



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

February 1, 2024

Walter L. Kirchner, Chairman  
Advisory Committee on Reactor Safeguards  
U.S. Nuclear Regulatory Commission  
Washington, DC 20555-0001

SUBJECT: RESPONSE TO THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS LETTER, "DRAFT WHITE PAPER, 'MICRO-REACTOR LICENSING AND DEPLOYMENT CONSIDERATIONS: FUEL LOADING AND OPERATIONAL TESTING AT A FACTORY'"

Dear Chairman Kirchner:

On behalf of the U.S. Nuclear Regulatory Commission (NRC or the Commission) staff, I would like to thank you for the letter from the Advisory Committee on Reactor Safeguards (ACRS or the Committee) dated October 25, 2023 (Agencywide Documents Access and Management System Accession No. ML23289A043). This letter addressed the NRC staff's efforts to develop options and recommendations for Commission consideration regarding licensing and deployment of factory-fabricated micro-reactors. I appreciate the substantial time and effort that the ACRS devoted to this subject during the ACRS Full Committee meeting October 3-5, 2023.

The NRC staff's interactions with the ACRS were supported by a September 2023 draft white paper<sup>1</sup> that described proposed regulatory approaches for fuel loading and operational testing of factory-fabricated micro-reactors at a factory and for features to preclude criticality that would allow the NRC staff to conclude that a factory-fabricated module is not "in operation" when loaded with fuel. The NRC staff included additional background and clarifying information in the Commission options paper SECY-24-0008, "Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory," dated January 24, 2024 (ML23207A252) to address specific areas identified in your letter. The NRC staff provides the responses below to the following recommendations in the ACRS letter regarding improving the clarity of the paper:

3. For completeness and improved clarity, the white paper should:
  - a. Define key terms, such as "micro-reactors" and "features to preclude criticality"; and
  - b. Expand the list of topics to address in guidance, such as acceptable attributes for features to preclude criticality, the required safety margin to criticality (especially for first-of-a-kind reactors with little or no operating experience), and the certification required for personnel conducting operational testing at a factory.

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<sup>1</sup> "NRC Staff Prepared White Paper—'Micro-Reactor Licensing and Deployment Considerations: Fuel Loading and Operational Testing at a Factory'—September 2023 Draft—Released to Support ACRS Interaction," September 2023, and its enclosure (ML23264A802 and ML23264A803, respectively).

**Staff Response:**

With respect to the recommendation to define “micro-reactors,” the NRC staff notes that a regulatory definition of “micro-reactor” has not been established. The NRC staff previously described the expected attributes of micro-reactors in SECY-20-0093, “Policy and Licensing Considerations Related to Micro-Reactors,” dated October 6, 2020 (ML20129J985). The staff carried over to the Commission paper the portions of the description of micro-reactors in SECY-20-0093 that are relevant to factory-fabricated micro-reactors. The NRC staff did not more specifically define “micro-reactors” in the Commission options paper because, with the exception of Option 3b, the approaches to fuel loading and operational testing described therein do not depend on specific limitations (e.g., maximum power level or potential dose consequences of postulated accidents). Instead, considerations such as transportability of a particular reactor design and necessary radiation shielding for reactors that are operated for testing prior to transport, are expected to make the proposed approaches to factory fuel loading and operational testing most beneficial to factory-fabricated micro-reactor developers and will tend to constrain the practical availability of the options to micro-reactors with the attributes described in SECY-20-0093.

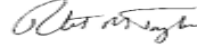
Under Option 3b, the NRC staff would apply most of the safety regulations for non-power reactors, as appropriate, as part of a graded review of an application for a license to operate a reactor at a factory for testing prior to deployment. The NRC staff clarified in the Commission options paper that in its review of an application for a license for operational testing of a micro-reactor at a factory under Option 3b, the staff would consider whether the reactor meets the technical criteria in the definition of testing facility in Title 10 of the *Code of Federal Regulations* Section 50.2, “Definitions,” when deciding which non-power reactor safety requirements should apply.

With respect to the recommendations to define “features to preclude criticality” and expand the list of topics to be addressed by guidance, the NRC staff clarified that implementation of Option 1b (under which a factory-fabricated module with features to preclude criticality would not be in operation when loaded with fuel) would include the development of guidance to address attributes of features to preclude criticality, such as redundancy and required margin to criticality, including associated uncertainties. This will allow the NRC staff to further engage stakeholders on the definition of features to preclude criticality to ensure that it is formulated in a technology-inclusive manner while emphasizing those attributes important to safety.

The NRC staff clarified in the paper that operational testing of micro-reactors at a factory requires NRC-licensed operators under both Options 3a and 3b. The NRC staff notes in the paper that depending on the specific programs for operational testing proposed, the NRC staff may need to develop additional guidance for licensed operator qualification and proficiency programs. The NRC staff also included additional information about existing guidance applicable to operator licensing under Option 3b.

The NRC staff appreciates its interactions with the ACRS on developing options to address licensing and deployment considerations for factory-fabricated micro-reactors and considers the Committee's recommendations to be valuable input to this important topic. The NRC staff will determine the need for further interactions between the NRC staff and the ACRS on future micro-reactor activities, including the preparation of additional Commission policy papers and guidance.

Sincerely,



Taylor, Robert signing on behalf  
of Veil, Andrea  
on 02/01/24

Andrea D. Veil, Director  
Office of Nuclear Reactor Regulation

cc: Chair Hanson  
Commissioner Wright  
Commissioner Caputo  
Commissioner Crowell  
SECY

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