Audit Question for General Audit

Below is a question the U.S. Nuclear Regulatory Commission (NRC) staff has prepared for the University of Illinois Urbana-Champaign (U. of I.) related to the U. of I. Preliminary Safety Analysis Report (PSAR). The NRC staff would like to discuss this question within the scope of the General Audit Plan dated June 26, 2026 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML26183A197). This question is provided in advance to facilitate discussion during audit meeting(s).

Item #	Question
1.1-1	(See also Key Technical Topics Audit Questions Gen-1 and Gen-13 (ML26163A203) and General Audit Question 1.3-1 (ML26221A002).) The PSAR references five topical reports (TRs) that were previously submitted by U. of I. and reviewed and approved by the NRC staff: • "Quality Assurance Program Description for the University of Illinois Urbana-Champaign Research and Test Reactor" (ML23167C137) • "University of Illinois Urbana-Champaign High Temperature Gas-cooled Research Reactor: Applicability of Nuclear Regulatory Commission Regulations" (ML24208A143) • "University of Illinois Urbana-Champaign High-Temperature Gas-cooled Research Reactor Fuel Qualification Methodology" (ML25101A107) • "University of Illinois Urbana-Champaign High Temperature Gas-cooled Research Reactor: Event Sequence Identification and [Structure, System, and Component (SSC)] Safety Classification Methodology" (ML24075A193) • "University of Illinois Urbana-Champaign High Temperature Gas-cooled Research Reactor: Micro Modular Reactor (MMR™) Principal Design Criteria" (ML24208A066) The NRC staff notes that approval of the last four of these topical reports was subject to limitations and conditions (L&Cs) identified in the associated TR safety evaluations (SEs). Please describe how U. of I. intends to address the applicable L&Cs for referencing these TRs in the PSAR. For each L&C, clarify whether or where it is addressed in the PSAR, and if it is not currently addressed in the PSAR, explain how it has been satisfied or otherwise dispositioned. Please also discuss any possible research and development (R&D) pursuant to 10 CFR 50.34(a)(8) which may be necessary in support of addressing the L&Cs. In addition, the NRC staff notes based on its review of the PSAR that certain reactor design and operating parameters may have changed since the TRs were reviewed. Please identify any applicable differences in the design, operating parameters, analytical assumptions, SSC classifications, and/or licensing approach from those which formed the basis for evaluation in the referenced TRs and SEs, and discuss how U. of I. determined that the NRC approvals of the TRs remain applicable in light of any differences. Specifically, regarding the four U. of I. TRs that the NRC staff approved subject to L&Cs: **a. Event Sequence Identification and SSC Classification Methodology TR** The Limitation 1 for this TR states that the NRC staff's approval was limited to the methodology approach itself, and that the specific implementation of the methodology, including the resulting event sequences and SSC classifications for the U. of I. KRONOS MMR™, would be subject to review in future licensing submittals. Accordingly, the TR SE did

not approve the specific event sequences, resulting SSC classifications, or the completeness of the identified events.

Please explain how U. of I. implemented the approved TR methodology in the PSAR and how Limitation 1 of the TR SE is addressed. In particular:

- Please provide the basis for the postulated initiating events (PIEs) and event sequences presented in the PSAR, including how the completeness of the identified events was established.
- Explain how the PSAR classification of SSCs (e.g., as safety-related or non-safety-related) is consistent with the approved TR methodology.

b. Principal Design Criteria (PDC) TR

The PDC TR SE states that approval of the TR is limited to the U. of I. KRONOS MMR™ design generally described in the TR, and that any departure from the design or licensing approach described in the TR would require justification in the referencing licensing action.

The NRC staff notes that certain design and operating parameters described in the PSAR appear to differ from those considered in the PDC TR and SE. For example, the intended reactor thermal power has been increased from 10 megawatts-thermal (MWth) to 45 MWth.

Please identify any departures from the design or licensing approach described in the PDC TR and evaluated in the associated SE, and provide the justification required by the TR SE L&C to demonstrate that the approved PDCs and their underlying safety bases remain applicable to the PSAR design.

For instance, the NRC staff notes that due to the increased power, there will be increases in fission rate, neutron flux/fluence, neutron-induced displacements per atom (DPA), decay heat, and other changes in the reactor that could have important implications and may warrant additional consideration. Please address the effects of changes in reactor power, and any other changes in reactor design, geometric, mechanical, or operating parameters to the extent that they could impact the assumptions and safety bases relied upon in the TR SE.

c. Applicability of Regulations TR

TR SE L&C 2 limits applicability of the SE to a reactor at U. of I. with a design of the type described in section 2.0 of the TR. Based on its review of the PSAR, the NRC staff notes that certain design and operating parameters, including reactor power (increased from 10 MWth to 45 MWth) appear to have changed since the TR was reviewed. Please identify any design changes from the design described in section 2.0 of the TR and explain how U. of I. determined that the conclusions in the TR and SE remain applicable to the PSAR design.

d. Fuel Qualification Methodology (FQM) TR

TR SE L&C 1 limits approval of the FQM TR to the U. of I. KRONOS MMR™ design and licensing approach generally described in the TR. L&C 1 also requires justification for departures from that design or licensing approach. The staff notes that there appear to be some fuel and core design differences between the TR and PSAR chapter 4, including the fuel-block configuration, number of fuel and burnable absorber channels, control-block arrangement, reflector configuration, and fuel pellet inner diameter. Please identify all

	departures from the fuel and core design described in the TR and explain how these changes affect the applicability of the approved fuel qualification methodology and qualification envelope. As appropriate, please elaborate on how U. of I. has addressed or intends to address these changes. TR SE L&C 2 requires appropriate degradation phenomena, including vibration and resultant wear or degradation of fully ceramic micro-encapsulated (FCM) pellets, to be identified and dispositioned in a licensing submission referencing the TR. The PSAR describes features intended to limit pellet movement and flow-induced vibration, but the bases demonstrating that vibration, wear, and other applicable FCM fuel degradation mechanisms have been adequately evaluated are not clear. Please describe how U. of I. has addressed or will address L&C 2, including the requirement for evaluation and disposition of vibration-induced wear and other applicable degradation mechanisms for the FCM pellets. TR SE L&C 3 states that the acceptance criteria in TR section 6.7 are preliminary and that the criteria ultimately relied upon for fuel qualification must be appropriate and justified for the specific licensing submittal. The PSAR references the TR section 6.7 acceptance criteria and states that successful fuel qualification testing will be evaluated against those criteria. Please elaborate on how U. of I. has addressed or intends to address L&C 3, including how the final fuel acceptance criteria will be established, justified, and demonstrated to remain applicable to the fuel design and operating envelope presented in the PSAR.