From:	Zackary Stone
Sent:	Tuesday, March 21, 2023 11:53 AM
To:	Rusty Towell; Lester Towell; Jordan Robison; Tim Head
Cc:	Edward Helvenston; Richard Rivera; Zackary Stone; Michael Wentzel; Greg Oberson (He/Him); Calvin Cheung; Nicholas Hansing; Kyle Song; Boyce Travis; Alexander Chereskin; Dong Park; Steve Jones; Zachary Gran; Adakou Foli; Kenneth Mott
Subject:	Abilene Christian University - Audit Questions Regarding ACU CP Chapters 1, 5, 8, 9 (Except 9.2 and 9.6), 10, 11, 12, 14-18, and General Topics (Batch 1)
Attachments:	Audit Questions Regarding Chapters 1, 5, 8, 9 (Except 9.2 and 9.6), 10, 11, 12, 14-18, and General Topics (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 5, “Molten Salt Reactor Cooling Systems”, Chapter 8, “Electrical Power Systems”, Chapter 9, “Auxiliary Systems”, Chapter 11, “Radiation Protection Program and Waste Management”, Chapter 12, “Conduct of Operations”, and General Topics. The NRC staff would like to discuss these questions within the scope of the ACU construction permit (CP) application review Audit Plan for Chapters 1, 5, 8, 9 (Except 9.2 and 9.6), 10, 11, 12, 14-18, and General Topics (see audit plan dated 3/2/2023, ML23065A052), 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 Edward, Richard, or I know.

Thank you,

Zackary Stone, Project Manger
Advanced Reactor Licensing Branch 2
Division of Advanced Reactors and Non-Power
Production and Utilization Facilities
Office of Nuclear Reactor Regulation

Docket No. 50-610

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Audit Plan: ML23065A052
General to Entire Preliminary Safety Analysis Report (PSAR)

Item #	Reviewer(s)	Date Sent to ACU (Accession No.)	PSAR Chapter or Topic	Question
PSAR-1	N. Hansing, C. Cheung	3/21/2023	General	The NRC staff notes that there are some inconsistencies with different terminology used throughout the PSAR. The NRC staff requests that ACU provides clarification for the following items and, where applicable, apply these consistently throughout the PSAR. I. The NRC staff notes that there appears to be some instances of the term “access tank,” which the NRC staff infers is early terminology for what is elsewhere referred to as the reactor access vessel (RAV) (PSAR Section 1.2.3.3 and 1.2.3.6). II. The NRC staff notes that stronger, more consistent controls are necessary in discussing the 316H materials used in the MSRR design. The PSAR uses “316H stainless steel,” “SS316H,” and “stainless steel 316” in various places. The NRC staff notes that if these components will satisfy the ASME Code requirements, then the materials used to fabricate them must also meet tighter controls on the material. As a technical example, “316 steel” can have wide variability in carbon content, so tighter controls are often indicated to lessen the potential for stress corrosion cracking. III. The NRC staff notes that loss of normal electric power (LONEP) is used throughout the PSAR and often points to Chapter 13. Upon reviewing PSAR Section 13.1.10, on Loss of Normal Electric Power, the acronym is no longer used.

Chapter 5, Section 5.2, “Fuel System Boundary and Fuel Salt Heat Transport”

Item #	Reviewer(s)	Date Sent to ACU (Accession No.)	PSAR Chapter or Topic	Question
5.2-1	A. Chereskin	3/21/2023	5.2	PSAR Section 4.2.2.2, “Reactivity Control System,” states that the control rods and thimble material is 316H SS. ORNL/TM-2020/1478 Section 5.2, “Fuel System Boundary and Fuel Salt Heat Transport,” states that the fuel salt should limit corrosion of control element surfaces. What data are available and what testing is planned to determine acceptable environmental conditions to limit control rod cladding degradation? How do these data bound anticipated environmental conditions (e.g. fluence, salt impurities, fission products, etc.)?
5.2-2	A. Chereskin	3/21/2023	5.2	How will secondary purity limits be set in order to ensure that corrosion of the heat exchanger (i.e. fuel salt boundary) is minimized in order to maintain consistency with PDCs 4, 14, and 31? What data and/or testing will be used to set purity limits for the intermediate salt?

5.2-3	A. Chereskin	3/21/2023	5.2	Has the potential for cooling and precipitation of fissile material or corrosion products in colder portions of the fuel salt boundary been considered for impacts on reactivity and/or fouling?
5.2-4	K. Song	3/21/2023	5.2	Design Criteria (DC) 30 commits to “appropriate quality standards”. The NRC staff requests that ACU describe what specifications are used to design, fabricate, erect, and test the components in the fuel salt boundary as they relate to the corrosion resistance of the fuel salt and the primary cooling salt.
5.2-5	K. Song	3/21/2023	5.2	In PSAR Section 5.3, ACU mentions tritium generated in the reactor may migrate into the coolant loop through the heat exchanger tube walls; PSAR Section 13.1.2 states tritium generated in the fuel salt can diffuse through the heat exchanger and accumulate in the coolant salt in the secondary cooling loop. PSAR Section 5.2.4 only describes the instrumentation and control system that ensures the required range for safe operation which provides information on how fuel temperature and pressure are monitored. How will fission product activity (tritium, noble gas, iodine, particulate, etc.) in the secondary cooling system be detected or managed?
5.2-6	K. Song	3/21/2023	5.2	PSAR Section 5.2.3 does not explain how the drain tank removes or manages fission gas volume or gaseous fission products when irradiated fuel salt is drained into the drain tank. Does PSAR Section 3.1.2.6, Criterion 61 which states, the fuel storage and handling, radioactive waste, and other systems which may contain radioactivity shall be designed to assure adequate safety under normal and postulated accident conditions, apply to the drain tank?

Chapter 5, Section 5.4, “Fuel Salt Cleanup System”

Item #	**Reviewer(s)**	**Date Sent to ACU (Accession No.)**	**PSAR Chapter or Topic**	**Question**
5.4-1	A. Chereskin	3/21/2023	5.4	The NRC staff notes that the PSAR does not appear to describe how on-line chemistry control will be performed outside of stating that metallic beryllium (Be) can be added to control the redox potential. How will the composition of the salt (including generation of fission products) be monitored and maintained during operations? Additionally, will ACU provide required action times to correct salt chemistry as part of the OL application?
5.4-2	A. Chereskin	3/21/2023	5.4	How will the redox potential be monitored? The PSAR is not clear about how this will be achieved, and the NRC staff are not aware of commercially available electrochemical potential probes for use in fuel salts.

Chapter 5, Section 5.5, "Salt Makeup System"

Item #	Reviewer(s)	Date Sent to ACU (Accession No.)	PSAR Chapter or Topic	Question
5.5-1	B. Travis	3/21/2023	5.5.3	The NRC staff requests that ACU make available the supporting basis (e.g., provide a calculation or analysis) for the statement "Preliminary analyses suggest that radiation heating does not lead to exceeding of safety limits."
5.5-2	K. Song	3/21/2023	5.5	The NRC staff requests that ACU provide a supporting basis for how the fuel salt chemistry changes during the course of operation (critically, power density, temperature, thermal hydraulics behavior, etc.). The NRC staff notes fuel salt chemistry changes are directly related to the plant performance which may include cooling performance, and the NRC staff expects at least a set of estimated ranges for fuel characteristics were used to produce preliminary analyses. I. In PSAR Section 5.5.1 ACU stated a small amount of excess volume in the RAV allows the system to accommodate temperature and pressure fluctuations and the resultant volume changes. What is the expected amount of this volume? In PSAR Section 4.2.1.1, ACU stated 100 liters (L) out of 500L are split between the RAV, reactor pump, heat exchanger, and associated piping. 20% of the 500L appears to be a significant amount, considering the potential uncertainty associated with fuel salt parameters. The NRC staff requests ACU provide a preliminary analysis of the salt volume change and its associated impacts on temperature and pressure. II. How does ACU plan to control or ensure there are no significant changes in fuel salt characteristics such as redox chemistry, etc., to control important fuel characteristics within the analytical assumptions?

Chapter 8, Section 8.2, "Emergency Electrical Power Systems"

Item #	Reviewer(s)	Date Sent to ACU (Accession No.)	PSAR Chapter or Topic	Question
8.2-1	A. Foli	3/21/2023	8.2	The PSAR, Table 3.1-1 "Cross Reference to Preliminary Safety Analysis Report Sections," provides a cross reference of the MSRR-specific DC 17 and 18 to the PSAR Section 8.2.3. The NRC staff notes that the PSAR does not include a section 8.2.3. Please clarify the section in Chapter 8 that is related to DC 17 and 18.

8.2-2	A. Foli	3/21/2023	8.2.1	PSAR Section 8.2.1, "Backup Electrical Power Systems," states, in part "The UPS are sized to provide sufficient power to those selected loads to maintain functionality for at least 24 hours after loss of power to the facility for operational convenience." a. Please explain what is meant by "operational convenience," and provide the technical basis for the 24 hours. Also, explain any impacts if UPS power is not available to the selected loads after 24 hours. b. PSAR Section 13.1.10, "Loss of Normal Electrical Power," states, "If offsite electrical power is lost, all electrically operated systems, including the auxiliary heat removal system, will stop in the MSRR." Clarify if power will remain available to selected electrical loads powered by the UPS in the MSRR if offsite power is lost, as stated in PSAR Section 8.2.1. If so, please consider revising the PSAR Section 13.1.10 with respect to the UPS.

Chapter 9, Section 9.1, "Heating, Ventilation, and Air Conditioning Systems"

Item #	**Reviewer(s)**	**Date Sent to ACU (Accession No.)**	**PSAR Chapter or Topic**	**Question**
9.1-1	S. Jones	3/21/2023	9.1	The NRC staff requests that ACU provide a basis for concluding normal HVAC does not affect post-accident diffusion from confinement (e.g., through development of differential pressure within building). Additionally, the NRC staff would like clarification on whether the ESF actuation of HVAC shutdown is necessary.
9.1-2	S. Jones	3/21/2023	9.1	The NRC staff notes that, based on the information in the PSAR, it is not clear how HVAC for the fuel salt storage enclosure functions. Request ACU provide context in this subject area.
9.1-3	S. Jones	3/21/2023	9.1	PDC 19, control room, states that adequate habitability will be provided for accident conditions. PSAR Table 19.4-1 identified that up to 15kg of Anhydrous Hydrogen Fluoride (HF) could be present in the facility for treatment of the fuel salt. This quantity could exceed habitability limits in RG 1.78 under accident conditions unless suitable protection against transport of the gas to the control room is available. The NRC staff requests clarification on how PDC 19 would be satisfied.

Chapter 9, Section 9.4, "Communication Systems"

Item #	Reviewer(s)	Date Sent to ACU (Accession No.)	PSAR Chapter or Topic	Question
9.4-1	C. Cheung	3/21/2023	9.4	The NRC staff requests that ACU provide additional information/details regarding communication systems specifically: I. PSAR Section 9.4.2 mentions a "cell phone in the control room." Is the cell phone a facility phone or personal device? Are other individuals in the facility carrying cell phones as well and are they facility or personal devices? What controls are in place to ensure the device is not carried off-site? II. Is the intent to satisfy the two-way communication criteria with this cell phone? If not the cell phone, please provide information to address the two-way communication criteria.

Chapter 11, Section 11.1, "Radiation Protection"

Item #	Reviewer(s)	Date Sent to ACU (Accession No.)	PSAR Chapter or Topic	Question
11.1-1	Z. Gran	3/21/2023	11.1.1	The NRC staff notes that PSAR Section 11.1.1, "Radiation Sources," is missing information on the estimated radionuclides released for Noble Gases, Iodine, and any other anticipated radionuclide releases from the MSRR. The NRC staff notes that preliminary estimates on radionuclide releases informs the design for effluent treatment systems and shielding during the early design phases. Early source term estimations provided during the CP phase help to ensure that the design includes ALARA design features to reduce occupational and public exposures ALARA as described 10 CFR 20.1101(b) and 20.1101(d). The NRC staff requests that ACU provide estimates on noble gas generation, collection, decay, and subsequent release of fission product gases. The NRC staff also requests that this include release from the Off-gas system, and any other release from the building ventilation to the environment.
11.1-2	Z. Gran	3/21/2023	11.1.1	PSAR Section 4.4.6 states Ar-41 generation is limited as described in Chapter 11. What is the anticipated generation rate of Ar-41? How does the facility design plan to control Ar-41 generation within the bio-shield areas? What are the anticipated release pathways for Ar-41 to be released to the environment?

11.1-3	Z. Gran	3/21/2023	11.1.1	The NRC staff requests ACU provide information that establishes the basis for the PSAR's stated tritium generation rates of 1.5 Ci per megawatt day. I. What does the MSRR plan to do to control the tritium releases from the facility? II. How does tritium get released from the fuel and cooling salts to the environment?
11.1-4	Z. Gran	3/21/2023	11.1.1	The NRC staff notes that corrosion control appears to be a significant part of the MSRR design. Does ACU have any estimates for the activation of corrosion products within the primary system? How will ACU handle sampling and measurement of corrosion products in the coolant?
11.1-5	Z. Gran	3/21/2023	11.1.1	Does ACU have any initial effluent dose calculations for their facility? Do these estimates assume the release of other radionuclides in addition to tritium?
11.1-6	Z. Gran	3/21/2023	11.1.5	The NRC staff notes that PSAR Section 11.1.5, "Radiation Exposure Control and Dosimetry," seems to be missing information or statements for when information will be provided. Does the applicant plan on providing initial radiation zoning for their facility? A figure is provided in PSAR Section 4.4 for the areas within and around the biological shield, but are there any more areas and maps that can be provided for the initial design?
11.1-7	Z. Gran	3/21/2023	11.1.5	The NRC staff notes that PSAR Section 11.1.5 does not address information about personnel badging or if this topic will be provided in the OL. The NRC staff requests that ACU provide additional information/clarification.
11.1-8	Z. Gran	3/21/2023	11.1.5	The NRC staff notes that radiation monitoring system references can be tied to how systems will have specific monitors to address compliance with the regulations. For example, providing information that there will be radiological effluent monitoring on the plant stack, off-gas system, and area monitoring around the biological shield. The NRC staff requests that ACU provide discussion, at a high level, about the radiation monitoring that will be in place to support monitoring effluent releases and occupational doses. The NRC staff also requests that this include, at a high level, discussion on the radionuclides (tritium, noble gas, iodine, particulate, etc.) that are anticipated to be measured to ensure that the OL will discuss the specific monitoring needs of the facility, and how compliance with the regulations will be achieved using these monitors.

Chapter 11, Section 11.2, "Radioactive Waste Management"

Item #	Reviewer(s)	Date Sent to ACU (Accession No.)	PSAR Chapter or Topic	Question
11.2-1	Z. Gran	3/21/2023	11.2.2	PSAR Section 11.2.2 states, "During normal operations, liquid radioactive wastes are packaged and disposed of using a licensed and qualified low-level radioactive waste disposal vendor. Solid radioactive waste at the MSRR facility is primarily generated by reactor operation, either as a byproduct of experiments, such as material coupons, or from maintenance, such as reactor structural components and tools. Additional radioactive waste is produced by laboratory activities, such as contaminated gloves or pipette tips. Solid radioactive waste is packaged to be stored temporarily onsite in a designated cell in the research bay. Appropriate disposal is organized with the licensing status of the material, its chemical form, and its radioactivity (or lack thereof) defined at the time of disposal. Solid radioactive wastes also include absorbing media such as off-gas charcoal, ion exchange resins, and air filters." Does ACU plan on providing expected waste generation rates for waste generated as a part of normal operations? Does ACU have any information related to the storage area that this waste will be stored prior to disposal?
11.2-2	Z. Gran	3/21/2023	11.2.2	Does ACU's solid waste also include the generation of greater than Class C (GTCC) waste or High-Level Waste (HLW)? Does ACU plan to generate GTTC or HLW because of reactor operations? If GTTC or HLW is anticipated where does ACU plan on storing the waste?
11.2-3	Z. Gran	3/21/2023	11.2.2	In PSAR Section 11.2.2, as part of the waste pathways being generated, ACU states that ion exchange resin waste is produced because of operations. In looking for system information around how this ion exchange resin is generated, the NRC staff could not find any specific information for how or where ion exchange resin would be used in the PSAR. The NRC staff requests that ACU provide information on how the fuel salt coolant is maintained and how the PSAR Section 11.2.2 stated solid waste streams are generated at the MSRR.
11.2-4	Z. Gran	3/21/2023	11.2.2	Does ACU have any plans to reference additional guidance related to the development of an offsite dose calculation manual (ODCM), radiological environmental monitoring program (REMP), or process control program (PCP)?

Chapter 12, Section 12.7, "Emergency Planning"

Item #	Reviewer(s)	Date Sent to ACU (Accession No.)	PSAR Chapter or Topic	Question
12.7-1	K. Mott	3/21/2023	12.7	The NRC staff was not able to find adequate or sufficient information in the PSAR Chapter 12, Appendix 12A, emergency response organization information and descriptions and figures, to address the ANSI/ANS-15.16, Section 3.3, "Organization and Responsibilities," and NUREG-0849, Section 3.0, "Organization and Responsibilities," guidance of: I. The reactor's emergency organization, including augmentation of the reactor staff to provide assistance for coping with the emergency situation, recovery from the emergency, and maintaining emergency preparedness. II. The capability of the emergency organization to function around the clock for a protracted period of time following the initiation of emergencies that have or could have radiological consequences requiring around the clock emergency response. III. A block diagram that illustrates the interrelationship of the facility emergency organization to the total emergency response effort. Interfaces between reactor and other onsite emergency organization groups and offsite local support organizations and agencies should be specified. The NRC staff requests that ACU provide additional information to address these guidance items.
12.7-2	K. Mott	3/21/2023	12.7	PSAR Chapter 12, Appendix 12A, "ACU Research Reactor Facility Preliminary Emergency Plan," Section 12A.2.2, "Emergency Organization Structure," and Section 12A.2.2.1, "Emergency Director (ED)," does not discuss or describe why it is acceptable for a "non-qualified" senior person on the emergency plan contact list to respond and perform the emergency response duties, at the onset of an emergency, of an on-shift senior emergency plan response qualified individual. The NRC staff request that ACU provide additional information.
12.7-3	K. Mott	3/21/2023	12.7	The NRC staff was not able to identify within the ACU PSAR, Chapter 12, Appendix 12A, "ACU Research Reactor Facility Preliminary Emergency Plan," the line of succession for the listed emergency response personnel of Emergency Director and Radiation Safety Officer. The NRC staff requests that ACU provide this information.

12.7-4	K. Mott	3/21/2023	12.7	The NRC staff was not able to identify within the ACU PSAR, Chapter 12, Appendix 12A, "ACU Research Reactor Facility Preliminary Emergency Plan," the identification by title of the individual, with a line of succession, responsible for relating information about the emergency situation to the news media and the public. The NRC staff requests that ACU provide this information.
12.7-5	K. Mott	3/21/2023	12.7	Please provide the definitions of the emergency plan terms "dedicated replacement" (As stated in PSAR Section 12A.2.2.1, "Emergency Director") and "off-hours" (As stated in PSAR Section 12A.2.4, "Staffing").
12.7-6	K. Mott	3/21/2023	12.7	The NRC staff request definitions and/or descriptions to define or describe the times when qualified emergency response individuals would not be present at the MSRR facility and would need to be called in during the onset of an emergency.
12.7-7	K. Mott	3/21/2023	12.7	The NRC staff request clarity of the PSAR Chapter 12, Appendix 12A, "ACU Research Reactor Facility Preliminary Emergency Plan," Section 12A.1.2, "Definitions," definition of "site boundary." Does this term describe the ACU campus site boundary or the MSRR facility site boundary?

Chapter 12, Section 12.9, "Quality Assurance"

Item #	**Reviewer(s)**	**Date Sent to ACU (Accession No.)**	**PSAR Chapter or Topic**	**Question**
12.9-1	D. Park	3/21/2023	12.9	The NRC staff notes that the PSAR does not reference the accepted version of the QAPD Topical Report. Does ACU intend to supplement their PSAR to reference the accepted version?