

Audit Questions for General Audit

Below are questions the U.S. Nuclear Regulatory Commission (NRC) staff has prepared for the University of Illinois Urbana-Champaign (U. of I.) related to section 4.2 of the U. of I. Preliminary Safety Analysis Report (PSAR). The NRC staff would like to discuss these questions within the scope of the General Audit Plan dated June 26, 2026 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML26183A197). These questions are provided in advance to facilitate discussion during audit meeting(s).

(Regarding all questions below, see also Key Technical Topics Audit Questions Gen-4 and Gen-5 (ML26163A203).)

Item #	Question
4.2-1	PSAR section 4.2.2 states that reactor graphite components are designed in accordance with American Society of Mechanical Engineers (ASME) Section III, Division 5. Please provide information related to U. of I.'s viscoelastic model development and preliminary results.
4.2-2	PSAR section 4.2.2 states that reactor graphite components are designed in accordance with ASME Section III, Division 5. Please provide information related to U. of I.'s damage tolerance assessment of the graphite core components.
4.2-3	PSAR section 4.2.2 states that reactor graphite components are designed in accordance with ASME Section III, Division 5. Please provide information related to U. of I.'s oxidation analysis for normal operation and air ingress events.
4.2-4	PSAR section 4.2.2 states that reactor graphite components are designed in accordance with ASME Section III, Division 5. Please provide information on how wear, abrasion, erosion, and fatigue are addressed in the design.
4.2-5	Please clarify whether graphite core components are expected to experience conditions where Wigner energy accumulation may occur (i.e., irradiation at temperatures below 300 degrees Celsius). If so, please provide information on whether the effects of Wigner energy accumulation have been considered and a description of that evaluation.
4.2-6	Please provide information on how acceptable performance of graphite core components will be ensured and confirmed during operation (e.g., use of witness specimens, surveillance, and/or monitoring), including how the reactor will be designed to accommodate any graphite performance evaluation activities that are needed during operation.
4.2-7	PSAR section 4.2.2.1.1 describes fuel pellet features that ensure vertical alignment. Please provide information on consideration of potential for fuel/graphite interactions, including effects of irradiation induced dimensional change and/or the coefficient of thermal expansion (CTE) of the graphite spacer, fuel channel cap (or plug), fuel element, and silicon carbide (SiC) fuel matrix, as well as potential for cracking or deformation of the surrounding graphite. Additionally, please provide information on the design considerations for reactor core system interaction with adjacent metallic structures, systems, and

	components (SSCs), including both dynamic and chemical (e.g., carburization) effects.
4.2-8	Please clarify the safety classification and functions of graphite SSCs in the reactor core system (control block elements, spacers, and caps (or plugs)) that do not appear to be specifically identified in PSAR table 3-3.
4.2-9	Please clarify whether the qualification window (temperature and peak fast fluence for normal operation) described in the Graphite Qualification Methodology information, dated July 31, 2026, that U. of I. provided for audit in response to Key Technical Topics Audit Question Gen-4 bounds the predicted environmental conditions of all graphite components in the reactor core system, including control block elements, spacers, caps (or plugs), reflector elements.
4.2-10	The ability of the reactor core system to perform its functions at the predicted accident conditions (e.g., temperatures) does not appear to be justified in the PSAR. Additionally, material property data at the elevated temperatures expected does not appear to be provided. Please provide information supporting integrity of graphite core component functionality at these conditions.
4.2-11	Please provide a description of U. of I.'s plans for monitoring and analysis of vibration and other dynamic effects that could potentially impact the reactor core system and other SR SSCs.
4.2-12	Please provide further description of the graphite support fins discussed in PSAR section 4.2.2.1.1, including information such as their arrangement relative to adjacent fuel elements and features; expected temperatures, irradiation, and stresses; and how those expected values were determined.
4.2-13	Based on the information provided in PSAR section 4.2.2, it is unclear to the NRC staff what is the basis behind the PSAR section 4.2.2.4 system evaluation intended to demonstrate the reactor core system's compliance with applicable principal design criteria. Please provide information justifying the assumptions and statements provided in PSAR section 4.2.2.4.