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

February 24, 2016

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

SUBJECT: RESPONSE TO GAP ANALYSIS SUMMARY REPORT FOR AUXILIARY FEEDWATER AND ANTICIPATED TRANSIENTS WITHOUT SCRAM REGULATORY ISSUES

Dear Mr. Bergman:

In a letter dated July 31, 2014, 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 warranted further consideration with regard 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*, 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 staff 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 that have focused on specific areas identified in the Report 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 or may not be technically relevant to NuScale based on their design as described in the Report. Should NuScale take the position that a regulation is not applicable or not technically relevant 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 or why the regulation is not technically relevant 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 so that the NRC staff can determine whether or not the regulation is applicable or technically relevant.

There are three enclosures to this letter. Enclosure 1 responds to the Report's Table 3-1, Gap 1, "Evaluation and Design Review of AFW System"; Enclosure 2 responds to the Report's Table 3-1, Gap 3, "Auxiliary Feedwater System Actuation and Flow Indication"; and Enclosure 3 responds to the Report's Table 3-1, Gap 9, "Reduction of Risk from ATWS Events."

These responses are based on information in the Report and from various NuScale meetings, presentations and 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 application at (301) 415-0546 or via email at Gregory.Cranston@nrc.gov.

Sincerely,

/RA/ MDelligatti for

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

Project No.: PROJ0769

Enclosures:
1. NRC Response to NuScale's position on Gap 1, "Evaluation and Design Review of AFW System"
2. NRC Response to NuScale's position on Gap 3, "Auxiliary Feedwater System Actuation and Flow Indication"
3. NRC Response to NuScale's position on Gap 9, "Reduction of Risk from ATWS Events"

cc: DC NuScale Power LLC Listserv

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U.S. Nuclear Regulatory Commission Staff's Response
to NuScale's Position on Gap 1, "Evaluation and Design Review of AFW System"

Summary of NuScale's Position: In its "Gap Analysis Summary Report," Revision 1, Table 3-1, Gap 1, submitted to the U.S. Nuclear Regulatory Commission (NRC) staff, NuScale states that Title 10 of the *Code of Federal Regulations* (10 CFR) Section 50.34(f)(1)(ii), "Contents of applications; technical information, . . . *Additional TMI-related requirements*," is not technically relevant to NuScale since NuScale does not have an auxiliary feedwater (AFW) system. NuScale states that the decay heat removal (DHR) system fulfills some of the functions of an AFW system at a typical light-water, pressurized water reactor (PWR). NuScale believes that the underlying purpose of the requirement for an AFW system, as stated in 10 CFR 50.34(f)(1)(ii), is related to the design basis functions for those AFW systems intended to prevent and mitigate small-break loss-of-coolant accidents (LOCAs). NuScale states that its DHR design and plant response to LOCAs differs from typical PWR designs. Therefore, NuScale states that in addition to this requirement "being literally not applicable," NuScale considers the underlying purpose of this requirement also not applicable to NuScale.

NuScale states that the DHR system is a safety-related system and is designed to be appropriately reliable, but 10 CFR 50.34(f)(1)(ii) is not considered applicable to the NuScale DHR system. NuScale stated that, because the literal language and intent of 10 CFR 50.34(f)(1)(ii) do not apply, the requirement is not technically relevant to the NuScale design. Therefore, NuScale believes an exemption would be unnecessary because 10 CFR 50.34(f)(1)(ii) only applies to the "technically relevant" portions of the Three Mile Island requirements.

NRC Staff's Response: Section 50.34(f) states that each applicant for a design certification under 10 CFR Part 52 shall demonstrate compliance with the technically relevant portions of the requirements in 10 CFR 50.34(f)(1). Section 50.34(f)(1)(ii) requires the applicant to perform an evaluation of the proposed AFW system. As noted by 10 CFR 50.34(f)(1)(ii)(A)-(C), the evaluation of the AFW system is to assess the design and reliability of the present or proposed auxiliary feedwater system design due to the complexity of the designs which involves valve alignment, pump operation and the need for alternating current power. The AFW system serves to remove decay heat in both small break LOCA and non-LOCA transients. Based on the information currently available to the staff, the NuScale DHR system, which removes decay heat during non-LOCA transients only, appears significantly simplified in that only valve alignment is needed to activate the system which can occur with or without direct current power. Once the valves align the DHR system performs its function passively via natural circulation. As such, the NuScale DHR system appears significantly different than the AFW systems generally implemented in existing large light pressurized water reactors in the U.S., and the NRC staff agrees that 10 CFR 50.34(f)(1)(ii) may not be technically relevant to the NuScale design. If so, an exemption may not be required. The NRC staff will remain receptive to additional information provided by NuScale.

Having said the above, the NRC staff does not now have before it a formal application that describes in detail the current NuScale design or a complete justification for the approach described above. Therefore, the NRC staff has not been able to engage with NuScale in a manner that would permit the detailed review necessary to finally resolve this issue.

The NRC staff has also concluded that this regulatory question is within the purview of the NRC staff to determine and, therefore, does not rise to the level of a policy issue that warrants Commission involvement.

U.S. Nuclear Regulatory Commission Staff's
Response to NuScale's Position on Gap 3, "Auxiliary Feedwater
System Actuation and Flow Indication"

Summary of NuScale's Position: In its "Gap Analysis Summary Report," Revision 1, Table 3-1, Gap 3, NuScale indicated that it will seek NRC staff concurrence that the auxiliary feedwater (AFW) actuation and indication specified by 10 CFR 50.34(f)(2)(xii), "Contents of applications; technical information, . . . *Additional TMI-related requirements,*" is not technically relevant to the NuScale decay heat removal (DHR) system and no exemption is needed.

NuScale states that their plant design does not have an AFW system as would be found at a typical light-water, pressurized water reactor (PWR). Also, while the DHR system performs some of the functions of an AFW system at a typical PWR, NuScale states that the DHR system is designed for NuScale-specific transients and system characteristics, and its actuation and indication is designed accordingly. Specifically, with regard to the portion of this requirement specifying control room flow indication, the DHR system operation involves passive, natural circulation flow, with flow characteristics that inherently vary with system conditions, which makes the DHR system flow a less useful measurement. For the NuScale design, NuScale states that their control room indication for system parameters other than DHR system flows are more appropriate to ensure operators have the information necessary to adequately monitor DHR system operation and reactor core cooling. These parameters include DHR system pressure, DHR passive condenser level, DHR system valve position indication, and reactor coolant system pressure and temperature.

Therefore, NuScale states that they do not consider 10 CFR 50.34(f)(2)(xii) requirements for automatic and manual AFW system initiation and AFW flow indication in the control room applicable to the NuScale DHR system. Consequently, because NuScale believes the literal language and intent of 10 CFR 50.34(f)(1)(ii) does not apply to its design, NuScale believes that the requirement is not technically relevant to the NuScale design and an exemption would be unnecessary because it only applies to the "technically relevant" portions of the Three Mile Island requirements.

NRC Staff's Response: Section 50.34(f) states that each applicant for a design certification under 10 CFR Part 52 shall demonstrate compliance with the technically relevant portions of the requirements in 10 CFR 50.34(f)(2). Section 50.34(f)(2)(xii) requires the applicant provide automatic and manual AFW system initiation, and provide AFW system flow indication in the control room. Based on the information currently available to the NRC Staff, the NRC staff agrees that 10 CFR 50.34(f)(2)(xii) may not be technically relevant to the NuScale design and if so, no exemption would be required, as the design would not include an AFW system (see NRC staff response to Gap 1). A more detailed technical explanation will need to be provided in the application. The staff also recognizes other regulatory requirements may address the DHR system initiation and indication. For instance, 10 CFR 50.55a(h)(3), which incorporates by reference Institute of Electrical and Electronics Engineers Standard 603-1991, requires means to automatically initiate and control all protective actions (Clause 6.1) and display information to provide accurate, complete, and timely information pertinent to safety system status (Clause 5.8.2). In addition, 10 CFR Part 50, Appendix A, "General Design Criterion (GDC) 13," requires instrumentation to monitor variables and systems that could affect the integrity of the reactor core. The NRC staff understands NuScale currently classifies the DHR system as a safety-related system which would require it to comply with 10 CFR 50.55a(h)(3) and GDC 13. The NRC staff will remain receptive to additional information provided by NuScale.

Having said the above, the NRC staff does not now have before it a formal application that describes in detail the current NuScale design or a complete justification for the approach described above. Therefore, the NRC staff has not been able to engage with NuScale in a manner that would permit the detailed review necessary to finally resolve this issue.

The NRC staff concluded this regulatory question is within the purview of the NRC staff to determine and, therefore, does not rise to the level of a policy issue that warrants Commission involvement.

U.S. Nuclear Regulatory Commission Staff's Response
to NuScale's Position on Gap 9, "Reduction of Risk from ATWS Events"

Summary of NuScale Position: In its "Gap Analysis Summary Report," Revision 1, Table 3-1, Gap 9, NuScale indicated that it will seek NRC staff concurrence that the underlying purpose of 10 CFR § 50.62(c)(1), "Requirements for reduction of risk from anticipated transients without scram (ATWS) events for light-water-cooled nuclear power plants," is satisfied by reliance on diversity within the NuScale module protection system (MPS) to reduce the risk associated with ATWS events.

Additionally, NuScale is seeking an exemption from the portion of 10 CFR 50.62(c)(1) that requires diverse capability to trip the turbine because the underlying purpose of the ATWS rule is met by an alternative approach consistent with 10 CFR 50.12(a)(2)(ii), "Specific exemptions."

NuScale will seek concurrence from the NRC staff that the portion of 10 CFR 50.62(c)(1) requiring diverse actuation of the auxiliary feedwater (AFW) system is not applicable to the NuScale design because the NuScale design does not include an AFW system.

NRC Staff Response: The staff notes that NuScale is crediting design diversity within their MPS system to meet the diversity requirement of 10 CFR 50.62(c)(1) to trip the turbine. This is inconsistent with 10 CFR 50.62(c)(1), which states:

> [e]ach pressurized water reactor must have equipment from sensor output to final actuation device, that is diverse from the reactor trip system, to automatically initiate the auxiliary (or emergency) feedwater system and initiate a turbine trip under conditions indicative of an ATWS. This equipment must be designed to perform its function in a reliable manner and be independent (from sensor output to the final actuation device) from the existing reactor trip system.

Specifically, the NRC staff notes that the equipment to initiate a turbine trip is not independent from the NuScale reactor trip system (i.e., the MPS) since the NuScale design provides diversity within the reactor trip system. Based on the text of 10 CFR 50.62(c)(1), and the NRC staff's current understanding of the NuScale design, the NRC staff's perspective is that NuScale's design approach to incorporate diversity within the MPS could be an acceptable means to address common-cause failure of the MPS. For instance, based on the currently available information, the MPS would contain four redundant, independent divisions to perform the turbine trip function. Two of the divisions will be diverse from the other two divisions by using different logic processing equipment. If the MPS satisfies all GDC requirements for redundancy, diversity, and independence, and also includes a reliable capability to trip the turbine that is diverse and independent from the portions of the MPS credited to satisfy the GDC, the design might comply with 10 CFR 50.62(c)(1), in which case an exemption in regard to the turbine trip function would be unnecessary. Common cause failure of other components from sensor output to the final actuation device would need to be addressed in the design certification application. As described in Gap 1, the NuScale design does not include an AFW or emergency feedwater system (EFW), but rather utilizes the DHR system for the functions AFW or EFW would perform, as assumed in 10 CFR 50.62(c).

At a minimum, the lack of separate equipment from the MPS to trip the turbine (in the absence of compliance as described above) and the lack of an AFW system would require exemptions from 10 CFR 50.62(c)(1). At this time, the NRC staff has minimal information describing the NuScale design and analysis as it relates to ATWS. For example, although it appears the DHR system would perform the function of AFW/EFW in the event of an ATWS, it is unclear to the NRC staff how the DHR system would be actuated and what other plant systems, if any, may be needed to demonstrate adequate safety in the event of an ATWS for the NuScale design. Therefore, other exemptions from 10 CFR 50.62 may be necessary or desired by NuScale. The NRC staff will remain receptive to additional information provided by NuScale.

As indicated above, the NRC staff does not now have before it a formal application that describes in detail the current NuScale design or a complete justification for the approach described above. Therefore, the NRC staff has not been able to engage with NuScale in a manner that would permit the detailed review necessary to finally resolve this issue.

The NRC staff concluded this regulatory question is within the purview of the NRC staff to determine and, therefore, does not rise to the level of a policy issue that warrants Commission involvement.