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Sent: Friday, March 24, 2023 4:24 PM
To: Rusty Towell; Lester Towell; Jordan Robison; Tim Head; Alexander Adams
Cc: Richard Rivera; Zackary Stone; Michael Wentzel; Greg Oberson (He/Him); Boyce Travis; Kyle Song; Barbara Hayes; Scott Stovall; Mike Mazaika; Kenneth See; Andrew Prinaris; Zuhan Xi; Nicholas Hansing; Matthew McConnell
Subject: Abilene Christian University - Audit Questions Regarding ACU CP PSAR Chapters 2 and 3 (Batch 1)
Attachments: ACU MSRR Chapter 2 and 3 Audit Questions (Batch 1).pdf

Dear Dr. Towell,

Attached is a list of questions the NRC staff has prepared for Abilene Christian University (ACU) related to the ACU Preliminary Safety Analysis Report, Chapter 2, "Site Characteristics," and Chapter 3, "Design of Structures, Systems, and Components." The NRC staff would like to discuss these questions within the scope of the ACU construction permit (CP) application review Audit Plan for Chapters 2 and 3 (see audit plan dated 3/2/2023, ML23065A048), and I am providing these in advance to facilitate discussion during an audit meeting. Once ACU is ready to discuss, please let us know and we can set up an audit meeting. We will add this e-mail, with questions, to public ADAMS. If you have any questions, please let Richard, Zack, or I know.

Thank you,

Ed Helvenston, U.S. NRC
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Division of Advanced Reactors and Non-Power Production and Utilization Facilities (DANU)
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PSAR Review Audit Questions for Chapter 2, “Site Characteristics,” Section 2.3, “Meteorology”

Item #	Question
2.3-1	PSAR Section 2.3.1 describes the general and local climate of the MSRR site, including information on temperature and humidity. However, the PSAR does not appear to specify dry-bulb temperature and concurrent or non-concurrent humidity indicator values (typically wet-bulb temperature, though other indicators of ambient moisture may be provided) that could pertain to the design of the various HVAC and other heating and cooling SSCs serving the MSRR facility. The staff notes that the acceptability of such system-specific specifications typically needs to be determined prior to system construction. Please provide information to allow the NRC staff to understand what safety impacts, if any, these values could have on associated SSCs such as auxiliary cooling and heating (PSAR Chapter 5) and heating, ventilation, air conditioning and cooling systems (PSAR Chapter 9). Specifically: i) Please discuss whether design dry-bulb temperatures and coincident or non-coincident atmospheric moisture indicators are applicable to the design of cooling and heating systems and whether there are any associated safety impacts. If so, please describe the data used for these designs including the corresponding return periods or percent exceedance levels, and the source(s) of such data. **ii)** Discuss whether there is a need to evaluate the persistence of high and low dry-bulb temperature conditions for the HVAC and other heating and cooling systems described in PSAR Chapters 5 and 9, and for the SSCs described in PSAR Chapter 3 as applicable. If so, please provide results of such evaluations, as appropriate.

PSAR Review Audit Questions for Chapter 2, “Site Characteristics,” Section 2.4, “Hydrology”

Item #	Question
2.4-1	PSAR Section 13.1.8 states, “The site has not historically experienced flooding, is outside the 500-year flood plan, and is outside the inundation area for dam failures, so flooding is not foreseeably a credible external event (see Section 2.4). Flooding of the reactor pit with water will not pose a criticality concern, as stated in Section 4.5.” PSAR Section 4.5.2.6 states “Flooding is a remote concern in the MSRR, but in the event that a tank of fuel salt located in the FHS is submerged in water, k_{eff} remains deeply subcritical.” PSAR Section 2.4 states, “The risk of flood near the reactor is deemed negligible, whether from drainage runoff, ground movement, dam failure, or creek and river blockages.” Based on the above statements, how is flooding (both internal and external) dispositioned with regards to safety impacts? The NRC staff understands based on PSAR Section 2.4 that ACU’s position is that external flooding is precluded, but it appears from PSAR Section 4.5 that the consequences are addressed via bounding event analysis. Please clarify ACU’s strategy to address potential MSRR flooding, and discuss and provide for audit relevant analyses if flooding is dispositioned analytically.

PSAR Review Audit Questions for Chapter 2, "Site Characteristics," Section 2.5, "Geology, Seismology, and Geotechnical Engineering"

Item #	Question
2.5-1	PSAR Section 2.5.5 states that "it is estimated [Reference 2.5-9] that the PGA [peak ground acceleration] for the proposed site is 0.0305 gravity, as shown in [PSAR] Figure 2.5-22. Using the ASCE [American Society of Civil Engineering] 7 hazard tool, this value is within the predicted 0.039 PGA provided and in the Seismic Design Category A [Reference 2.5-9]." PSAR Reference 2.5-9 is also stated as the source for PSAR Figure 2.5-22. PSAR Reference 2.5-9 is the ASCE 7 hazard tool. However, the staff notes that PSAR Figure 2.5-22, which shows seismic hazard curves along with the uniform hazard spectrum, does not appear to come from PSAR Reference 2.5-9. The staff notes that the graphs shown in Figure 2.5-22 of the PSAR appear to come from the USGS's unified hazard tool (earthquake.usgs.gov/hazards/interactive). The staff notes that, for the latitude and longitude of the SERC, the ASCE 7 hazard tool only provides hazard calculations for the boundary between B and C soil site classes (i.e., the B/C boundary), where the average site shear-wave velocity (V_s) equals 760 m/s. The values provided by the USGS's unified hazard tool and reported in the PSAR appear to be for a B/C boundary site classification, consistent with the ASCE 7-10 hazard tool. However, PSAR Section 3.4.2.3 states that "the SERC is supported on a foundation system on stiff competent soils. The site is classified as Site Class C prescribed in ASCE/SEI 7-10, Table 20.3-1. The typical shear wave velocities for the soils present at the site are 1,200 to 2,500 ft/sec." i) The ASCE 7-10 hazard tool reports site specific design ground motions using hazard estimates from the 2008 USGS Long-term Nation Seismic Hazard Mapping project. The staff notes, however, that in 2018 the USGS updated its hazard maps to reflect changes in hazard resulting from significant updates in source characterization and ground motion modeling approaches. Please explain and justify why the ASCE 7 hazard tool that uses the 2008 USGS hazard estimates is appropriate for reporting the seismic hazard at the site. ii) Please clarify why ACU used the B/C boundary site classification to define the uniform hazard, given that the site classification is defined as site class C in PSAR Section 3.4.2.3. If the reported uniform hazard is corrected to site class C, will this affect the anchoring of the design spectrum to 0.03 gravity as discussed in PSAR Section 3.4.2.2? iii) Was (or will be) any geophysical testing conducted to verify the shear-wave velocities for the soil and rock strata beneath the site for the determination of the site classification? If not, please justify ACU's estimation of the shear-wave velocities reported in the PSAR. If so, will these be provided in the operating license application?

2.5-2	PSAR Section 2.5 states that "The seismic design basis reflects … data from a detailed geophysical and geotechnical investigation at the site." Please provide for audit the geotechnical site investigation report detailing relevant information, such as locations of all borings relative to the SERC, systems pit, and planned MSRR, respective soil boring profiles, field and laboratory testing performed, and results obtained that provide subsurface materials engineering and materials properties for the design and construction of the systems pit foundation system and MSRR. The staff notes that PSAR Section 2.5.2, states that 9 borings were drilled to depths of 5, 30, 40 and 60 ft. However, it is unclear where the bore holes are located in relation to the systems pit where the reactor would be located.
2.5-3	PSAR Section 3.1.1 states that deep drilled concrete pier foundations will be used with the foundation tip (toe) extending into the shale layer at a depth of about 55 feet below grade. The drilled piers are sized to have a maximum bearing pressure of 17 kilopounds per square foot (ksf). PSAR Figure 2.5-17, which summarizes borings at the SERC site, indicates that the site soil is highly plastic (plasticity index generally >17), with liquid limits as high as approximately 50 percent. The staff notes that design guides such as the Texas Department of Transportation Geotechnical Manual recommend characterizing geotechnical properties to a depth of 15 to 20 ft below the toe of drilled shafts. PSAR Section 2.5.2 states that prior to SERC construction, borings were drilled to depths of up to 60 ft, although the depth of most borings is 40 ft or less based on PSAR Figures 2.5-6 through 2.5-16. The staff also notes that the exact locations of the borings are not clear from the PSAR (see also audit question 2.5-2). Justify the adequacy of the limited number of borings used for defining and assessing factors that affect the MSRR deep foundation stability (such as soil bearing capacity and soil settlement), including the basis for characterizing geotechnical properties to a depth of 60 ft, which is only 5 feet below the drilled pier toe.
2.5-4	The staff notes that the PSAR does not appear to discuss potential foundation settlement. Please discuss what information was used or what assumptions were made about the geotechnical properties along and below the drilled piers to evaluate settlement of the systems pit and research bay. If assumptions were made about geotechnical properties, what are the bases for the assumptions?
2.5-5	PSAR Section 3.1.1 states that expansive soils exist at the site. Please provide information regarding the location, extent, and expansion characteristics of such soil. The staff seeks this information to evaluate the foundation and subsurface materials stabilities under the design loading (static and dynamic) conditions.
2.5-6	PSAR Section 2.5.7 states that the risk of liquefaction is low and that results of liquefaction hazard analyses based on site conditions and seismic design requirements will be provided in the Operating License application. PSAR Section 19.3.4.2, "Soils," states that "[b]ased on soil moisture content, the groundwater table is considered to exist below 35 ft (10.7 m) across the site." However, it is unclear to the staff whether sufficient geotechnical investigations (such as Standard Penetration Test (SPT), Core Penetration Test (CPT), or shear wave velocities) have been conducted to support a deterministic liquefaction analysis. If an evaluation of the soil at the site to liquefaction has been performed, provide results of the analysis (e.g., in an electronic portal) demonstrating adequacy of mitigating measures. Otherwise justify why liquefaction of the soil at the MSRR site is not possible and why an appropriate analysis of liquefaction susceptibility is not necessary as part of the construction permit application. The staff notes that liquefaction susceptibility and triggering evaluations are an important factor in siting evaluation/selection prior to construction.

2.5-7	PSAR Section 3.4.2.3 states that the typical shear wave velocities for the soils present at the site are 1,200 to 2,500 ft/sec. However, the PSAR does not appear to include any information about in-situ geophysical surveys determining the profiles of shear wave velocities. The staff notes that shear wave velocities are important soil parameters for Soil-Structure Interaction (SSI) analysis. It is unclear whether any of the in-situ geophysical surveys that may be necessary for SSI have been carried out. Additionally, the PSAR does not appear to include fundamental information on other soil parameters such as minimum soil unit weight and Poisson's ratio (that the staff notes would be necessary for SSI analysis and foundation stability assessment), nor on how these soil parameters would be determined, if necessary. Please provide information on the soil parameters applicable for foundation design/SSI analysis in the PSAR. Alternatively, justify why such parameters are not needed for the foundation design/SSI analysis of the research bay and MSRR systems pit foundation system.
2.5-8	PSAR Figure 3.1-5 shows “Select Fill” placed after placement of the concrete systems pit. However, the PSAR does not appear to include any information regarding the “Select Fill.” Define what soil backfill material constitutes the “Select Fill.” Clarify whether native soils are acceptable as “Select Fill.” Confirm that compaction requirements of PSAR Section 3.1.1 are followed for the provided “Select Fill” material. If not, provide actual compaction of the material.

PSAR Review Audit Questions for Chapter 3, “Site Characteristics” (General questions relevant to entire chapter)

Note:

Item #	Question
3-1	The regulation 10 CFR 50.34(a)(4) requires that the preliminary analysis of the design of a facility include “…determination of the margins of safety during normal operations and transient conditions anticipated during the life of the facility…”. PSAR Section 3.4.2.1 states that “[b]y designing the SSCs in accordance with RG 1.29 to withstand the effects of [a safe-shutdown earthquake], a designed-in safety margin is provided for bringing the reactor to a safe shutdown condition…”. However, it is not clear to the staff whether ACU is committing to design the MSRR SSCs fully consistent with RG 1.29 (RG 1.29, Revision 6 (ADAMS Accession No. ML21155A003), or another version). It is also not clear to the staff what the “designed-in safety margin” for seismic hazards is for the MSRR, including whether it relates to performance requirements, such as margins ensuring structural integrity and adequacy of safety-significant or safety-related facility SSCs. Furthermore, it is not clear to the staff what SSC design margins are for hazards other than seismic hazards (e.g., meteorological and flood hazards). Please discuss the implementation of RG 1.29 in the design of MSRR SSCs. In addition, please discuss and provide in an electronic reading room for audit any relevant reports/calculations for review that would allow the staff to better understand information on construction materials and design methodologies used, and resulting margins associated with the design of SSCs against meteorological, flood/water, and seismic damage, and against damage from other abnormal loads (if any).

3-2	PSAR Figure 3.1-3 shows a rendering of the MSRR systems pit with the shielded reactor, fuel storage, and coolant salt and heat management enclosures. It also shows that these extend above the MSRR pit and into the research bay. PSAR Figure 4.1-2 also shows that the concrete reactor enclosure extends above the pit and into the bay. However, PSAR Figure 3.4-1 shows the pit covered with 16 inch precast panels. It is not clear to the staff whether all of the MSRR hardware, enclosures, and safety-related SSCs are subterranean (i.e., below the precast panels), for protection against abnormal loads, such as heavy lift drops or tornados. Clarify whether all the MSRR SSCs are subterranean, located in the pit, and covered with the aforementioned precast panels sized against all loading conditions to preclude damage. Provide relevant additional construction drawings and calculations for audit, as appropriate.
3-3	PSAR Section 2.2.2.7.3 states that the "probability for an airplane crash into the SERC research bay is 3.6×10^{-6} per year. The MSRR and all structures, systems, and components are positioned inside a subterranean concrete vault within the SERC research bay with an above-grade target size of approximately 3 ft by 30 ft by 18 ft (1m by 10m by 6m), which results in a probability for an airplane crash into the MSRR facility of 8.2×10^{-7} per year." The staff notes, however, that DOE-STD-3014-2006, "Accident Analysis for Aircraft Crash into Hazardous Facilities," which is referenced in PSAR Section 2.2.2 and outlines methodologies to evaluate aircraft crash into hazardous (e.g., nuclear) facilities, also discusses secondary effects such as fuel fires that could spread beyond the area directly damaged by the crash. DOE-STD-3014-2006 also states, "[d]ue to the difficulty of demonstrating that active systems can function following a crash, credit should not be allowed for fire suppression systems unless an explicit analysis shows that they will remain effective." Although PSAR Figure 3.4-1 shows precast slabs covering the MSRR pit, the staff notes that PSAR Figure 3.4-1 and other information in the PSAR does not appear to describe any fire stops or other mitigating measures that would preclude burning fuel from entering into the MSRR pit. Discuss whether spreading of aircraft fuel fires resulting from crash have been considered in the design of the MSRR and pit, and if they are not considered, justify the absence of such consideration.
3-4	PSAR Section 4.2.5.3 states that the "reactor enclosure support system is rigid and transmits force to the systems pit wall. The systems pit wall has notches or ledges (not shown in the figure) which serve as anchoring points for the reactor enclosure support structure." However, it is not clear to the staff what figure is being referred to in this portion of the PSAR. The staff also notes that PSAR Figure 3.1-3 does not show the reactor enclosure support system being attached and transmitting force to the systems pit wall. It is not clear to the staff whether this interaction between the reactor enclosure support system and systems pit wall has been considered in the structural analysis including potential seismic loading of the systems pit. Please discuss whether this interaction is considered in the design.
3-5	PSAR Section 13.1.9 discusses a potential malfunction of the research bay overhead crane (a 40-ton crane according to PSAR Section 16.1) that potentially could drop a heavy object onto the external concrete shield of the reactor. PSAR Section 13.1.9 states that the "concrete [reactor enclosure] barrier is able to withstand the weight and impact of any object that would foreseeably be moved with the overhead crane." However, the PSAR does not appear to discuss the potential for dropping of a heavy load on the fuel storage or coolant salt and heat management enclosures. Please discuss how the fuel storage and coolant salt, heat management enclosures, and any safety-related SSCs and non-safety-related SSCs requiring functionality will be protected from potential dropping of heavy loads, and as appropriate, what controls ACU will use for lifting of heavy loads.

PSAR Review Audit Questions for Chapter 3, “Site Characteristics,” Section 3.2, “Meteorological Damage”

Item #	Question
3.2-1	PSAR Section 19.4.12.1.7.2 states that “[a]lthough damage to the reactor building is likely if it is in the direct path of a strong tornado, a reactor shutdown is standard protocol in the event of severe weather warnings, and no safety critical components are foreseeably affected by this occurrence.” PSAR Section 3.2.2.2 states that “[t]he systems pit is covered with precast concrete panels … to protect required safety-related SSCs from tornado missiles and debris from failure of the research bay structure.” However, the PSAR does not appear to clearly indicate whether the pit precast panels are designed to resist tornado-generated high wind speeds, atmospheric pressure changes, and missile impacts (see PSAR Section 3.2.2), to protect against and mitigate subterranean MSRR SSC damage. Clarify whether and how the panels are designed to resist such loads, and if they are not, discuss whether ACU has analyzed the application of such loads internal to the systems pit and its safety-related SSCs.

PSAR Review Audit Questions for Chapter 3, “Site Characteristics,” Section 3.3, “Water Damage”

Item #	Question
3.3-1	PSAR Section 3.3.1.1.1 states that the “systems pit is a reinforced concrete structure designed to meet ACI 349-2013...”. The staff notes that NRC endorses ACI 349-13, “Code Requirements for Nuclear Safety-Related Structures and Commentary” subject to the staff regulatory positions and regulatory guidance in RG 1.142, “Safety-Related Concrete Structures for Nuclear Power Plants (Other than Reactor Vessels and Components),” Revision 3 (ADAMS Accession No. ML20141L613). Although RG 1.142 is guidance for nuclear power reactors, it is not clear to the staff to what extent ACU incorporated the RG’s staff regulatory positions and guidance augmenting ACI 349-13 to the design of the MSRR, as applicable. Clarify whether and to what extent the design of the MSRR facility will be consistent with RG 1.142 endorsing the ACI 349-13.

PSAR Review Audit Questions for Chapter 3, “Site Characteristics,” Section 3.4, “Seismic Damage”

Item #	Question
3.4-1	PSAR Section 3.4.2.1 describes seismic categories, and includes a reference to NRC RG 1.29, “Seismic Design Classification for Nuclear Power Plants.” Specifically, PSAR Section 3.4.2.1 states “By designing the SSCs in accordance with RG 1.29 to withstand the effects of [a safe-shutdown earthquake], a designed-in safety margin is provided for bringing the reactor to a safe shutdown condition, while also reducing potential offsite doses from seismic events.” However, it is not fully clear if ACU is committing to designing SSCs in accordance with RG 1.29 (RG 1.29, Revision 6 (ADAMS Accession No. ML21155A003), or another version; see audit question 3-1). The staff notes that there appear to be some differences between the terminology used in RG 1.29 and the PSAR that could require clarification if ACU is committing to RG 1.29, such as the difference between “collapse” and “failure” for Seismic Category II. Please clarify as necessary.
3.4-2	PSAR Section 3.5.2.4 states that “Safety-related SSCs are classified as Quality-Related, while non-safety related SSCs are classified as Not Quality Related.” PSAR Section 3.4.2.1 states that non-safety-related SSCs are those not classified as Seismic Category I or II, which suggests that all Seismic Category II SSCs are safety-related (and therefore also quality-related). Please clarify if this is correct. (See also audit question 3.5-6.)
3.4-3	PSAR Section 3.1.1 discusses the MSRR research bay systems pit. PSAR Figures 3.1-5 through 3.1-9 show the pit to be attached to drilled piers (which extend to 55 feet below grade according to PSAR Section 3.1.1) and the research bay slab to be on more slender deep foundations, which the staff presumes to be piles. The staff also notes that Section 3.1.1 of the PSAR states that “[t]he floor slab [of the research bay systems pit] is supported by the piers and structurally isolated from the subgrade to prevent interaction with the expansive surficial soils.” The PSAR does not appear to discuss the slender drilled piles that appear to support the research bay and its slab, including whether they are safety-related, what material they are made of (e.g., steel or concrete) and what their depth of penetration is. The staff notes that any feedback from the research bay to its supporting slender drilled piles would create an interaction of these piles with the soil that could affect the response of the systems pit and its drilled pier foundation system. The staff notes that drilled piers or piles should typically be designed and constructed to withstand maximum imposed curvatures from earthquake ground motions and structure response. The staff also notes that curvatures should typically include free-field soil strains modified for soil/pile/pier/structure interaction and potential coupling of curvatures with pier or pile deformations induced by lateral pier or pile resistance to structure seismic forces. It is not clear whether the design of the SERC/slender pile/systems pit/drilled pier foundation system described in PSAR Section 3.4.2.3 has addressed such soil-structure interactions. Please discuss the piles that appear to support the research bay and its slab, including whether they are safety-related, materials, and penetration depth. In addition, please describe any analyses that ACU performed of the SERC/slender pile/systems pit/drilled pier foundation system, and whether these analyses considered the potential aforementioned couplings of curvature and deformations of the drilled piers, slender piles, and the systems pit, subject to all applicable loads. Provide information regarding these analyses for audit.

3.4-4	PSAR Section 3.4.2.5 references codes and standards for seismic analysis of SSCs, including ASCE 4 and ASCE 43. The staff notes that ASCE 4-16, "Seismic Analysis of Safety-Related Nuclear Structures," states that it provides "criteria for determining the response of structural elements in new facilities when subjected to earthquake ground motion [however] the analysis of caisson [i.e., drilled pier] and pile-supported foundations are not covered by the standard." It is not clear to the staff to what standard the SERC/pile/systems pit/drilled pier foundation system is designed to. For the SERC/pile/systems pit/drilled pier foundation system, specify the standard to be used for analysis and the acceptance criteria for "caisson and pile-supported foundations" that are applicable for the SERC/pile/systems pit/drilled pier foundation system.
3.4-5	PSAR Section 2.1.1.2 states that the "MSRR operations area, or the exclusion area boundary, which is anticipated to be the area directly under the U.S. Nuclear Regulatory Commission (NRC) facility operating license […] consists of the research bay, reactor control room, radiochemistry lab, and dress-out room." PSAR Section 3.4.1 states that: "Where portions of an MSRR system are classified as Seismic Category I, the boundary limits of that portion of the SSCs designed to Seismic Category I provisions are reviewed against the design of the existing SERC facility. … [F]or fluid systems that are partially Seismic Category I or are Seismic Category II because of location in the existing MSRR facility, the Seismic Category I portion of the system extends to the first seismic restraint beyond the isolation valves that isolate the part that is Seismic Category I. At the physical interface between seismic and non-seismic Category I piping systems, the Seismic Category I dynamic analysis is extended to either the first anchor point in the non-seismic system or to a sufficient distance into the non-seismic system so as not to degrade the validity of the Seismic Category I analysis. Those interfaces and seismic classifications are clearly identified on the final arrangement drawings of the MSRR facility." It is not clear to the staff whether the aforementioned Seismic Category I systems extend beyond the exclusion area boundary into other portions of the existing SERC, and whether they have been designed to same seismic design standards and acceptance criteria as other Seismic Category I systems. Please clarify, and as appropriate and available, provide drawings indicating interfaces and seismic classifications of SSCs in an electronic reading room for audit. Discuss the standards used for seismic classification of each system extending beyond the exclusion area boundary; if different from other systems, discuss what acceptance criteria were used for systems extending beyond the exclusion area boundary and why such criteria were used.

3.4-6	PSAR Section 2.5.5 states that it is estimated based on the ASCE 7 hazard tool that the peak ground acceleration (PGA) for the proposed site is 0.0305 gravity (g), “within the predicted 0.039 PGA denoting ASCE 7 Seismic Design Category A.” PSAR 3.4.2.2 states that the MSRR facility design basis uses a response spectrum anchored to a PGA of 0.03 g. PSAR Section 3.4.2.2 states that NRC RG 1.60, “Design Response Spectra for Seismic Design of Nuclear Power Plants,” is used for the development of the design response spectra. The staff notes that RG 1.60, Revision 2 (ADAMS Accession No. ML13210A432), states that a “response spectrum, anchored at 0.1 g, is an appropriately shaped response spectrum to define the minimum seismic input requirement at the foundation ...”. The staff also notes that the guidance in NUREG-1537, “Guidelines for Preparing and Reviewing Applications for the Licensing of Non-Power Reactors,” and ORNL/TM-2020/1478, “Proposed Guidance for Preparing and Reviewing a Molten Salt Non-Power Reactor Application,” references IAEA TECDOC-403, “Siting of Research Reactors,” which similarly assigns a value of 0.1 g (i.e., 0.08 g multiplied by 1.25; see TECDOC-403 Tables 3.2 and 3.3) for the type of soil described in the MSRR application. It is not clear to the staff why PSAR Section 3.4.2.2 states that RG 1.60 is used for the development of the design response spectra, but PSAR Section 2.5.5 appears to indicate that ACU developed the response spectra consistent with ASCE 7-10. Clarify what guidance ACU follows to determine the response spectrum for the design of the MSRR and its foundation system. (See also audit questions 2.5-1 and 3.4-7.)
3.4-7	PSAR Section 3.4.2.5 references ASCE 43-19, “Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities,” and states that this standard, along with ASCE 4-16, “Seismic Analysis of Safety-Related Nuclear Structures,” is used for the MSRR seismic analysis. However, the PSAR does not appear to clearly describe how this framework (or a different framework) is followed for evaluating loads for nuclear safety significant (or safety-related) SSCs, particularly for seismic design. The staff notes that ASCE 43-19 indicates that the seismic design basis for nuclear facilities is a combination of a qualitative description of the acceptable level of damage, denoted by its limit state (LS), and a seismic design category (SDC). However, it is not clear to the NRC staff how the proposed design response spectrum (DRS) for the MSRR conforms to ASCE 43-19. It is not clear to the staff whether ACU assigns SDCs for its SSCs consistent with ASCE 43-19 (and ANSI/ANS-2.26-2004, “Categorization of Nuclear Facility Structures, Systems, and Components for Seismic Design,” which is referenced in ASCE 43-19). In addition, it is not clear to staff whether (and if not, why not) ACU’s design satisfies the ASCE 43-19 provision of elevating the DRS to at least 0.04 g for certain SDCs. Please discuss, and as appropriate, provide information on SDC and corresponding LS assignment for each of the MSRR safety significant (or safety related) SSCs.

PSAR Review Audit Questions for Chapter 3, "Site Characteristics," Section 3.5, "Systems and Components"

Item #	Question
3.5-1	The staff requests that ACU discuss (or provide relevant information for audit, as appropriate) the following to allow the staff to better understand how the MSRR design, specifically ACU's proposed equipment qualification program, will comply with PDCs 1, 2, 4, and 23: i. PSAR Sections 3.5.2.2 and 3.5.2.3.2 reference IEEE/IEC 60780-323, "International Standard – Nuclear Facilities – Electrical Equipment Important to Safety - Qualification," with respect to qualification of MSRR equipment. Provide a list of electric equipment that must be qualified and discuss the criteria used to identify this equipment as needing to be qualified (i.e., scoping criteria). ii. The staff notes that NRC has yet to officially endorse IEEE/IEC 60780-323. It is not clear to the staff from the PSAR whether ACU is committing to this standard in its entirety, or may take certain exceptions from the standard. Explain how ACU plans to use this standard as well as any other equipment-specific standards that will be used to qualify electric equipment, as appropriate.
3.5-2	PSAR Section 3.5.2.1 provides safety classification criteria, specifically, a definition of "safety-related." However, the definition appears to contain a circular reference. Please clarify the meaning of the definition and discuss whether revision of the definition may be necessary.
3.5-3	ORNL/TM-2020/1478, Appendix A, Part 1, Section 3.5, states that applicants should give the design bases for the systems and components required to function for safe reactor operation and shutdown. However, it is not clear to the staff if the PSAR contains such design bases based on a comprehensive consideration of conditions that may be important for reliable operation of MSRR systems and components. Please discuss or provide for audit preliminary design specifications for MSRR electromechanical systems and components, to allow the NRC staff to confirm that appropriate considerations discussed in the ORNL/TM-2020/1478, Appendix A, Parts 1 and 2, Section 3.5, guidance for systems and components (for example, dynamic and static loads, number of cycles, vibration, wear, friction, and effects of the operating environment) are properly incorporated into the MSRR design.
3.5-4	PSAR Section 3.5.2.2 discusses qualification of safety-related systems and components using IEEE/IEC 60780-323. However, the staff notes that this standard covers electrical equipment. Please provide additional details regarding equipment qualification for other SSCs, including mechanical equipment and any equipment containing non-metallic materials (e.g., O-rings, gaskets, or seals), as applicable.
3.5-5	PSAR Section 3.5.2.2 states that safety-related systems and components are qualified using applicable guidance in IEEE/IEC 60780-323. PSAR Section 3.5.2.2 also states that "nonsafety-related components and systems are qualified to withstand stress caused by environmental and dynamic service conditions under which their failure could prevent satisfactory accomplishment of the safety-related functions." Please discuss and provide details on the qualification methodology used for non-safety-related components and systems.

3.5-6	PSAR Section 3.5.2.4 states that “safety-related” SSCs are quality-related, while non-safety-related SSCs are not quality-related. However, the PSAR, including in Sections 3.1 and 3.5, also refers to SSCs that are “important to safety,” and it is not clear to the staff what quality controls such SSCs may be subject to. Describe the controls for non-safety-related SSCs that are “important to safety.” (See also audit question 3.4-2).
3.5-7	PSAR Sections 3.5.2.3.1 and 3.5.2.3.2 discuss seismic qualification of MSRR SSCs, and reference IEEE 344, “IEEE Standard for Seismic Qualification of Equipment for Nuclear Power Generating Stations,” and NRC RG 1.180, “Guidelines for Evaluating Electromagnetic and Radio-Frequency Interference in Safety-Related Instrumentation and Control Systems.” The staff notes that the NRC endorsed IEEE 344-2013 with certain regulatory (staff) positions in NRC RG 1.100, “Seismic Qualification of Electrical and Active Mechanical Equipment and Functional Qualification of Active Mechanical Equipment for Nuclear Power Plants,” Revision 4 (ADAMS Accession No. ML19312C677). Please clarify how ACU will use the IEEE 344 standard, including what specific edition ACU will use, and if it will incorporate the regulatory (staff) positions in NRC RG 1.100, Revision 4, when using the standard. In addition, please clarify which revision of NRC RG 1.180 ACU intended to reference in the PSAR.