UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D.C. 20555-0001

June 10, 2025

Dr. Walt L. Kirchner, Chairman
Advisory Committee on Reactor Safeguards
U.S. Nuclear Regulatory Commission
Washington, DC 20555

SUBJECT: U.S. NUCLEAR REGULATORY COMMISSION STAFF'S RESPONSE TO THE ADVISORY COMMITTEE ON REACTOR SAFEGUARDS LETTER PERTAINING TO THE SAFETY EVALUATION OF THE TERRESTRIAL USA TOPICAL REPORT, "PRINCIPAL DESIGN CRITERIA FOR IMSR STRUCTURES, SYSTEMS AND COMPONENTS," REVISION C

Dear Chairman Kirchner,

By letter dated April 21, 2025 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML25099A144), the Advisory Committee on Reactor Safeguards (ACRS) reported on its review of the U.S. Nuclear Regulatory Commission (NRC) staff's safety evaluation (SE) of the Terrestrial USA (TEUSA) Topical Report (TR), "Principal Design Criteria [PDC] for IMSR [Integral Molten Salt Reactor] Structures, Systems and Components," Revision C (ML24204A092). The NRC staff briefed the ACRS on its SE on March 20, 2025.

In its letter to the NRC Executive Director for Operations, the ACRS made the following conclusions and recommendations:

1. The PDC proposed by TEUSA for the IMSR reactor have been developed by adapting Advanced (Non-Light Water) Reactor design criteria from NRC guidance; design criteria from draft guidance in the American National Standards Institute (ANSI)/American Nuclear Society (ANS) ANSI/ANS-20.2-2023, "Nuclear Safety Design Criteria and Functional Performance Requirements for Liquid-Fuel Molten Salt Reactor (MSR) Nuclear Power Plants"; and consideration of the unique design features of the IMSR.

2. The use of a negative fuel salt temperature coefficient as the sole means of placing and maintaining the reactor in a "safe state" has not yet been demonstrated for this design. Additionally, the use of a "safe state" as equivalent to "safe shutdown," with long-term criticality as an acceptable post-accident state, is a significant departure from accepted nuclear safety practices. The following have not been justified for this first-of-a-kind reactor:

    a. Absence of an automatic reactor protection system to ensure that the reactor can always be placed in a safe condition.

    b. Lack of a shutdown system with appropriate margin for malfunctions to ensure, that post accident, the reactor can be maintained in a subcritical state, not just a "safe

state." This position is consistent with the ANSI/ANS MSR Standard Criteria 20, "Protection System Functions," and 26, "Reactivity Control and Redundancy."

3. The PDC proposed by TEUSA removed the requirement for a containment cleanup system as found in Criterion 41, "Containment Atmosphere Cleanup," of the draft ANSI/ANS standard. The Committee considers this premature given that the final design is not complete.

4. The PDCs are foundational to the overall safe design of the reactor. Therefore, they should be available in a non-proprietary format to provide transparency to the public.

5. The NRC staff should consider these comments prior to issuing the final SE.

The NRC staff acknowledges the conclusions and recommendations of the ACRS. The SE, as written, provides the technical and regulatory basis to support the NRC staff's determination that the TEUSA PDC are acceptable and addresses the issues identified in the respective recommendations. While this response does not reiterate all the considerations discussed in its SE, the NRC staff emphasizes the following points.

Regarding Recommendation 2, the conceptual design of the IMSR includes multiple means for the reactor to achieve and maintain subcriticality. While there are no automatic actuations, the IMSR relies upon on a reactivity control system as a defense-in-depth measure to remain available for plant operator action which can render the reactor subcritical during normal operation, anticipated operational occurrences (AOOs), and design basis accidents (DBAs).

TEUSA has not described what specific information it, or any other applicant referencing the IMSR design, will provide to demonstrate that the negative fuel salt temperature coefficient can be relied upon as the primary means for reactivity control, only that it intends for the design to allow for this approach in conformance with the PDCs. The NRC staff has determined this is appropriate at this stage of design development and allowable within the regulatory framework. The requirements in Title 10 of the *Code of Federal Regulations* (CFR) 50.43(e), provide the criteria for designs differing significantly from light-water reactors (LWRs) that were licensed before 1997, or use simplified, inherent, passive, or other innovative means to accomplish their safety functions. These include a combination of analysis, appropriate test programs, experience, sufficient data, and testing of a prototype plant. The limitations and conditions imposed in the SE outline what must be addressed in a licensing application. The NRC staff will evaluate the information provided during a future license application review and ultimately make a conformance finding for 10 CFR 50.43(e).

The NRC staff acknowledges that determining a safe state, rather than a safe shutdown, as the acceptable transient end state represents a departure from the approach used for previously licensed LWRs. This is permissible when it is justified by a safety analysis and, as needed, regulatory exemptions that the NRC staff has found to be appropriate. For instance, the SE highlights an exemption permitting this for the NuScale LWR design (ML20205L408). The NRC staff's limitation and condition 4 articulates that TEUSA, or any other applicant referencing the IMSR design, will need to demonstrate the attributes of the IMSR that satisfy this approach. Regulatory implementation would be handled through the appropriate process. Further, the 10 CFR Part 53 rulemaking, if approved, will allow this without an exemption.

Regarding Recommendation 3 involving the containment cleanup system, the applicant states that the IMSR400 design does not employ such a system because there would be no fuel salt

discharge from the reactor to the containment. Hydrogen and other non-condensable gases are not expected to be generated following postulated accidents. Therefore, any release of radionuclides from the reactor vessel into containment areas is expected to be negligible.

At this early stage of engagement, the NRC staff has not yet completed its review of the IMSR400 containment design including the capabilities and its related systems. However, once a license application is submitted, the NRC staff will perform an in-depth review to ensure that containment integrity and other safety functions are maintained during normal operation and under postulated accident conditions. If TEUSA later determines that a containment cleanup system is needed, it would be expected that TEUSA submit updated PDCs and supporting information to reflect the change, ensuring regulatory alignment and maintaining the integrity of the design basis.

With respect to Recommendation 4 concerning the proprietary nature of the PDCs, the NRC staff agrees that PDCs are typically not withheld from public disclosure. However, PDC topical reports can be proprietary, whereas PDCs in preliminary and final safety analysis reports are not proprietary, even if they were once proprietary in a previous submittal. The proprietary determination of this topical report was made consistent with NRC regulations and policies.

Sincerely,

Signed by King, Michael
on 06/10/25

Michael F. King, (Acting) Director
Office of Nuclear Reactor Regulation

Project No. 99902076

cc: Chairman Wright
Commissioner Hanson
Commissioner Caputo
Commissioner Crowell
Commissioner
Marzano
SECY

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