

**U.S. Nuclear Regulatory Commission Preliminary Questions regarding X Energy LLC
Topical Report: Xe-100 Risk-Informed Performance-Based Licensing Basis Development”
(XE00-R-R1ZZ-RDZZ-L-001522)**

X Energy LLC (X-energy) submitted a licensing topical report XE00-R-R1ZZ-RDZZ-L, “Xe-100 Risk-Informed Performance-Based Licensing Basis Development,” (Agencywide Documents Access and Management System (ADAMS) Accession No. ML21196A071) in June 2021. The U.S. Nuclear Regulatory Commission (NRC) staff performed an acceptance review of the subject topical report and found in August 2021, that the material presented was sufficient to begin the detailed review (ADAMS Accession No. ML21210A311).

During the detailed review of the topical report, the NRC staff identified a set of preliminary questions and observations to improve its understanding of the information presented in the subject report. The questions are intended to:

- Obtain clarification regarding the material in the topical report.
- Promptly identify areas where additional information may be needed.
- Facilitate discussions and continue an effective communication between the NRC staff and X-energy.

The NRC staff request that X-energy propose a date to discuss the enclosed preliminary questions in a public meeting. Based on the outcome of its discussions with X-energy, the NRC staff may develop formal requests for additional information or continue with the development of the safety evaluation report.

Preliminary Questions:

1. The topical report appears to use the terms ‘departure’ and ‘deviation’ interchangeably. The NRC staff recommends consistent use of ‘deviation’ because ‘departure’ is typically associated with the changes from the certified information in Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants.”
2. Regarding Section 3.4.3., “Clarification C.1.c and Xe-100 Position,” of the topical report, Nuclear Energy Institute (NEI) 21-07, Revision 0, “Technology Inclusive Guidance for Non-Light Water Reactors: Safety Analysis Report Content for Applicants Using the NEI 18-04 Methodology,” was submitted to the NRC for review and approval in August 2021. It states the following:

These considerations are reflected in the selection of the Design Basis Hazard Levels (DBHLs) for the standard plant design (referred to as Design Basis External Hazard Levels or DBEHLs in NEI 18-04).

Note that this guidance document uses the nomenclature of DBHL instead of the DBEHL term from NEI 18-04. While not discussed comprehensively in NEI 18-04, there is a need to consider not only hazards external to the plant (traditional external events) but also hazards external to the SSCs performing PRA [Probabilistic Risk Assessment] Safety Functions – i.e., internal plant hazards such as internal fires, floods, turbine missiles, and high energy line breaks. To clarify the original intent of NEI 18-04 to address both categories of hazards, this guidance document uses the DBHL term instead of DBEHL.

NEI 21-07, Revision 0 indicates that DBEHLs in NEI 18-04, Revision 1, “Risk-Informed Performance-Based Technology Inclusive Guidance for Non-Light Water Reactor Licensing Basis Development,” are meant to include both internal and external hazards.

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Please state if X-energy plans to capture this distinction in this topical report or address it separately, outside of this topical report, after the NRC staff’s position on NEI 21-07, Revision 0, is formally established as part of the Technology-Inclusive Content of Application Project (TICAP) and Advanced Reactor Content of Application Project (ARCAP) efforts.

3. Section 3.4.5., “Clarification C.1.e and Xe-100 Position,” of the topical report recites a portion of the NRC staff clarification regarding NEI 18-04:

The methodology in NEI 18-04 includes an expanded role for PRA beyond that currently required by 10 CFR Part 52 and policies related to new applications under 10 CFR Part 50. The staff’s review of the PRA prepared by a reactor designer could be facilitated by the designer’s use of NRC-endorsed consensus codes and standards (e.g., potential NRC endorsement of the American Society of Mechanical Engineers/American Nuclear Society RA-S-1.4, “Probabilistic Risk Assessment Standard for Advanced Non-LWR Nuclear Power Plants”). However, the NRC has not yet endorsed a consensus code or standard for non-LWR PRAs. In the absence of such an endorsed standard, the NRC staff will develop review strategies to address the performance and use of PRAs for specific applications.

Regarding the last sentence, note that the NRC staff developed a draft white paper titled “Non-Light Water Review Strategy” (ADAMS Accession No. ML19275F299), in 2019 and discussed it with stakeholders. Although it is not a formal guidance document, it provides useful information on PRAs.

Regarding the NRC staff clarification above, the topical report states:

The Xe-100 Program PRA will be developed to meet the requirements of the American Society of Mechanical Engineers/American Nuclear Society RA-S-1.4, “Probabilistic Risk Assessment Standard for Advanced Non-LWR Nuclear Power Plants.” [3] It is anticipated that the NRC will issue a draft Regulatory Guide in late 2021 endorsing this PRA Standard. X-energy is proceeding with PRA development and monitoring the endorsement activities as they progress at this time.

The NRC staff notes that the agency released preliminary Draft Regulatory Guide (RG) 1.247, “Acceptability of Probabilistic Risk Assessment Results for Advanced Non-Light Water Reactor Risk-Informed Activities” (ADAMS Accession No. ML21246A216), for interactions with stakeholders. This document is expected to be issued for public comments later this year. Also note that preliminary Draft RG 1.247 proposes endorsement of NEI 20-09, “Performance of PRA Peer Reviews Using the ASME/ANS Advanced Non-LWR PRA Standard.” The NRC staff’s endorsement may include clarifications that should be addressed by applicants when using ASME/ANS RA-S-1.4 and NEI 20-09.

Please state if X-energy intends to follow NEI 20-09. If not, the NRC staff request X-energy to clarify what guidance it plans to use to perform a peer review of its PRA.

4. Section 4.1., “SSC Safety Classification Approach for the Xe-100,” of the topical report states:

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NEI 18-04 is not explicitly clear on the level of decomposition (e.g., functional level, system or component level, event sequence level) the reliability and capability targets should be derived from to support licensing documentation. The Xe-100 Program does not require any departures from NEI 18-04 guidance but will clarify an approach that identifies reliability and capability targets at an appropriate level of decomposition for documentation in the licensing bases and plant records and programs.

Section 4.4., “Development of SSC Design and Performance Requirements,” of the topical report states:

At the end of [NEI 18-04] section 4.4.5, “Special Treatment Requirements for SSCs” paragraph entitled “Reliability Assurance for SSCs” notes that all safety-significant SSCs should be included in a Reliability Assurance Program (RAP) similar to that described in the Standard Review Plan (SRP), Chapter 17.4. Similar to the discussion at the end of Section 4.1 of this report, the Xe-100 program will clarify an approach that identifies reliability targets for safety-significant SSCs at an appropriate level of decomposition for documentation in the licensing bases and plant records and programs.

The topical report states that X-energy “will clarify an approach that identifies reliability and capability targets at an appropriate level.” **Please discuss how X-energy will document the approach in the future.**

The NRC staff notes that the topic of reliability and capability targets is one of the key topics surrounding NEI 21-07, Revision 0 and the NRC staff review of the document as part of the TICAP/ARCAP efforts.

Section 5.6., “Establishing the Adequacy of Plant Capability DID [Defense in Depth],” of the topical report states that, “The Xe-100 Program follows the guidance in section 5.6.1 through 5.6.3 and does not require any departures from or clarifications of NEI 18-04 guidance.”

It appears that NEI 18-04 contains guidance for applicants under the Section 5.6 heading outside of the lower-level Sections 5.6.1 - 5.6.3. For example, NEI 18-04 Section 5.6 states, “This decision should be clearly recorded, including the bases for this decision, in a configuration-controlled document.”

Please discuss if X-energy intends to follow the entirety of the guidance under NEI 18-04 Section 5.6. If X-energy intends to just follow Sections 5.6.1-5.6.3, please provide a justification for not following all of Section 5.6.

Section 5.7., “Evaluation of Licensing Basis Events against Layers of Defense,” of the topical report states that, “The Xe-100 Program follows the guidance in section 5.7.1 through 5.7.2 and does not require any departures from or clarifications of NEI 18-04 guidance.”

Please discuss if X-energy intends to follow the entirety of the guidance under NEI 18-04 Section 5.7. If X-energy intends to just follow Sections 5.7.1 and 5.7.2, please provide a justification for not following all of Section 5.7.

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Section 6., “X-energy Implementation of the NEI 18-04 RIPB Licensing Basis Framework,” of the topical report states that, “The Xe-100 Program follows a Systems Engineering Management Plan (SEMP) approach to design that implements a phased process of the system life cycle (e.g., conceptual design, preliminary design, final and detailed design, etc.).”

Typically, a systems engineering plan (SEP) is used to implement a design through a system lifecycle. According to available literature, a SEMP appears to be a document that addresses a contractor’s overall systems engineering management approach (e.g., the application of a contractor’s standards, capability models, configuration management, and toolsets to their organization).

Due to the differences between the generally accepted definitions/uses of SEPs and SEMPs, please provide more details on the X-energy SEMP if they are available. If the X-energy SEMP is already in place, state if it could be made available for NRC staff audit as part of the topical report review.