September 8, 2016

Mr. Thomas Bergman
Vice President, Regulatory Affairs
NuScale Power, LLC
1100 Circle Boulevard, Suite 200
Corvallis, OR 97330

SUBJECT: RESPONSE TO NUSCALE GAP ANALYSIS SUMMARY REPORT FOR REACTOR SYSTEMS REACTIVITY CONTROL SYSTEMS, ADDRESSING GAP 11, GENERAL DESIGN CRITERION 27 (PROJ 0769)

Dear Mr. Bergman:

In a July 31, 2014, letter, NuScale Power, LLC (NuScale) submitted to the U.S. Nuclear Regulatory Commission (NRC) staff the "Gap Analysis Summary Report," Revision 1 (Report). The stated purpose of the Report was to facilitate discussion on specific regulations listed in Table 3-1 of the Report that warrant further consideration with regard to their applicability or relevancy to the NuScale power plant design and to solicit feedback on the utility of the document. The Report provided the results of a regulatory gap analysis performed by NuScale as part of pre-application activities. This analysis identified potential regulatory issues (gaps) by comparing current NRC requirements and guidance to the characteristics of the NuScale power plant design. Current NRC requirements are set forth in Title 10 of the *Code of Federal Regulations* (CFR), Parts 1 through 199, and current NRC guidance is set forth in NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition" (SRP) and documents referenced in the SRP. The Report highlights the unique features of the NuScale reactor design that may present novel applications of existing NRC requirements and guidance. NuScale stated in the Report that the intent of highlighting these issues was to determine the appropriate regulatory process to be used to address the "regulatory gaps" identified in the Report.

As you are aware, the NRC staff and NuScale representatives have had a number of engagements to further the NRC staff's understanding of the NuScale design. The NRC staff acknowledges that it is important that the key regulatory process issues be addressed before NuScale submits a design certification application to facilitate the development of a complete application.

The NRC staff understands that in some cases NuScale believes that regulations are not applicable to NuScale based on the design as described in the Report. In addition, other NRC regulations by their terms may or may not apply to the NuScale design. For example, a regulation that applies only to boiling water reactors would not apply to the NuScale design, which is a pressurized water reactor. In general, a regulation that requires, for example, a certain function or design attribute will apply to the NuScale design. The mere fact that the NuScale design employs a novel means to perform a required function or include a required design attribute does not necessarily trigger a need for an exemption, nor is the novel means for compliance a reason why the regulation would not apply.

Should NuScale take the position that a regulation is not applicable to its design, it is incumbent upon NuScale to provide a technical basis to explain why the requirements in the regulation do not apply to the design. To the extent NuScale shows that the requirement is not necessary for the NuScale design to meet the underlying purpose of the regulation, that showing would appear to address the "special circumstances" required to justify an exemption from the regulation under 10 CFR § 50.12. This important documentation must be provided as part of the design certification application in chapter one, so that the NRC staff can determine whether or not the regulation is applicable.

There is one enclosure to this letter which responds to Report Table 3-1, Gap 11, "Combined Reactivity Control Systems Capability," regarding 10 CFR Part 50, Appendix, A, "General Design Criteria," (GDC) 27, "Combined reactivity control systems capability."

This letter supplements the recently sent reactor systems gap letter (Agencywide Document Access and Management System Accession No. ML15265A252). The NRC staff will address the rest of Gap 11, which relates to GDC 26, "Reactivity control system redundancy and capability," by a separate letter. This response is based on information in the Report and obtained during various NuScale meetings, presentations, and from submitted information. However, as you are aware, there is no licensing action before the NRC staff in these areas and, therefore, the NRC staff cannot perform its detailed technical review on all technical and regulatory issues at this time to determine if the design will be acceptable in its present form.

Should you have any questions, please contact Mr. Gregory Cranston, Senior Project Manager for the NuScale design certification at (301) 415-0546 or via email at gregory.cranston@nrc.gov.

Sincerely,

/RA/

Frank Akstulewicz, Director
Division of New Reactor Licensing
Office of New Reactors

Project No.: PROJ0769

Enclosure: NRC Response to NuScale's Position on Gap 11, "Combined Reactivity Control Systems Capability," (GDC 27 only)

cc: DC NuScale Power LLC Listserv

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NRC Response to NuScale's Position on Gap 11, "Combined Reactivity Control Systems Capability," (GDC 27 only)

Summary of NuScale Power, LLC (NuScale) Position:

In its "Gap Analysis Summary Report," (Report) Revision 1, Table 3-1, Gap 11, NuScale indicated that the it will request concurrence from the U.S. Nuclear Regulatory Commission (NRC) staff stating that the NuScale design as proposed would be compliance with Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, Appendix A, "General Design Criteria," (GDC) 27, "Combined reactivity control systems capability," and that an exemption would not be required.

NuScale's position is that its emergency core cooling system (ECCS) does not perform, or need to perform, a poison addition safety function or provide any makeup function. NuScale interprets GDC 27 as allowing ECCS poison addition to be credited within the combined reactivity control capability, but not requiring it. NuScale states that the reactivity control systems associated with the NuScale design meet the requirements of GDC 27 with regard to reliably controlling reactivity changes and maintaining the capability of cooling the core without poison addition by the ECCS. Therefore, NuScale does not believe an exemption is needed regarding GDC 27.

NRC Staff Response:

The NRC staff began addressing the Gap 11 technical area, as described in the July 2014 Report, some time ago based on the staff's understanding that the NuScale safety-related control rod system alone was adequate to maintain the reactor subcritical in the event of a design basis accident (DBA), with appropriate margin for stuck rods. The NRC staff was in the process of responding to NuScale based on that understanding. However, in March of 2016, the staff learned from NuScale that reactor subcriticality cannot be maintained with the control rod system alone, assuming the most reactive rod fully withdrawn, in certain design basis event scenarios. The fact that the reactor would return to critical and reach a post trip power level was not described in the Report. This new information is important and called into question the staff's prior understanding of how NuScale will meet GDC 27. The staff's investigation of this phenomenon resulted in a public meeting with NuScale on May 10, 2016, in which NuScale provided information to the staff to the effect that, under certain circumstances, the reactor would be unable to maintain subcriticality in the long term, with appropriate margin for stuck rods, following a design basis event. On May 19, 2016 the staff held a closed meeting with NuScale on reactivity control and NuScale subsequently provided responses in the NuScale electronic reading room to staff questions in this area.

GDC 27 states the following:

> "The reactivity control systems shall be designed to have a combined capability, in conjunction with poison addition by the emergency core cooling system, of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained."

Based on the staff's current understanding of the NuScale design, the NuScale design would not appear to meet the GDC 27 requirement of "reliably controlling reactivity changes to assure that under postulated accident conditions, and with appropriate margin for stuck rods, the capability to cool the core is maintained." The staff acknowledges that currently licensed pressurized water reactors (PWR) would not remain subcritical in the short term (i.e., within about the first few minutes of accident initiation) for some accident scenarios (e.g., main steam line break). Nonetheless, beyond the short term, all PWRs remain subcritical indefinitely, and the NRC has not licensed a power reactor that did not remain subcritical beyond the short term following an accident through the use of safety related structures, systems and components (SSC). GDC 27 allows credit for boron addition from the ECCS, and PWRs maintain subcriticality indefinitely beyond the short term by taking credit for such boron addition. In regard to system safety class, the reactivity control systems function together with the heat removal systems to perform the functions described in the 10 CFR 50.2 definition of safety-related SSCs and, therefore, those reactivity control and cooling systems are safety related.

The Commission addressed similar topics in the context of the policy expressed in SECY-94-084, "Policy and Technical Issues Associated with the Regulatory Treatment of Non-Safety Systems in Passive Plant Designs," dated March 28, 1994, in regard to heat removal by passive systems. In the June 30, 1994, Staff Requirements Memorandum (SRM) on SECY 94-084, the Commission approved the concept of reliance on systems that are not safety-related as support to the safety-related passive heat removal systems after 72 hours from the onset of a DBA. As stated in SECY 94-084, "[t]he staff believes that [conditions other than cold shutdown] may constitute a safe shutdown state as long as reactor subcriticality, decay heat removal, and radioactive materials containment are properly maintained for the long term."

In view of the foregoing, the staff's current view is that GDC 27 requires that the reactor be reliably controlled and that the reactor achieve and maintain a safe, stable condition, including subcriticality beyond the short term, using only safety related equipment following a postulated accident with margin for stuck rods. Both current, approved PWRs, using safety related control rods and safety-related soluble boron addition, and boiling water reactors (BWR), using safety related control rods, reliably control reactivity and achieve a safe, stable condition with appropriate margin for stuck rods.

Because the currently available information indicates that the NuScale design does not ensure that the reactor would remain subcritical beyond the short term, it would appear that NuScale would need to request an exemption from GDC 27, with respect to re-criticality. The staff has also concluded that consideration of such an exemption entails policy issues under the purview of the Commission and that such an exemption would warrant Commission consideration and direction prior to the staff supporting the exemption. The staff will proceed and engage the Commission on the policy issues; however, the staff does not believe these policy issues will likely be resolved prior to the anticipated submittal date for the application.

The staff will await NuScale's feedback regarding potential technical solutions to address the GDC 27 issue. As always, the staff will remain receptive to additional information provided by NuScale that may demonstrate alternative options or perspectives on these topics.