Abilene Christian University Construction Permit Application

Request for Supplemental Information Pertaining to Preliminary Safety Analysis Report (PSAR) Chapter 7: Instrumentation and Control (I&C)

Request for Supplemental Information 1 – Overall I&C Design

Proposed Guidance for Preparing and Reviewing a Molten Salt Non-Power Reactor Application, (ORNL/TM-2020/1478), July 2020, provides guidance for preparing and reviewing a Molten Salt Non-Power Reactor (MSR) Application. Section 7.1, Summary Description, states that the application "should briefly describe the I&C systems of the non-power MSR, including block, logic, and flow diagrams showing major components and subsystems, and connections among them... summarize the technical aspects, safety, philosophy, and objective of the I&C system design and should discuss such factors as redundancy, diversity, and isolation of functions."

Preliminary Safety Analysis Report (PSAR) Chapter 7 Figure 7.2-1 and the related description depicts the architecture of the proposed I&C system. However, the current Figure and description do not provide sufficient detail for the staff to begin the review of the Construction Permit (CP) application.

As a minimum, the Nuclear Regulatory Commission (NRC) staff requests the following supplemental information:

- PSAR Figure 7.2-1 and the design description should provide sufficient detail to construct the I&C system in accordance with design principles (redundancy, diversity, and isolation of functions).
- PSAR Figure 7.2-1 and the design description should identify outputs from the Reactor Protection System (RPS) and Engineered Safety Features Actuation System (ESFAS) to end devices, such as actuation of dropping rods, starting pumps, and opening valves to drain MS tank.
- PSAR Figure 7.2-1 and the design description should provide sufficient detail on critical communication paths. For example:
    - Communication paths should reflect directionality (one-way or two-way) and any isolation devices (power and classification).
    - All communication paths should be identified (e.g., those within each safety-related (SR) system, sensor to RPS, sensor to Reactor Control System (RCS), SR to non safety-related (NSR), between Distributed Control System (DCS) and Trip Circuit, manual trip, and offsite).

Request for Supplemental Information 2 – Protection of Safety Limits

ORNL/TM-2020/1478, July 2020, provides guidance for preparing and reviewing an MSR Application. Section 7.4, Reactor Protection System, states that the RPS is designed to detect the need to place the reactor in a subcritical, safe shutdown condition (scram) when any of the monitored parameters exceeds the limit as determined in the safety analysis report (SAR). Upon detecting the need, the RPS should promptly and automatically place the reactor in a subcritical, safe shutdown condition (scram) and maintain it there. An MSR scram may include a

combination of dumping fuel salt into a drain tank, minimizing reactor fuel flow, or manipulating control elements.

As part of the criteria above, the CP application should provide a system performance analysis of the proposed I&C system to ensure the design criteria and design bases are met and performance requirements of the system are specified, similar to the guidance in ORNL/TM-2020/1478. This should include analysis of any features, aspects, or technical specifications (TS), including surveillance requirements, that may be specific to the reactor and support systems and not identified in the general system requirements. These analyses should be based on postulated credible accidents, transients, and other events that could require RPS intervention, and should include all of the applicable features noted in ORNL/TM-2020/1478, July 2020, Section 7.3 for the RCS. The analyses should include quantitative performance of all scrams, runbacks, interlocks, and ESF initiators.

The staff requests supplemental information on how the objectives of the above paragraphs are met. CP Application Table 7.4-1, Reactor Safety Circuits, describes 10 reactor scram circuits for different conditions to presumably protect safety limits. However, fundamental details needed to begin an evaluation are missing.

- Basic details of many functions are missing or are unclear of what are safety limit protections as credited elsewhere in the PSAR versus operational protections. For example, is the safety channel reactor scram for “Temperature” for a high, low, or both setpoint?
- When the I&C “scrams” the reactor, it is not clear what is meant from an actuation and safety credit/limit standpoint. The application uses various terms including “SCRAM valves,” “system SCRAM,” “Reactor scram,” “Reactor scram on loss of power,” and “protective scram.” Are these terms equivalent?

The staff also requests supplemental information on when an ESF actuation is required by the accident analysis. The description in PSAR Section 7.5 states “[t]he ESFAS is designed to trigger in all credible accident scenarios.” Is ESF actuation initiated under all scenarios examined under PSAR Table 13.2-1?

Request for Supplemental Information 3 – Principal Design Criteria for I&C and Design Standards

A CP application needs to provide principal design criteria (PDCs) that are applicable to the I&C system with respect to its function in safe reactor operation and shutdown, and response to anticipated accidents and analyzed accidents. The application would also reference applicable codes and standards that will be achieved. The PSAR narrative would subsequently describe the key design attributes that will be relied upon to address those PDCs

PSAR Chapter 3 provides PDCs, as applicable to the ACU I&C system. However, the staff requests the following supplemental information that could impact I&C system design:

- PDC 19 states that equipment at appropriate locations outside the control room shall be provided with a design capability for safe shutdown of the reactor, including necessary

instrumentation and controls to maintain the unit in a safe condition and allow for interventions such as fuel loading, inspection, and repair. However, there is no fundamental discussion of this alternate shutdown location in the PSAR.

- PDC 21 states that no single failure results in loss of the protection. However, there is no fundamental discussion of how “Individual components of the RPS can be removed from service for testing without loss of required minimum redundancy” can be accomplished in the PSAR.
- It is not clear if PDC 26 is applicable to RCS. PSAR Section 7.3 does not list PDC 26, while PSAR Section 4.2.2.2 identifies PDC 26, and states “the RPS in conjunction with the RCS provide separate and diverse means for controlling reactivity changes.” The discussion of PDCs and respective function/credit of I&C needs to be consistent throughout the PSAR.