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

March 17, 2023

Ms. Carrie Fosaaen
Senior Director, Regulatory Affairs
NuScale Power, LLC
1100 NE Circle Boulevard, Suite 200
Corvallis, OR 97330

SUBJECT: ACCEPTANCE REVIEW OF THE NUSCALE US460 STANDARD DESIGN APPROVAL APPLICATION (DOCKET NOS. 05200050 and 99902078)

Dear Ms. Fosaaen:

By letter dated November 21, 2022, NuScale Power, LLC (NuScale) informed the U.S. Nuclear Regulatory Commission (NRC) of its intent to submit, in stages, a standard design approval (SDA) application for a US460 Small Modular Reactor (SMR) to the NRC by December 31, 2022 (available in the NRC Agencywide Documents Access and Management System (ADAMS) at Accession No. ML22325A349). NuScale listed its intended individual electronic submissions in that letter. By letter dated December 31, 2022 (electronically submitted on January 1, 2023), NuScale transmitted the last of its listed submittals. NuScale submitted the SDA application pursuant to the requirements of Title 10 of the *Code of Federal Regulations*, Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants." The documents that were submitted as part of NuScale's SDA application can be found in ADAMS at ML22339A066.

In accordance with 10 CFR 2.101, 10 CFR 52.136 and 52.137, the NRC staff performed an acceptance review to determine if the SDA application for the NuScale US460 SMR contains sufficient technical information in scope and depth to allow the NRC staff to conduct a detailed technical review of the application and complete it on a predictable schedule. In doing so, the NRC staff focused its review on risk and safety significant items as well as novel design features. The staff applied available risk insights and plans to continue applying these insights along with risk-informed decision-making principles during its review of the SDA application. We encourage NuScale to continue to maintain open and frequent communication of updated risk information with the NRC staff throughout the staff's review of the application.

Based on its review to date, the NRC staff has identified technical sufficiency issues in the SDA application related to density wave oscillation (DWO), with impacts on some parts of the SDA application Part 2, Final Safety Analysis Report (FSAR) Chapters 3, 5, 6, 15 and 19, and the following associated licensing topical reports (LTRs): (1) TR-0516-49422, "Loss-of-Coolant Accident [LOCA] Evaluation Model," Rev. 3 (ML23008A002); (2) TR-0516-49416, "Non-Loss-of-Coolant Accident Analysis Methodology," Rev. 4 (ML23005A305); (3) TR-124587, "Extended Passive Cooling and Reactivity Control Methodology," Rev. 0 (ML23005A308); and (4) TR-131981, "Methodology for the Determination of the Onset of Density Wave Oscillations (DWO)," Rev. 0 (ML22364A332). As a result, the NRC staff has concluded that supplemental information on this topic is required before the NRC staff could accept the SDA application for docketing and conduct a detailed technical review of all aspects of the application.

As stated in the NRC staff's letter to NuScale, dated May 11, 2022 (ML22124A209), the four LTRs referenced above include substantive and complex information that is integral to the

technical sufficiency of the SDA application and were required to be submitted before the NRC staff could accept the SDA application for review. Accordingly, in accordance with 10 CFR 2.101, the application will be considered tendered but not docketed until the supplemental information listed in the enclosed Request for Supplemental Information (RSI) is submitted and the SDA application is found to be acceptable for detailed technical review by the staff.

The NRC staff has outlined, at a high-level, the missing DWO-related information in Enclosure 1 to this letter. This information is required to be submitted as soon as practicable, but no later than September 15, 2023, which is 6-months after the issuance of this letter, in order for the SDA application to be accepted for detailed technical review. The staff plans to conduct an audit on the RSI as stated in Enclosure 1.

Further, in Enclosure 2 to this letter, the staff has identified "focus" items that are needed to support a reliable schedule development (FISDs). These are items where additional information is needed to ensure the development of an accurate and responsive schedule and resource estimates.

Additionally, the NRC staff has identified five High Impact Technical Issues (HITIs) related to the SDA application that will likely require increased attention by both NuScale and the staff to ensure timely completion of the staff's safety review. The staff will apply risk insights and risk-informed decision-making principles to determine the necessary level of detail needed to resolve each of these issues. These topics include the following:

- Design and classification of the non-safety-related augmented direct current (DC) power system (EDAS) and the reliance on EDAS in the FSAR Chapter 15 safety analyses.
- LOCA break spectrum due to the addition of flow restricting venturis in the emergency core cooling system (ECCS) valves.
- Topical reports and other critical references that will be needed by the staff to be "Incorporated by Reference (IBR)" into the application. These references are needed to be incorporated for the staff to rely thereon in reaching a safety finding.
- A containment vessel material change for the lower containment vessel (CNV) shell above the reactor pressure vessel (RPV) flange elevation, the lower flange, upper flange, upper shell, and top head (i.e., a change from low alloy steel to martensitic stainless steel).
- A lower RPV material change (i.e., a change from low alloy steel to austenitic stainless steel).

During the NRC staff's acceptance review of the NuScale SDA application, the staff and NuScale have had extensive discussions on various issues. NuScale had undertaken optimization and streamlining of its application content to include only the information that NuScale believed was necessary for NRC to make its regulatory findings. However, during the staff's acceptance review process, it was noted that there are now many areas where the level of detail in the SDA application is not sufficient to provide the bases for NuScale's stated conclusions. In addition, the staff noted that the SDA application includes a significant number of design changes from the NuScale certified design (ML20247J564) and the DWO phenomena, which was not resolved by the certified design. There appear to be some areas where it is not yet clear if sufficient experimental test data is available to support the method or analysis provided in the SDA application. The staff will engage with NuScale during the review to understand the details of testing and analyses that support the passive and innovative safety features of this design and whether there is reasonable assurance that they will perform their

intended safety functions. If during the course of its review, the staff finds that additional testing or analysis is needed for these features, it will then be critical that the timelines and resources for those tests be promptly identified so that the staff can re-assess any potential impact to the schedule for its review of the SDA application.

The NRC staff plans to continue its interactions with NuScale, as necessary, while NuScale completes and updates its SDA application and applicable LTRs. NuScale and NRC have discussed and agreed that the staff will commence a technical review of parts of the SDA application that are not impacted by the RSI for DWO (i.e., all parts of the application, except some parts of the SDA application Part 2, FSAR Chapters 3, 5, 6, 15 and 19, and some parts of the four LTRs that are impacted by the RSI). Please note, however, that the staff's determination to commence this partial review of portions of the application does not signify a determination that the NRC staff will accept the SDA application for docketing and does not preclude the staff from requesting further information during its review of the SDA application. In addition, the staff notes that its commencement of this partial review is undertaken at the applicant's risk, in that there is no assurance that the SDA application will be accepted for docketing and review or, if the application is accepted, that it will be approved upon completion of the staff's review.

Following NuScale's submittal of its completed responses to the RSI for DWO (Enclosure 1), the staff will determine whether to accept the application for docketing. Additionally, taking into consideration the information provided on the FISDs (Enclosure 2), the staff will establish a detailed review schedule (which may be longer or shorter than the staff's generic review schedule) and resource estimate.

If you have any questions, I can be reached at (301) 415-8013 or by email at Getachew.Tesfaye@ nrc.gov.

Sincerely,

/RA /

Getachew Tesfaye, Senior Project Manager
New Reactor Licensing Branch
Division of New and Renewed Licenses
Office of Nuclear Reactor Regulation

Docket No: 05200050

Enclosures:
1. NuScale Standard Design Approval Application Request for Supplemental Information (RSI)
2. NuScale Standard Design Approval Application Focus Items supporting reliable Schedule Development (FISDs)

cc w/encls: DC NuScale Power LLC Listserv

SUBJECT: ACCEPTANCE REVIEW OF THE NUSCALE US460 STANDARD DESIGN APPROVAL APPLICATION (DOCKET NOS. 05200050 and 99902078) DATED: MARCH 17, 2023

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OFFICE	NRR/DNRL/NRLB: PM	NRR/DNRL/NRLB:LA	NRR/DNRL/NRLB: BC
NAME	GTesfaye*	SGreen*	MDudek
DATE	2/26/2023	02/27/2023	03/04/2023
OFFICE	NRR/DSS: D	NRR/DNRL: D	NRR/DNRL/NRLB: PM
NAME	JDonoghue	BSmith	GTesfaye
DATE	03/14/2023	03/13/2023	03/17/2023

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Enclosure 1: NuScale Standard Design Approval Application Request for Supplemental Information (RSI)

The NRC staff's acceptance review of the NuScale Standard Design Approval Application (SDAA) was performed to determine if there is sufficient technical information in scope and depth to allow the NRC staff to complete its detailed technical review. The acceptance review is also intended to identify any readily apparent deficiencies in the application's characterization of applicable regulatory requirements or the licensing basis of the plant.

Section 52.137 of Title 10 of the *Code of Federal Regulations* (10 CFR) Subpart E, Contents of applications; technical information, (a)(2) requires "A description and analysis of the SSCs [structures, systems, and components] of the facility, with emphasis upon performance requirements, the bases, with technical justification, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished…" and (b) requires that "An application for approval of a standard design, which differs significantly from the light-water reactor designs of plants that have been licensed and in commercial operation before April 18, 1989, or uses simplified, inherent, passive, or other innovative means to accomplish its safety functions, must meet the requirements of 10 CFR 50.43(e)."

Based on the above regulatory requirements, the NRC staff has concluded that NuScale's SDA application does not contain sufficient technical information related to the evaluation of potential density wave oscillations (DWO) and other flow instability phenomena on steam generator operation at various expected operating and design basis event conditions. DWOs or other instability phenomena can lead to a disruption in the flow of coolant through the steam generators and may challenge steam generator tube integrity. These may have adverse impacts on fission product barriers which could result in a release of radioactive material and potential offsite doses.

More specifically, the NRC staff has identified information that is necessary to enable the staff to conduct a detailed technical review of the SDAA and related licensing topical reports (LTRs) (i.e., Chapters 3, 5, 6, 15 and 19, and associated LTRs: (1) TR-0516-49422, "Loss-of-Coolant Accident [LOCA] Evaluation Model," Rev. 3 (ML23008A002); (2) TR-0516-49416, "Non-Loss-of-Coolant Accident Analysis Methodology," Rev. 4 (ML23005A305); (3) TR-124587, "Extended Passive Cooling and Reactivity Control Methodology," Rev. 0 (ML23005A308); and (4) TR-131981, "Methodology for the Determination of the Onset of Density Wave Oscillations (DWO)," Rev. 0 (ML22364A332)). In particular, the NRC staff has identified that the NuScale SDAA and applicable LTRs are missing sufficient information in the following areas:

- Scope of the methodology for calculating DWO[1] and the full applicability range, conditions, and figures of merit;
- Testing that was performed including test results and test data;
- Comparisons of test data to the analysis models and justification for the applicability of the models for evaluation of the SDAA design; and
- Evaluations of the effect of DWO on safety system performance during all operating conditions including normal operation, LOCAs,[2] Non-LOCAs,[3] and extended passive cooling.[4]

1 TR-131981, "Methodology for the Determination of the Onset of Density Wave Oscillations (DWO)," Rev. 0
2 TR-0516-49422, "Loss-of-Coolant Accident [LOCA] Evaluation Model," Rev. 3
3 TR-0516-49416, "Non-Loss-of-Coolant Accident [Non-LOCA] Analysis Methodology," Rev. 4
4 TR-124587, "Extended Passive Cooling and Reactivity Control Methodology," Rev. 0

Enclosure 2: NuScale Standard Design Approval Application Focus Items supporting reliable Schedule Development (FISDs)

The NRC staff has identified Focus Items supporting reliable Schedule Development (FISDs) where significant information is needed to ensure the development of accurate schedule and resource estimates. While some of these issues were addressed during the staff's review of the design certification application, the SDA's increased thermal power and proposed design changes may impact important risk and safety significant attributes such as safety margins in the SDA. These items are as follows:

1. Decay Heat Removal System (DHRS) design basis*
2. Chemical and Volume Control System (CVCS) compliance with General Design Criteria (GDC) 4*
3. Combustible gas accumulation in the Reactor Coolant System (RCS)*
4. Credit for operator actions to mitigate event sequences *
5. Credit for non-safety-related Main Steam Isolation Valve (MSIV)
6. Testing and validation of Extended Passive Cooling and Reactivity Control Methodology LTR models
7. ECCS Supplemental Boron (ESB) description*
8. Long-Term Cooling information
9. Subchannel information for correlations to predict critical heat flux*
10. Fluence Technical Report neutron source calculation method
11. Computational Fluid Dynamics information for the non-LOCA LTR
12. Treatment of new ECCS Low Riser Water-Level Sensor
13. Evaluation from 72 hours up to 7 days following a design basis event to ensure that nonsafety-related structures, systems, and components are not relied on for long-term safety.*
14. Critical heat flux correlation
15. Digital information and data to support staff review
16. Turbine Missiles barrier analysis*
17. Design and qualification of reactor vessel internal components*, including helical coil steam generator(SG)*, SG tube inlet flow restrictors (IFRs), and completion of Comprehensive Vibration Assessment Program (CVAP)

* These items were also identified during the readiness assessment (ML22305A518).