From: Edward Helvenston
Sent: Friday, December 1, 2023 12:58 PM
To: Rusty Towell; Lester Towell; Benjamin Beasley; Tim Head; Jordan Robison; Alexander Adams; Brazos Fitch
Cc: Richard Rivera; Mohsin Ghazali; Michael Wentzel; Andrew Prinaris; Ian Tseng
Subject: ACU MSRR PSAR Chapter 3 Audit Question
Attachments: Question 3-6.pdf

Dear Dr. Towell,

Attached is a question the NRC staff has prepared for Abilene Christian University (ACU) related to the ACU Preliminary Safety Analysis Report, primarily Chapter 3, "Design of Structures, Systems, and Components." The NRC staff would like to discuss this question 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 in advance to facilitate discussion during an audit meeting. We will add this email, with the question, to public ADAMS. If you have any questions, please let Richard, Mohsin, 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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ACU Chapter 3, Structural Engineering Question

Question 3-6

The regulation 10 CFR 50.34(a)(3)(iii) requires that the PSAR include "[i]nformation relative to materials of construction, general arrangement, and approximate dimensions, sufficient to provide reasonable assurance that the final design will conform to the design bases with adequate margin for safety."

The regulation 10 CFR 50.34(a)(4) requires, in part, that the PSAR include "[a] preliminary analysis and evaluation of the design and performance of structures, systems, and components of the facility with the objective of assessing the risk to public health and safety resulting from operation of the facility and including determination of the margins of safety during normal operations and transient conditions anticipated during the life of the facility, and the adequacy of structures, systems, and components provided for the prevention of accidents and the mitigation of the consequences of accidents."

The regulation 10 CFR 50.34(a)(7) requires, in part, that the PSAR include "[a] description of the quality assurance program to be applied to the design, fabrication, construction, and testing of the structures, systems, and components of the facility."

ORNL/TM-2020/1478 (ML20219A771), Part 1, Section 12.9, states that guidance in ANSI/ANS-15.8-1995, "Quality Assurance Program Requirements for Research Reactors," and NRC Regulatory Guide (RG) 2.5, Revision 1, "Quality Assurance Program Requirements for Research and Test Reactors" (ML093520099), which references ANSI/ANS-15.8-1995, provide an acceptable method for complying with quality assurance program requirements for research reactors.

ACU MSRR PSAR, Revision 1 (ML23319A094), Section 3.1.2, PDC 1, "Quality standards and records," states:

> The safety related SSCs shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed. Where generally recognized codes and standards are used, they shall be identified and evaluated to determine their applicability, adequacy, and sufficiency and shall be supplemented or modified as necessary to assure a quality product in keeping with the required safety function. A quality assurance program consistent with ANS 15.8 shall be established and implemented in order to provide adequate assurance that these SSCs will satisfactorily perform their safety functions. Appropriate records of the design, fabrication, erection, and testing of safety related SSCs shall be maintained by or under the control of ACU (licensee) throughout the life of the MSRR facility.

ANSI/ANS-15.8-1995 (R2018) provides guidance on quality assurance programs for research reactors. It recommends control provisions to ensure that design requirements are correctly incorporated into the facility design and construction.

American Concrete Institute (ACI) 349-13, "Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary," states that it "provides [the] minimum requirements for design and construction of nuclear safety-related concrete structures and structural members for nuclear facilities," where protection against potential radioactive releases is a concern. ACI

349-13 specifically addresses the need to follow these requirements and states that “quality assurance program[s] covering nuclear safety-related structures shall be developed … before starting any work.”

Although not applicable to research reactors such as the MSRR, NRC RG 1.142, Revision 3, “Safety-Related Concrete Structures for Nuclear Power Plants” (ML20141L613), endorses ACI 349-13 and adds conservatisms to the minimum requirements of ACI 349-13 for the design and construction of safety-related concrete nuclear structures. RG 1.142 addresses standards for quality assurance in its Regulatory Position 1.

The PSAR, Revision 1, Section 3.1.1, states that the “[SERC] research bay systems pit is on a deep drilled concrete pier foundation with the drilled piers extending into the shales…”. The PSAR, Revision 1, Section 1.8 states that “the [SERC] research bay floor and subterranean systems pit concrete structure was designed to meet ACI 349-2103 [*sic*].”

On June 20, 2023, ACU provided a written response for audit in response to Audit Question 3.3-1 (ML23086A017) provided by the NRC staff as part of the ACU PSAR Chapter 2 and 3 Audit (ML23065A048), stating that the systems pit was designed to ACI 349-2013 as “informed by Regulatory Guide 1.142, but the guide is not strictly incorporated in the entirety of the design.” The NRC staff notes that ACU’s as-built facility design drawings, provided for audit on May 5, 2023, indicate that ACI 349-13 is the code of reference for the design and construction of the SERC research bay concrete structure. However, it is not fully clear to the staff how the ACI 349-13 requirements were implemented in their entirety in the construction of the safety-related portions of the SERC research bay, MSRR systems pit, and its foundation slab structure including its drilled piers (system), and how the design and construction may have been informed by RG 1.142, particularly with regard to quality assurance. The staff notes that quality assurance provisions throughout all phases of building design and construction are mandated by codes and industry accepted standards. The staff notes that this is because, for example, code designed drilled pier capacities can be significantly affected by quality of their construction, existing subsurface conditions, excavation, reinforcing steel installation, and concrete placement. It is also not clear to the staff whether the safety-related portions of the SERC, including the MSRR systems pit and its foundation slab structure including the drilled piers, may have been designed and constructed applying any other standards and/or specifications relevant to quality assurance that would minimize the inherent risks for defects during construction.

The PSAR, Revision 1, Section 12.9, states that the Quality Assurance Program Description, based on ANSI/ANS-15.8-1995 (R2018), for the design and construction of the MSRR was submitted as a topical report that was approved by the NRC (ML22293B802). However, PSAR Revision 1, Chapter 3, does not appear to include information about a quality assurance program for structural design and construction of safety-related portions of the SERC research bay, MSRR systems pit, and its foundation slab structure including its drilled piers.

A. Discuss how ACU implemented PDC 1 as given in PSAR Revision 1 with respect to structural design and construction of the as built safety-related portions of the SERC research bay, MSRR systems pit, and its foundation slab structure including its drilled piers.

B. Discuss how ACU determined that there was adequate quality assurance to meet PSAR Revision 1 referenced codes and industry-accepted standards at each phase of the structural design and construction of the safety-related portions of the SERC research bay, MSRR systems pit, and its foundation slab structure including the drilled piers. Consider in the discussion whether project specifications for the designed drilled piers included procedures,

materials, and performance criteria that would potentially minimize inherent risks for defects during their construction; the extent of the implemented quality assurance program(s) to cover pier drilled holes, subsequent placing of concrete and reinforcing steel, and follow-up inspection to ensure that the inherent risks of defects associated with construction of the drilled piers were minimized; and whether any post-construction testing was performed to help provide assurance that the MSRR systems pit foundation slab structure including its drilled piers could adequately perform its intended function through the proposed 20-year operating license period and subsequent decommissioning.

C. Clarify how RG 1.142, Revision 3 (or another revision), informed the design and construction of the safety-related portions of the SERC research bay including the MSRR systems pit and its foundation structure including the drilled piers. Specifically, describe what information contained in RG 1.142, Revision 3 (or another revision), was considered in the analysis, design, construction, testing, and evaluation of the ACU multi-use SERC building that includes the research bay, MSRR systems pit, and its foundation structure including its drilled piers.