From: Edward Helvenston
Sent: Wednesday, December 20, 2023 4:29 PM
To: Rusty Towell; Lester Towell; Benjamin Beasley; Tim Head; Jordan Robison; Alexander Adams; Brazos Fitch
Cc: Richard Rivera; Michael Wentzel; Greg Oberson (He/Him); Mohsin Ghazali; Boyce Travis; Alexander Chereskin; Ryann Bass
Subject: ACU MSRR PSAR Section 4.3 and 9.2 Audit Questions (Related to Material Degradation)
Attachments: Material degradation follow up audit questions for ACU (final).pdf

Dear Dr. Towell,

Attached are 2 questions the NRC staff has prepared for Abilene Christian University (ACU) related to the ACU Preliminary Safety Analysis Report, primarily Sections 4.3, “Vessel,” and 9.2, “Handling and Storage of Reactor Fuel.” The NRC staff would like to discuss these questions within the scope of the ACU construction permit (CP) application review Audit Plans for Chapters 4 and 6 and Section 9.6 (see audit plan dated 3/2/2023, ML23065A055), and Section 9.2 and Chapter 13 (see audit plan dated 3/2/2023, ML23065A056), respectively, and I am providing in advance to facilitate discussion during an audit meeting. We will add this email, with the questions, 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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Audit Question 4.3-17

Abilene Christian University (ACU) Molten Salt Research Reactor (MSRR) Preliminary Safety Analysis Report (PSAR), Revision 1 (ML23319A094), Section 4.3.5, states, "Considering that MSRR is a low-pressure system, and that the fuel salt chemistry will be tightly controlled to minimize corrosion susceptibility, we expect that up to 5 [displacements per atom (dpa)] for SS316 components will be acceptable. Further justification for this assumption as well as a more detailed assessment of maximum dpa to any component will be provided in the application for the Operating License."

a. It is not clear to the staff what the term "…will be acceptable" means. For instance, the staff notes that this could mean that ACU does not believe that the cited level of irradiation will have any effect to degrade the material properties. Alternatively, it could mean that ACU understands that the material properties will be degraded, but that ACU considers the design margin to be sufficient to compensate for any loss capacity to accommodate operating conditions. (The staff notes that other explanations may also be possible.) Please clarify the intent of this term.
b. The PSAR states, as quoted above, that this expectation is an "assumption" for which a "more detailed assessment" will be provided later. However, it is not clear to the staff how the word "assumption" should be interpreted, as used here; for instance, if this is based on any evaluation or analysis. Please clarify. The staff also notes that the phrase "more detailed assessment" could imply that some "less detailed" or preliminary assessment has been already performed to support the statement that 5 dpa will be acceptable. Please clarify whether any assessment has been performed, and if so, describe the preliminary assessment and what it entails (e.g., reduction of allowable stress values).
c. The PSAR does not appear to address the effect of irradiation on the ER316 weld metal (see PSAR Section 4.3.3). In addition, references previously identified as part of the ongoing MSRR construction permit application audits (e.g., E. E. Bloom and J. R. Weir Jr., "Effect of Neutron Irradiation on the Ductility of Austenitic Stainless Steel," Nuclear Technology, 16:1, 45-54 (1972); D. Kramer, K.R. Garr, A.G. Pard, and C.G. Rhodes, "Survey of Helium Embrittlement of Various Alloy Types" (1972); and A-A. Tavassoli, C. Picker, and J. Wareing, "Data Collection on the Effect of Irradiation on the Mechanical Properties of Austenitic Stainless Steels and Weld Metals," Effects of Radiation on Materials: 17th International Symposium, ASTM STP 1270, David S. Gelles, Randy K. Nanstad, Arvind S. Kumar, and Edward A. Little, Eds., American Society for Testing and Materials (1996)) do not appear to contain data for effects of irradiation on the weld metal. Clarify whether the PSAR statement relating to SS316 components above also pertains to the weld metal, and describe how any preliminary assessment has accounted for the impact of irradiation on degradation of the weld metal.

Audit Question 9.2-5

ACU MSRR PSAR, Revision 1, Section 9.2.3, states "Welding between SS316H and Alloy 201 will make use of a suitable material as defined by the appropriate code."

a. It is not clear to the staff what is meant by the term "suitable material." Describe the attributes or properties of the material that would make it "suitable." The staff notes that this could include, for instance, resistance to stress-rupture, creep and creep-fatigue, and environmental degradation.

b. It is not clear to the staff what is meant by the term “appropriate code” in the context of this sentence. Describe the judgment or criteria used to determine that the code is “appropriate,” or who makes that determination. The staff presumes that, based on typical engineering practice, necessary conditions for the weld material (i.e., to maintain the attributes that make it “suitable”) would be identified, then a code would be selected that conforms to the establishment or maintenance of those attributes.
c. It is not clear to the staff what is meant by the term “as defined by” in the context of this sentence. The staff notes that this could be understood as the specification of a particular material. Alternatively, this could mean the specification of attributes or properties that the fabricator would then apply to the material selection. It is not clear to staff how ACU has concluded that an “appropriate code” will necessarily “define” a “suitable material,” given that the presumptions underlying this claim do not appear to be discussed. Please explain.