micro-reactors," dated October 6, 2020 (ML20129J985), and in SECY-24-0008, "Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory," dated January 24, 2024 (ML23207A252).[4] The NRC staff anticipates that microreactors will have small site footprints and will have thermal power levels on the order of several megawatts to a few tens of megawatts. The radionuclide inventories of these reactors are likely to be about 1 percent of those of typical large light-water reactors, or less. Thus, the potential radiological consequences of a microreactor accident are anticipated to be significantly lower than those for typical large light-water reactors, with a correspondingly lower impact on public health and safety. Microreactors 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 in this paper and has not constrained the applicability of the options presented by proposing any specific limitations on the meaning of the term "microreactor" (e.g., limitations on reactor power level), as used in those options. However, practical considerations—such as the extent to which reactors can be fabricated away from the site of permanent deployment, the reactor site footprint, the level of radioactive effluents, the level of reliance on site-specific reactor design features, the extent of the interfaces between the reactor and the site, and the complexity of operations—will tend to limit the options to microreactors such as those described in SECY-20-0093 and SECY-24-0008.

For the purposes of this paper, the term "NOAK microreactor" means a microreactor of a design that has been previously approved by the NRC through a design certification rule (DCR), ML, or a first-of-a-kind COL or CP/OL. The term "NOAK licensing" refers to the licensing of NOAK microreactors 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 DCR or ML and construct and operate the reactor without departures from the approved design, but experience has shown that construction and operation of a first-of-a-kind reactor generally involve such departures. For this reason, design standardization might not be achieved until after the first reactor has been constructed and placed into operation and any DCR or ML for the design has been updated to incorporate the design changes necessitated by the departures. Departures from the approved design in subsequent COL or CP/OL licensing applications, whether due to site-specific issues or other reasons, may decrease the efficiency of NOAK licensing by requiring additional NRC staff review. This may also be true for aspects of design that factor into the alternative approaches for environmental reviews described in enclosure 2 to this paper or that affect adoption of standardized operational programs.

The deployment models for microreactors considered in this paper complement and are consistent with the generic factory-fabricated microreactor deployment model described in SECY-24-0008. Based on feedback from microreactor developers and other stakeholders, the

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[4] 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.

NRC staff anticipates that DCs, MLs, or both will be employed to standardize designs for microreactors that would be mostly or entirely fabricated in factories. As described in SECY-24-0008, there will likely be two types of microreactor designs. The first type is a "self-contained" design that would incorporate the reactor and balance of plant in one or more transportable containers, and so would require minimal site preparation or construction activities at the deployment site. The second type is a design consisting of a "core module" (which 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. The microreactors considered in this paper include transportable microreactors, meaning that the reactor (or a substantial portion of the reactor) could be fabricated in a factory and transported to the deployment site where it would be operated at a fixed location. This paper does not explicitly consider deployment of a mobile microreactor, which would be a microreactor that is intended to be operated at more than one fixed location on an as-needed, where-needed basis. The enclosure to SECY-24-0008 provides additional information on licensing and deployment considerations related to mobile microreactors.

DISCUSSION:

With this paper, the NRC staff is seeking Commission approval of the staff's proposal to review operational programs contemporaneously with the review of a design described in a DC or ML application ("at the design stage"). Commission direction in this area will clarify the regulatory viability of various licensing strategies and deployment models for microreactor developers and potential applicants; these strategies are complementary, though independent of other NRC initiatives to support licensing and deployment of microreactors. The NRC staff is also providing information to the Commission and the public on strategies to employ risk insights and performance-based approaches to licensing and regulating microreactors and other aspects of NOAK licensing. In parallel with the efforts outlined in this paper, the NRC staff is also developing a proposed rule to expedite the licensing process for microreactors and other low safety/security consequence reactors. The NRC staff envisions the rule leveraging deterministic entry criteria to facilitate reduced information needs on design, environmental, and operational aspects to support rapid licensing.

The NRC staff recognizes that some topics raised in this paper and its enclosures could be 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 consider opportunities to apply the strategies described in this paper to other reactor technologies, including through further Commission engagement, as appropriate.

Legislative and Regulatory Considerations

The NRC staff has assessed the current regulatory framework in Title 10 of the *Code of Federal Regulations* (10 CFR), the AEA, and the National Environmental Policy Act of 1969, as amended (NEPA). The NRC staff specifically considered the requirements of 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 and strategies presented in this paper provide the NRC staff's recommendations on regulatory approaches for 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 10 CFR Part 53 proposed rule, "Risk-Informed,

Technology-Inclusive Regulatory Framework for Advanced Reactors," published in Volume 89 of the *Federal Register* (FR), page 86918 (89 FR 86918) on October 31, 2024, would apply to microreactors.

The NRC staff also considered Congressional direction in the Accelerating Deployment of Versatile, Advanced Nuclear for Clean Energy (ADVANCE) Act in the development of this paper. 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), related to the licensing and regulation of microreactors. In developing and implementing these strategies and guidance, the NRC was directed to consider "the unique characteristics of micro-reactors," including physical size, design simplicity, and source term; opportunities for specific improvements related to streamlining the review process; and other policy and licensing issues. As required by Section 506, "Modernization of Nuclear Reactor Environmental Reviews," of the ADVANCE Act, the NRC submitted a report to the appropriate committees of Congress in January 2025 (ML24290A159) on its 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 are consistent with that report and address, at least partially, direction in these sections of the ADVANCE Act to develop strategies for inspections, security, emergency preparedness, and environmental reviews, and to consider opportunities to address redundancies and inefficiencies. The NRC staff intends to implement the strategies and options presented in this paper through a combination of guidance under the existing regulatory framework, the 10 CFR Part 53 rulemaking, and pending or new rulemaking.

The NRC staff is also implementing Congressional direction in the Fiscal Responsibility Act of 2023 (FRA) amendments to NEPA, as discussed in enclosure 2. The FRA requires specific changes to Federal agencies' NEPA practices. Implementation of the FRA will continue to result in a more streamlined NEPA process than the one existing under current NRC regulations in 10 CFR Part 51. For example, for all environmental reviews, the NRC staff considers exemptions from 10 CFR 51.20(b), which requires preparation of an environmental impact statement for specified NRC actions, on a case-by-case basis with appropriate communication to the Commission. In addition, NRC staff proposed a rulemaking in SECY-24-0046, "Implementation of the Fiscal Responsibility Act of 2023 National Environmental Policy Act Amendments," which would provide more flexibility in the type of environmental document that is developed.

This paper focuses on the aspects of licensing over which applicants, or the NRC exercise, the majority of control, and on the associated opportunities for public involvement afforded under NRC regulations. Additional legal and regulatory aspects of licensing commercial nuclear power reactors involve Tribal nations and other interested and affected parties, such as State governments and Federal agencies. 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 U.S. Department of Homeland Security concerning the potential vulnerabilities of the location of a proposed facility to terrorist attack before issuing a license. Similarly, section 106 of the National Historic Preservation Act (NHPA) requires the NRC to provide the Advisory Council on Historic Preservation a reasonable opportunity to comment on the effects of projects that the NRC licenses on historic properties. In addition, section 106 of the NHPA requires the NRC to take into account the effect of issuing a license on any historic property, which normally involves consultation with other persons (e.g., a State or

Tribal Historic Preservation Officer). These processes (and others not directly under NRC control) have historically taken several months to complete. The NRC staff is engaging with such other interested and affected parties to examine whether and how these processes can be tailored to support more timely completion of microreactor reviews.

Licensing Strategy for NOAK Microreactors

For applications that contain complete design information and meet all applicable regulations and statutes, the NRC staff has developed an approach for approval of a standard design that will enable efficient, predictable licensing of NOAK microreactors. It has two main phases. Phase 1, approval of the standard plant, encompasses the following:

- approval of a standard design in a DCR, ML, COL, or CP/OL (see enclosure 3, which provides details on various licensing pathways for a standard design)
- approval of standardized operational programs at the design stage, to the extent practicable and if approved by the Commission (see options below, and enclosure 1)
- completion of a generic environmental review, to the extent practicable (see enclosure 2)
- completion of hearings covering the standard design and environmental review (see enclosure 3)

The timeframe for the approval of the standard plant depends on the quality of the application and the particular licensing pathway (i.e., DC, ML, COL, or CP/OL) and is bounded by the generic milestone schedules established by the NRC in response to direction in the Nuclear Energy Innovation and Modernization Act of 2019.[5] Timeframes range from 30 to 42 months; however, recent NRC reviews of advanced reactor applications have been completed on significantly shorter schedules, especially when an applicant had robust preapplication engagement with the NRC staff that identified issues and pathways for resolving them.[6, 7] Since this paper focuses on the NOAK licensing phase (described below), it does not discuss timeframes for the approval in detail. However, as described in enclosure 3, the licensing pathway chosen for the approval (i.e., DC, ML, COL, or CP/OL) and the degree of finality afforded by the proceeding with that pathway may affect the timeframe for NOAK licensing. For example, approval of the design in an ML will tend to support shorter NOAK licensing timeframes than approval in a first-of-a-kind COL (custom COL) because the ML regulations provide finality for COL or CP/OL applications referencing the ML. This contrasts with a proceeding on a standalone (custom) first-of-a-kind COL or OL application which would only

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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," issued March 2024 (ML23277A139).

7 For example, the NRC issued the construction permits for Kairos Power LLC's Hermes 2 Test Reactor Facility (ML24324A023) approximately 16 months after receipt of the application (ML23195A122).

resolve issues for a contemporaneous application for an identical design as provided for in 10 CFR Part 2, Subpart D, and 10 CFR Part 50, Appendix N (see enclosure 3).[8]

Phase 2, NOAK licensing, leverages the approval in Phase 1 to enable efficient, predictable licensing of NOAK microreactors. It includes the following:

- 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 reviews that apply the generic environmental review, as appropriate (see enclosure 2)
- 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 inspections (see enclosure 3)
- completion of site-specific hearings[9]

Licenses for NOAK microreactors may be issued in accordance with the regulations in either 10 CFR Part 50 or 10 CFR Part 52.[10] Enclosure 4 to this paper show the steps involved in NOAK licensing under 10 CFR Part 50 and 10 CFR Part 52 and the associated estimated timeframes, assuming that the design has already been approved in another proceeding. The NOAK licensing timeframe is as short as about 7 months under both 10 CFR Part 50 and 10 CFR Part 52. These estimated timeframes are for illustrative purposes and reflect the recommended option in this paper for approval of standardized operational programs and the alternative environmental reviews described in enclosure 2. In addition to the topics addressed in this paper, the NRC staff is exploring other topics that could result in NOAK licensing timeframes of 6 months or less, if approved and implemented. For example, timeframes could be reduced by rulemaking to shorten the 60-day minimum period specified in 10 CFR 2.309(b)(3) for submission of hearing requests (except for the time for requesting a

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8 Under 10 CFR 50.32 and 52.8(b), an application may reference information in applications, statements, or reports previously filed with the Commission, including the final safety analysis report for a COL or OL that has been issued. While such referencing may simplify the application process and facilitate NRC staff review of a subsequent application referencing a previously docketed FSAR, issuance of a COL or CP and OL does not resolve design issues in a proceeding on a subsequent referencing application.

9 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, dated July 18, 2024 (ML24200A044), for the current Commission policy on the timeframe for mandatory hearings.

10 The regulations in 10 CFR Part 53 would provide an additional licensing pathway for NOAK microreactors, but this paper does not discuss that topic in detail because those regulations are in development. However, the NRC staff anticipates that the NOAK 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.

hearing on ITAAC, which is set by AEA section 189a.(1)(B) at 60 days). Enclosure 3 identifies other topics that the NRC staff is considering as part of its overall integrated microreactor activities plan could offer additional efficiencies.

EO 14300, "Ordering the Reform of the Nuclear Regulatory Commission" (90 FR 22587), among other things, directs the NRC to "[e]stablish fixed deadlines for its evaluations and approvals of licenses" and other actions, and in part, to "[e]stablish a process for high-volume licensing of microreactors and modular reactors, including by allowing for standardized applications and approvals." This paper does not establish the "fixed schedules" directed by EO 14300, but describes a strategy, based on standardization, that may result in the NRC completing licensing actions for NOAK microreactors in significantly less time than the 18-month deadline specified in the Order. The NRC staff will communicate with the Commission as it implements EO 14300.

Options for Review of Standardized Operational Programs

The NRC staff has developed strategies for the review of measures proposed to satisfy operational requirements[11] (e.g., technical specifications and other operational programs) before submission of an OL or COL application. Currently, the NRC staff may review and approve such measures 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.[12] This paper presents an alternative that would allow applicants to submit measures to satisfy operational programs 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 information regarding operational programs, e.g., design quality assurance, so that the NRC staff can evaluate the proposed design, but most operational programs are not generally required at that stage. Furthermore, current Commission policy does not allow for approval of an operational

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11 Although most Design Control Documents (DCDs) incorporated by reference into 10 CFR Part 52, Appendices A through G (certifying various designs) include information on operational matters, for the most part these DCs do not provide approval for operational information and none provide approval of "operational programs" (e.g., emergency preparedness programs, operational quality assurance programs). Most operational information in the DCD simply serves as contextual information necessary to understand the design of certain SSCs and how they would be used in the overall context of the facility. The NRC did not use the contextual information to support the NRC's safety conclusions, and such information does not constitute the underlying safety bases for the adequacy of those SSCs. Thus, contextual operational information on any particular topic does not constitute one of the matters resolved under paragraph VI.B of each 10 CFR Part 52 appendix certifying a particular design. If the Commission approves Option 2, staff may be able to review and approve operational requirements on a case-by-case basis in connection with review of a DC or ML application, assuming that portion of the program is provided as essentially complete. See Economic Simplified Boiling-Water Reactor Design Certification, Final Rule, 79 FR 61944, 61974 (October 15, 2014).

12 Under the design-centered review approach, the staff would review measures to satisfy operational requirements for the first microreactor application of a particular design, then apply the review results to any subsequent applications for microreactors of the same design that use the same approach as proposed in the first application. The NRC staff previously used the design-centered review approach for design matters in COL applications referencing the same certified design, applying the review of a lead or "reference" combined operating license application to a subsequent combined operating license application. See Regulatory Issue Summary 2006-06, "New Reactor Standardization Needed to Support the Design-Centered Licensing Review Approach," dated May 31, 2006 (ML053540251).

requirement in the context of a DC or ML application unless the adequacy of that operational requirement is material to the adequacy of the design. Even then, staff review and approval of the operational requirement in the DC proceeding does not resolve issues in a proceeding on a referencing application within the meaning of 10 CFR 52.63, as stated in Section VI.C of each 10 CFR Part 52 appendix that certifies a standard design. Nonetheless, each 10 CFR Part 52 appendix certifying a design includes provisions (in Section VIII.C) governing changes to such operational requirements and intervenor challenges to them; under these provisions, generic changes to the approved operational requirements are governed by 10 CFR 50.109.

The final DCR for the U.S. Advanced Boiling Water Reactor (62 FR 25806; May 12, 1997) explains 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 increased regulatory stability to approved operational requirements, should the Commission decide to allow approval of all such requirements, will be a matter for Commission consideration. If Option 2 is approved, staff will explore the regulatory vehicles for implementation discussed below, all of which are anticipated to provide for future Commission engagement and direction with each ML and DC application. For example, for a NOAK applicant or licensee that references a DCR, the Commission could direct that matters associated with operational requirements that are 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, "Backfitting." Should the Commission approve a strategy for resolution of operational matters during DC or ML review, an OL or COL applicant referencing the DCR or ML would not be bound to an approved method for satisfying an operational requirement but, as an alternative, 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 such a case, an intervenor would be free to raise the adequacy of the program as a contention in the proceeding on the OL or COL application (provided the contention requirements of 10 CFR 2.309 are satisfied).

In SECY-05-0197, "Review of Operational Programs in a Combined License Application and General Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria," 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.[13] SECY-05-0197 lists operational programs required by regulation. Examples of such programs include those for testing and inspection, radiation protection, the maintenance rule, quality assurance, security, and emergency preparedness. 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," Section 13.4, "Operational Programs," issued April 2019 (ML18344A032).[14]

For the purposes of this options paper, the NRC staff used the guidance in section 13.4 of NUREG-0800 to inform the list of operational programs considered in enclosure 1. The enclosure provides additional background and details on the staff's rationale. The NRC staff notes that the list of operational programs discussed in enclosure 1 may not be all-inclusive or applicable to every microreactor or advanced reactor design. Appendix B to

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13 The staff requirements memorandum for SECY-05-0197 was issued February 22, 2006 (ML060530316).

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

DANU-ISG-2022-01, which is part of the Advanced Reactor Content of Applications Project guidance (ML23277A105) and which was developed to support near-term advanced reactor applicants, describes the regulations that are generally applicable to non-light-water reactor applications for CPs and OLs under 10 CFR Part 50 and for DCs, COLs, and standard design approvals under 10 CFR Part 52. The applicant should identify which operational programs are relevant to its design and deployment models. Preapplication engagement with the NRC staff may help applicants identify such programs.

Option 1—Status Quo Only

Under this option, the NRC staff would apply the Commission's historical position to review and approve only those operational requirements material to the findings on the adequacy of the design as part of a DC or ML proceeding, and thus would afford some measure of finality only to the corresponding programs. The NRC staff would not review or approve any other operational requirements with a DC or ML.

Under the current process, a DC, ML, or potential COL or CP/OL applicant could, at its discretion, submit an operational program topical report for NRC staff review and approval, and a CP/OL or COL applicant could then incorporate the topical report by reference in its application. The topical report process allows the staff to review proposed methodologies, designs, operational requirements, or other safety subjects on a generic basis so that they may be implemented by reference by multiple licensees, provided that each application referencing the topical report demonstrates that it satisfies the conditions for use of the topical specified in the staff safety evaluation and the topical report itself. The NRC staff would not revisit its evaluation of the topical report except if the staff identified new information material to its conclusions on the adequacy of the program, or for other good cause. Alternatively, an applicant could pursue a design-centered review approach and reference an operational program previously approved by the NRC.

Implementation

This option would not necessarily require NRC staff action to implement. However, because of the wide range of potential deployment models, guidance may need to be updated. An applicant should identify, and the NRC staff should verify, the operational requirements that are applicable to its design (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 for this approach to be fully effective.

Advantages

- Under this option, the NRC staff would continue to use established processes for reviewing operational programs through either topical reports or a design-centered review approach.

- Under this option, a topical report could be submitted at any time (though Option 2, below, would allow for the topical report alternative, Option 2 is centered on the submission of operational requirement descriptions together with the DC or ML application for review with those applications).

Disadvantages

- This option would not provide for optimal review efficiency for staff to support streamlined microreactor NOAK deployment models, as finality or regulatory stability offered by a DCR or ML would not be accorded to operational programs referenced in a COL or CP/OL (except to the extent operational requirements are material to the adequacy of the design, have been completely reviewed and approved, and are governed by the change requirements in 10 CFR 50.109).

- COL and CP/OL applicants would likely have to reference numerous topical reports. The NRC staff would need to verify the applicability and appropriateness of each topical report with regard to the design in its safety evaluations. This also includes any new information material to its conclusions regarding the approved topical report.

- Submission of a topical report does not initiate a licensing action, and the NRC does not offer an opportunity to request a hearing on a topical report. While the topical report safety evaluation can set the conditions for use of the topical report, the safety evaluation is not an order and does not resolve issues within the meaning of 10 CFR 52.63(a)(5) in a proceeding on a referencing application. Thus, matters addressed in the topical report would be subject to hearings in a CP/OL or COL review because staff findings on a topical report do not bind prospective intervenors, the Atomic Safety and Licensing Board, or the Commission.

If this option is selected, the NRC staff will consider updating guidance on preapplication engagement and topical reports to mitigate potential inefficiencies for NOAK licensing.

Option 2—Include Pathway for NRC Staff Review and Approval of Operational Programs Proposed in a Design Certification or Manufacturing License 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. If Option 2 is approved, a COL or CP/OL applicant could reference the operational programs approved with a DCR or ML, in addition to topical reports related to other operational programs.

The NRC staff would review these proposed measures or programs and could approve them, as appropriate, as part of the DCR or ML to afford finality. Assuming the proposed measures constituted an essentially complete program such that the staff could make a safety finding, and assuming the staff comprehensively reviewed the proposed measures, this would provide greater regulatory stability for those programs when referenced by COL or CP/OL applicants in NOAK licensing. The NRC staff acknowledges that there are many possible microreactor deployment models, and that the information needed to describe all operational programs in sufficient detail may not be known at the design stage for a DC or ML. This option would allow the NRC staff the flexibility to review proposed measures to satisfy operational requirements in connection with a DC or ML application and make findings on the programs, provided that they are described in sufficient detail. However, the NRC staff could decline to make a finding if the program descriptions are incomplete or inadequate. Specifically, the NRC staff could certify a design by issuing the DCR or license a design by granting the ML but deny approval of a particular program if a safety finding cannot be made with respect to the program and the program is not material to the safety of the design. The staff would provide guidance to clarify its regulatory approach and ensure consistency between COL and CP/OL reviews.

Option 2 would increase the efficiency of NOAK licensing for COL and CP/OL applicants referencing those approved standardized operational programs, particularly for those applicants new to the nuclear industry who, for example, do not have an existing quality assurance program in accordance with 10 CFR Part 50, Appendix B. However, staff will continue to use regulatory tools to streamline licensing reviews as discussed in Option 1, if an applicant chooses that pathway.

Implementation

The NRC staff would implement this option through DC rulemaking and other appropriate regulatory vehicles to give DC and ML applicants the 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. The extent and degree of finality associated with the NRC staff's review and approval of the operational program would be established through Commission direction on each DC rule or the Commission's issuance of a rule of particular applicability or case-specific order for addressing an ML application. If the staff determines that it would be more efficient to amend the regulations in 10 CFR Part 52, Subpart F, "Manufacturing Licenses," to provide for the review of operational programs in a manufacturing license proceeding, then further Commission engagement would be necessary.[15]

Whichever regulatory vehicle is used, the NRC staff will consider including flexibility to allow the staff to exclude review and approval of a specific program if it would unnecessarily delay the entire DCR or issuance of the ML. The NRC staff will also consider flexibilities for COL and CP/OL applicants that do not wish to reference all of the standardized programs approved in a DCR 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 1). 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.[16]

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 the appropriate regulatory vehicles by which the NRC staff could review the information in a DC or ML proceeding and document safety findings. The NRC staff notes that the DC or ML applicant should ensure that any changes made to the design during the DC or ML review are considered and reflected in the operational programs, as appropriate.

Also, as in Option 1, because of the range of potential deployment models and microreactor technologies, it is likely that guidance on the development of operational programs for microreactors will need to be updated. In addition, applicants would need to identify the milestones for implementing the various programs or portions of them, which would be included in a COL, and the schedule for achieving the milestones, which would be set forth in the final safety analysis report, in accordance with current practice under 10 CFR Part 52. To the extent the NRC staff deems it warranted, the staff would verify the adequacy of implementation of any

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15 Rulemaking that would modify the scope of information collected in a DC or ML application would likely require an amendment to the Office of Management and Budget approval of information collections under 10 CFR Part 52.

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

operational requirements when the COL holder reaches the various milestones or afterwards. The NRC staff would also explore whether additional guidance would be needed to describe how a CP/OL or COL applicant or licensee can make changes to an operational program once it is approved in a DCR or ML.

Currently, microreactor developers have not provided specific details on how they intend to implement standardized operational programs. Staff will further engage stakeholders as developers' deployment models evolve to better inform which regulatory vehicle(s) would provide an optimal pathway for review and approval of standardized operational programs in connection with a DC or an ML, including finality considerations. Similarly, stakeholders and other interested and affected parties would be engaged in the development of specific implementation guidance for the selected regulatory vehicle(s).

The staff is currently using the tools discussed under Option 1 to enhance COL or CP/OL review efficiency. However, the staff believes that Option 2 would provide an alternative to better support the high-volume licensing and deployment plans of microreactor developers due to the finality offered by a DCR or ML. If the Commission directs the staff to pursue Option 2, the staff also intends to continue to use the regulatory tools described in Option 1 to further streamline the COL and CP/OL reviews.

Advantages

- A DC and ML resolve issues through the rulemaking and adjudicatory processes, respectively. Under this option, operational programs afforded finality in a DCR or ML would be considered resolved in a proceeding on a CP/OL or COL application that references the DCR or the manufactured reactor.

- This option would provide for optimal NOAK licensing review efficiency and reliability for the staff and NOAK applicants because COL and CP/OL applicants would reference the programs approved and afforded finality in the DCR or ML.

- This option gives COL and CP/OL applicants the flexibility to either reference topical reports or use the operational programs approved in the DCR or ML.

- This option could provide for a more efficient staff review of multiple operational programs at once as part of a DC or ML proceeding, as opposed to individual topical reports.

Disadvantages

- Under this option, the NRC staff would have to pursue rulemaking or use another appropriate regulatory vehicle (which might not provide the same degree of finality as a rulemaking approach) 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, "Finality of standard design certifications," after approval through a DCR or ML could be subject to more resource-intensive change control compared to changes to an operational program described in a topical report and referenced in a COL or CP/OL application.

- Under this option, contentions related to operational programs could affect the estimated timeline for issuance of an ML.

If this option is approved, NRC staff will consider whether new or revised guidance is necessary to minimize any inefficiencies that may result.

STAKEHOLDER ENGAGEMENT:

The NRC staff engaged with stakeholders and other interested and affected parties on the topics in this paper through the periodic Advanced Reactor Stakeholder Meetings held in May and July 2024. During the May meeting, the staff presented the topics it was considering including in the paper and received verbal feedback on the scope of the paper. During the July meeting, the staff confirmed the topics to be included in the paper and provided preliminary information about the options it was considering. Meeting participants provided oral feedback at these meetings, which the staff considered when developing the paper. The NRC staff also released a draft white paper with enclosures, "Nth-of-a-Kind Micro-Reactor Licensing and Deployment Considerations" (ML24270A206 and ML24302A292), on September 27 and October 29, 2024, and held a related public information meeting on November 6, 2024, to provide clarity and transparency on the topics covered in the paper. The NRC staff did not solicit written public comments on the draft white paper but received oral feedback from several meeting participants during the meeting. A representative of the Nuclear Energy Institute (NEI) provided a presentation titled, "NEI Preliminary Perspectives on NRC Draft NOAK MicroReactor White Paper" (ML24310A226). The staff also coordinated with several other Federal agencies, such as the U.S. Department of Energy, on the topics covered in this paper and its enclosures, to ensure that the paper would accurately represent their involvement in microreactor deployment.

During the public meeting on November 6, meeting participants expressed general agreement with the scope of microreactor licensing and deployment topics being addressed by the NRC staff and their prioritization. Meeting participants agreed that approval of standardized operational programs in connection with a DC or ML application (Option 2) and the alternative approaches for environmental reviews described in enclosure 2 would enhance the efficiency of NOAK microreactor licensing and support deployment models currently under consideration. Meeting participants also supported the NRC staff's concepts and strategies described in the information topics in enclosure 3. Meeting participants raised several concerns related to the details of standardization of specific operational programs, such as radiation protection and staff training programs, which the staff plans to address during the development of guidance on standardized operational programs.

Meeting participants also noted that several topics described in SECY-24-0008 and its enclosure, such as loading fuel into a manufactured reactor at a factory, features to preclude criticality for a fueled reactor, transportation of fueled reactors, licensing of replacement reactor modules, and decommissioning, are priorities for further engagement with the NRC staff as microreactor developers continue to mature their deployment models and the Commission provides related policy direction. Meeting participants also requested clarity on the distinction between "transportable microreactors" and "mobile microreactors," which the staff added to the "Background" of this paper. A meeting participant suggested that the concept of a core standard design should be used instead of maximal design standardization. The NRC staff notes that the degree of standardization is a decision that will be made by an applicant. Several meeting participants requested that the NRC staff engage stakeholders in the development of any guidance needed to implement Commission direction on the options in this paper (and SECY-

24-0008) and to implement the strategies described in enclosure 3. The staff agrees stakeholder interaction on specific implementation guidance will be necessary.

On December 20, 2024, NEI provided written feedback (ML24358A266) on the NRC staff's draft white paper on NOAK microreactor licensing and deployment considerations and its enclosures. This feedback included comments related to several areas that may warrant further consideration by the staff and stakeholder engagement during implementation of Commission direction on this paper or in future activities. NEI also recommended that the NRC establish a roadmap or project plan to address the full scope of microreactor topic areas and how the NRC will integrate various sources of direction affecting prospective microreactor regulation, such as the Commission direction on SECY-24-0008. The NRC staff released a draft of its integrated plan detailing microreactor licensing and deployment considerations and planned implementation actions on February 5, 2025 (ML25036A199), and held a related public workshop on February 20, 2025. The NRC plans to hold additional public meetings and workshops in 2025 to further discuss microreactor licensing and deployment considerations.

The staff has also engaged with microreactor developers and other stakeholders through preapplication interactions and public meetings to understand their technologies and planned deployment models. These interactions have enabled the staff to refine the planned enhancements to support NOAK licensing and the policy options outlined in this paper. This paper was also informed by NEI's July 31, 2024, letter on rapid deployment of microreactors. In the NRC's response to the NEI letter (ML24317A174), the staff noted numerous prior engagements with stakeholders and initiatives to optimize the regulatory framework for microreactors. This paper and these prior initiatives combined address nearly all of the topics outlined in the NEI letter, and these initiatives have resulted in significant progress towards addressing Section 208 of the ADVANCE Act.

Based on interactions with current microreactor developers, the staff believes the issues presented in this paper, combined with other initiatives, will provide the requested regulatory clarity to proceed with planned deployment models. Activities to further enhance the regulatory framework for microreactors will likely continue beyond implementation of the ADVANCE Act as microreactor technologies and deployment models evolve.

INTERACTIONS WITH THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS:

The NRC staff met with the Advisory Committee on Reactor Safeguards to discuss the staff's draft white paper in a subcommittee meeting on October 17, 2024, and a full committee meeting on November 6, 2024. The Committee decided not to write a letter to the Commission regarding the options described in the paper.

COMMITMENT:

If the Commission approves the staff's recommendation of Option 2 for review and approval of standardized operational programs at the design stage, the NRC staff will engage stakeholders and develop technology-inclusive guidance for microreactor applicants to voluntarily submit, and the NRC staff to review, information on operational programs in connection with DC and ML applications. The NRC staff will also consider whether to develop an appropriate regulatory vehicle (e.g., rulemaking) to more formally establish the approved positions in Option 2 and will seek further Commission direction as necessary. The NRC staff will also begin work to implement the alternative environmental review processes in enclosure 2 and will engage stakeholders and other interested and affected parties in the process as appropriate. This will

include development of any guidance necessary for applicants to submit and the NRC staff to review environmental information at the design stage.

RECOMMENDATION:

The NRC staff recommends that the Commission approve Option 2 and take the position that the NRC staff may review and approve, as appropriate, information on standard operational programs or requirements submitted by applicants in connection with a DC or ML application. Staff notes that the regulatory tools discussed under Option 1 would still be available for applicants to pursue to support a more efficient COL or CP/OL review.

RESOURCES:

While there are no resources specifically assigned to this activity currently, if the Commission approves the NRC staff's recommended option, the staff will use the planning, budgeting, and performance management process to reallocate resources within the non-fee recoverable advanced reactor regulatory infrastructure budgeted resources in fiscal year (FY) 2025 and FY 2026 to implement the Commission's direction. If resources are needed in FY 2027 and beyond, resources will be addressed during the planning, budgeting, and performance management process.

COORDINATION:

The Office of the General Counsel has reviewed this paper and has no legal objection.

Mirela Gavrilas, PhD
Executive Director
for Operations

Enclosures:
1. Standardization of Operational Programs for Nth-of-a-Kind Microreactors
2. Environmental Reviews for Nth-of-a-Kind Microreactors
3. Technical, Licensing, and Policy Considerations for Nth-of-a-Kind Microreactors
4. Licensing Steps and Estimated Timeframes for Nth-of-a-Kind Microreactors

SUBJECT: NTH-OF-A-KIND MICRO-REACTOR LICENSING AND DEPLOYMENT CONSIDERATIONS DATED: June 18, 2025

ADAMS Accession No.: ML24309A266 (Package) **SECY-012**

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