UNITED STATES
NUCLEAR REGULATORY COMMISSION
ADVISORY COMMITTEE ON REACTOR SAFEGUARDS
WASHINGTON, DC 20555 - 0001

February 13, 2020

MEMORANDUM TO: Matthew W. Sunseri, Chairman
Advisory Committee on Reactor Safeguards

FROM: Joy Rempe, Member **/RA/**
NuScale Subcommittee
Advisory Committee on Reactor Safeguards

SUBJECT: PROPOSED RECOMMENDATION FOR ACRS REVIEW OF NUSCALE POWER, LLC, DESIGN CERTIFICATION APPLICATION – SAFETY EVALUATION WITH NO OPEN ITEMS FOR CHAPTER 9, "AUXILIARY SYSTEMS"

In response to the Committee's request, I reviewed the NRC staff's advanced safety evaluation with no open items for Chapter 9, "Auxiliary Systems," dated December 10, 2019 (ML19170A126). This memorandum provides my recommended course of action concerning further review of this chapter of the design certification application (DCA) and the associated staff safety evaluation report (SER).

SER Phase 4 Summary

Chapter 9 of the SER documents the staff review of Revision 3 of Chapter 9, "Auxiliary Systems," of the NuScale DCA, Part 2, Tier 2 "Final Safety Analysis Report". The auxiliary systems include: fuel storage and handling systems; water systems; process auxiliaries; heating, ventilation, and air conditioning systems; and systems required for fire protection, communication, and lighting.

The staff Phase 4 SER underwent substantial changes from their Phase 2 SER. Rather than discuss the individual open items identified in their Phase 2 SER, the staff evaluated the adequacy of the information submitted on the docket, including information in the Revision 3 of the DCA, to make their determination that all open items have been satisfactorily closed in their Phase 4 SER. In addition, the Phase 4 SER identified confirmatory items that have not yet been incorporated but deemed acceptable.

Concerns from ACRS Phase 3 Letter Report

In our Phase 3 letter report on Chapters 9, 10, 11, 12, and 16, we provided the following conclusion:

> There are potentially risk-significant items in the NuScale design that are not yet fully developed. For these items, requirements should be included in the DCA to ensure that the licensed NuScale plant will perform as credited.

We observed that the NuScale design has several unique features and processes where additional design information and requirements should be provided in the DCA for the combined license applicant. Examples identified in our Chapter 9 review included: human actions associated with reactor building crane operations, motion limiters and interlocks associated with manipulations of all cranes, and ultimate heat sink water sampling (the ultimate heat sink includes the spent fuel pool) to ensure adequate boron concentration throughout the pool. We also emphasized the importance of functions provided by the chemical and volume control systems installed in each NuScale module, noting that its ability to inject boron involves a circuitous path that requires successful operation of multiple valves in series.

NRC Staff Response to ACRS Letter Report

The staff response to our initial conclusion indicated that they expected further enhancement of the DCA descriptions in risk-significant areas, consistent with the objectives of the design certification process.

Open Items from Phase 3 Requiring Further ACRS Review

The Phase 4 SER did not address all the concerns raised in our interim letter. However, the staff adopted an approach in which they directly evaluated information on the docket rather than discussing the individual Chapter 9 open items and their resolution. It is difficult to identify and evaluate the bases for several differences that exist between the Phase 2 and Phase 4 SERs and discern whether there are open items that require additional ACRS review. The following examples illustrate this issue.

- The Phase 2 SER indicated that staff was tracking resolution of RAI 9328, Question 9.1.2-36 and Open Item 9.1.2-1 requiring modification of the Pool Leakage Detection System design description to indicate that the system is capable of detecting pool leakage and preventing degradation of safety-related concrete structure of the pools and the spread of contamination. The Phase 4 SER indicates that the Radioactive Waste Drain System provides alarms when the leakage rate reaches a predetermined level. The Phase 4 SER does not provide sufficient information to discern the basis for this “predetermined level.”

- There is no justification for why different values are specified in the Phase 4 and Phase 2 SERs. Examples of interest include:

  - Section 9.1.3.4.4 states that the pool cooling systems (the Spent Fuel Pool Cooling System and the Reactor Pool Cooling System) are designed to maintain the pool bulk temperature below 110°F. The Phase 2 SER specifies a temperature of 140°F.

- Section 9.1.3.4.4 of the Phase 4 SER indicates that the minimum safe water level for the ultimate heat sink (with respect to ECCS operation) is 55 ft from the floor of the pool. The Phase 2 SER stated that this minimum height was 3 meters above the top of fuel.
- Section 9.1.3.4.4 states that the ultimate heat sink is designed to maintain sufficient inventory of cooling water, such that no makeup water is needed for at least 30 days. The Phase 2 SER states, "... such that no makeup water is needed for several weeks."
- The Phase 4 SER indicates that the design specific review standard Section 9.1.3.III.3.D recommends that the cooling system should retain at least half of its full heat removal capacity assuming a single active failure. The Phase 2 SER stated that the Standard Review Plan Section 9.1.3.III.1.D recommends that the minimum heat removal capacity of the forced-circulation cooling system be greater than 0.3 percent of the reactor rated thermal power.

- The discussion about the ability of the Chilled Water System (CHWS) to meet GDC 44 /PDC 44 differs significantly in the Phase 4 and Phase 2 SERs. In Section 9.2.8 of the Phase 4 SER, the staff provided:

  > Standard Review Plan Section 9.2.7 provides guidance for addressing GDC 44 requirements that are applicable to safety-related SSCs in the CHWS of an active PWR plant. The applicant has requested an exemption for certain electrical power provisions of GDC 44 and proposed an alternate PDC 44 to address cooling water requirements. In the NuScale passive design, the CHWS does not support any safety-related SSCs under normal and accident conditions, and the entire system is classified as not safety-related. Additionally, there is no importance to safety function associated with providing cooling water. The staff determined that since CHWS performs no important to safety cooling water functions, the provisions of PDC 44 do not apply to this system.

  In their Phase 2 SER, the staff concluded that the CHWS complied with the requirements of the GDC 44.

- The staff evaluation of the adequacy of the process sampling system differs significantly in the Phase 4 and Phase 2 SERs. In the Phase 2 SER, the requirements for GDC 13 and 14 include post-accident sampling; whereas in the Phase 4 SER, the requirement for post-accident sampling has been removed because of a NuScale exemption request. In the Phase 4 SER, the staff documents that the leakage control and detection requirements of 10 CFR 50.34(f)(2)(xxvi) and related clarifications of Item III.D.1.1 in NUREG-0737 are not met and remaining programmatic requirements of 10 CFR 50.34(f)(2)(xxvi) will be fulfilled at the combined license stage by including applicable portions of the systems in a leakage control program that provides for periodic leak testing and measures to minimize the leakage from the systems. Post-accident sampling requirements, which were put in place after the TMI-2 accident, provide plant operators indicators of core damage. Typically, sampling indicators include noble gas, radioiodine, cesium, and nonvolatile isotope concentrations, hydrogen in the containment atmosphere, and dissolved gases, chlorides, and boron concentrations. In their Phase 4 evaluation, the staff acknowledges that NuScale design considerations eliminate the need for such requirements. For example, the staff allows the NuScale hydrogen and oxygen monitoring system to replace the need for any post-accident sampling.

Furthermore, the staff has evaluated that unisolating containment could eventually impact the control room habitability. In addition, when the containment isolation valves are opened, the containment atmosphere fills the Containment Evacuation System volume; from then on, the sampling system may no longer be representative of the containment atmosphere.

As we observed in our December 20, 2019, letter summarizing our findings from our Source Term Area of Focus Review, the risk tradeoff between unisolating the NuScale containment to enable long-term hydrogen and oxygen monitoring should be weighed against alternatives that may not require such monitoring, and we are continuing to explore this issue in our NuScale review. For example, our NuScale review will explore the risk tradeoff between unisolating the NuScale containment to enable long-term hydrogen and oxygen monitoring against other alternatives.

Open Items from Phase 3 Requiring Further ACRS Review

The remaining Chapter 9 items identified in our interim letter are being investigated in our focus area reviews and in our discussion of Chapter 15. Because of the approach used to develop the Phase 4 SER, additional information is needed to determine that no additional ACRS review is required for Chapter 9. Namely, a list of risk-significant Chapter 9 SER changes and the bases for such changes should be developed.

Recommendation

The Phase 4 SER did not address all the concerns raised in our interim Chapter 9 letter. I recommend that we request additional information regarding the changes incorporated into the staff Phase 4 SER. As noted above, a list of substantive Chapter 9 SER changes and the bases for such changes should be provided by the staff.

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Package No.: ML20044D595
Accession No: **ML20044D648** **Publicly Available Y** **Sensitive N**
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