



June 07, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 18 (eRAI No. 8778) on the NuScale Design Certification Application

REFERENCES: 1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 18 (eRAI No. 8778)," dated May 05, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 18 (eRAI No. 8778)," dated July 05, 2017
3. NuScale Power, LLC Supplemental Response to "NRC Request for Additional Information No. 18 (eRAI No. 8778)" dated November 16, 2017

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) supplemental response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's supplemental response to the following RAI Question from NRC eRAI No. 8778:

- 04.02-1

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments

If you have any questions on this response, please contact Paul Infanger at 541-452-7351 or at pinfanger@nuscalepower.com.

Sincerely,

A handwritten signature in black ink, appearing to read "Zackary W. Rad".

Zackary W. Rad

Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Omid Tabatabai, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A

Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8778



Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8778

Response to Request for Additional Information Docket No. 52-048

eRAI No.: 8778

Date of RAI Issue: 05/05/2017

NRC Question No.: 04.02-1

In accordance with 10 CFR 50 Appendix A GDC 10, "Reactor design," the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

To meet the requirements of GDC 10, as it relates to SAFDLs for normal operation, including AOOs, fuel system damage criteria should be included for all known damage mechanisms. Fuel damage criteria should assure that fuel system dimensions remain within operational tolerances and that functional capabilities are not reduced below those assumed in the safety analysis. When applicable, the fuel damage criteria should consider high burnup effects based on irradiated material properties data. Complete damage criteria should address, in part, that the cumulative number of strain fatigue cycles on the structural members of the fuel assembly (e.g. grids, guide tubes, thimbles, fuel rods, control rods, etc.) should be significantly less than the design fatigue lifetime, which is based on appropriate data and includes a safety factor of 2 on stress amplitude or a safety factor of 20 on the number of cycles; otherwise, other proposed limits must be justified.

The staff notes that in TR-0816-51127, Revision 1, "NuFuel-HTP2 Fuel and Control Rod Assembly Designs," the applicant has considered load following in the fuel rod fatigue analysis (see Table 4 -3), but no discussion is provided to justify the current thermal-mechanical models for load follow use. For example, it is unclear to the staff from the information provided if the fission gas release model was designed to model load following and was approved for this purpose. However, in FSAR Tier 2, Section 4.3.2.4.16, the applicant states that while power maneuvering operations within the capabilities of the rod control system are anticipated, continuous load following operation using the control rod assemblies is not anticipated. Based on the docketed information, the staff is unable to determine if the NuScale DCA requests approval for load following; therefore, the staff cannot determine if the fuel and control rod assembly designs have been adequately designed to incorporate fatigue effects from load following such that the requirements of GDC 10 are met.

1. Does NuScale request NRC approval for load follow (i.e. power maneuvering) use for the NuScale SMR design?
 - a. If no, the staff requests the applicant to clearly identify in FSAR Section 4.2 that load



following will not be used.

- b. If yes, the staff requests the applicant to clearly identify in FSAR Section 4.2 that load following will be used, describe the type of load following (e.g. daily load follow), and to justify the thermal–mechanical models and analysis for the NuScale fuel design for the requested load follow use. Additionally, the impacts of load follow operation on control rod nuclear lifetime (FSAR section 4.3) and initialization of postulated accident analyses (FSAR Section 15) should be addressed in their respective sections.
 - c. If the applicant intends to leave the choice for load following operations up to the COL holder, the staff requests the applicant to include an appropriate COL information item that discusses the information needed to be submitted by the COL applicant for NRC review.
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NuScale Response:

On November 16, 2017 NuScale Power, LLC provided a supplemental response to Request for Additional Information (RAI) 04.02-1 (eRAI No. 8778) in NuScale Letter Number RAIO-1117-57232 (ML17320A984). The following response further supplements the November 16, 2017 letter by adding a Combined License (COL) item to Final Safety Analysis Report (FSAR) Section 4.2.

The COL Item states:

A COL applicant that references the NuScale Power Plant design certification and wishes to utilize non-baseload operations will provide justification for the fuel performance codes and methods corresponding to the desired operation.

This COL Item is also added to FSAR Table 1.8-2, Combined License Information Items. All of the other FSAR changes submitted to the NRC in the November 16, 2017 RAI response letter remain unchanged.

Impact on DCA:

FSAR Sections 1.8 and 4.2 have been revised as described in the response above and as shown in the markup provided in this response.

RAI 01-61, RAI 02.04.13-1, RAI 03.04.02-1, RAI 03.04.02-2, RAI 03.04.02-3, RAI 03.05.01.04-1, RAI 03.05.02-2, RAI 03.06.02-15, RAI 03.06.03-11, RAI 03.07.01-2, RAI 03.07.01-3, RAI 03.07.02-8, RAI 03.07.02-12, RAI 03.08.04-23S1, RAI 03.08.05-14S1, RAI 03.09.02-15, RAI 03.09.02-48, RAI 03.09.02-67, RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-6, RAI 03.09.06-16, RAI 03.09.06-16S1, RAI 03.09.06-27, RAI 03.11-8, RAI 03.11-14, RAI 03.11-14S1, RAI 03.11-18, RAI 03.13-3, RAI 04.02-152, RAI 05.02.05-8, RAI 05.04.02.01-13, RAI 05.04.02.01-14, RAI 06.04-1, RAI 09.01.02-4, RAI 09.01.05-3, RAI 09.01.05-6, RAI 09.03.02-3, RAI 09.03.02-4, RAI 09.03.02-5, RAI 09.03.02-6, RAI 09.03.02-8, RAI 10.02-1, RAI 10.02-2, RAI 10.02-3, RAI 10.02.03-1, RAI 10.02.03-2, RAI 10.03.06-1, RAI 10.03.06-5, RAI 10.04.06-1, RAI 10.04.06-2, RAI 10.04.06-3, RAI 10.04.10-2, RAI 13.01.01-1, RAI 13.01.01-1S1, RAI 13.02.02-1, RAI 13.03-4, RAI 13.05.02.01-2, RAI 13.05.02.01-2S1, RAI 13.05.02.01-3, RAI 13.05.02.01-3S1, RAI 13.05.02.01-4, RAI 13.05.02.01-4S1, RAI 13.05.02.01-4S1, RAI 14.02-7, RAI 19-31, RAI 19-31S1, RAI 19-38

Table 1.8-2: Combined License Information Items

Item No.	Description of COL Information Item	Section
COL Item 1.1-1:	A COL applicant that references the NuScale Power Plant design certification will identify the site-specific plant location.	1.1
COL Item 1.1-2:	A COL applicant that references the NuScale Power Plant design certification will provide the schedules for completion of construction and commercial operation of each power module.	1.1
COL Item 1.4-1:	A COL applicant that references the NuScale Power Plant design certification will identify the prime agents or contractors for the construction and operation of the nuclear power plant.	1.4
COL Item 1.7-1:	A COL applicant that references the NuScale Power Plant design certification will provide site-specific diagrams and legends, as applicable.	1.7
COL Item 1.7-2:	A COL applicant that references the NuScale Power Plant design certification will list additional site-specific piping and instrumentation diagrams and legends as applicable.	1.7
COL Item 1.8-1:	A COL applicant that references the NuScale Power Plant design certification will provide a list of departures from the certified design.	1.8
COL Item 1.9-1:	A COL applicant that references the NuScale Power Plant design certification will review and address the conformance with regulatory criteria in effect six months before the docket date of the COL application for the site-specific portions and operational aspects of the facility design.	1.9
COL Item 1.10-1:	A COL applicant that references the NuScale Power Plant design certification will evaluate the potential hazards resulting from construction activities of the new NuScale facility to the safety-related and risk significant structures, systems, and components of existing operating unit(s) and newly constructed operating unit(s) at the co-located site per 10 CFR 52.79(a)(31). The evaluation will include identification of management and administrative controls necessary to eliminate or mitigate the consequences of potential hazards and demonstration that the limiting conditions for operation of an operating unit would not be exceeded. This COL item is not applicable for construction activities (build-out of the facility) at an individual NuScale Power Plant with operating NuScale Power Modules.	1.10
COL Item 2.0-1:	A COL applicant that references the NuScale Power Plant design certification will demonstrate that site-specific characteristics are bounded by the design parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the COL applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its combined license application.	2.0
COL Item 2.1-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site geographic and demographic characteristics.	2.1
COL Item 2.2-1:	A COL applicant that references the NuScale Power Plant design certification will describe nearby industrial, transportation, and military facilities. The COL applicant will demonstrate that the design is acceptable for each potential accident, or provide site-specific design alternatives.	2.2
COL Item 2.3-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3
COL Item 2.4-1:	A COL applicant that references the NuScale Power Plant design certification will investigate and describe the site-specific hydrologic characteristics for Section 2.4.1 through Section 2.4.14, as applicable except Section 2.4.8 and Section 2.4.10.	2.4
COL Item 2.5-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site-specific geology, seismology, and geotechnical characteristics for Section 2.5.1 through Section 2.5.5, below.	2.5
COL Item 3.2-1:	A COL applicant that references the NuScale Power Plant design certification will update Table 3.2-1 to identify the classification of site-specific structures, systems, and components.	3.2

Table 1.8-2: Combined License Information Items (Continued)

Item No.	Description of COL Information Item	Section
COL Item 3.10-2:	A COL applicant that references the NuScale Power Plant design certification will develop the equipment qualification database and ensure equipment qualification record files are created for the structures, systems, and components that require seismic qualification.	3.10
COL Item 3.10-3:	A COL applicant that references the NuScale Power Plant design certification will submit an implementation program for Nuclear Regulatory Commission approval prior to the installation of the equipment that requires seismic qualification.	3.10
COL Item 3.11-1:	A COL applicant that references the NuScale Power Plant design certification will submit a full description of the environmental qualification program and milestones and completion dates for program implementation.	3.11
COL Item 3.11-2:	A COL applicant that references the NuScale Power Plant design certification will develop the equipment qualification database and ensure equipment qualification record files are created for the structures, systems, and components that require environmental qualification.	3.11
COL Item 3.11-3:	A COL applicant that references the NuScale Power Plant design certification will implement an equipment qualification operational program that incorporates the aspects in Section 3.11-7 specific to the environmental qualification of mechanical and electrical equipment.	3.11
COL Item 3.11-4:	A COL applicant that references the NuScale Power Plant design certification will ensure the environmental qualification program cited in COL Item 3.11-1 includes a description of how equipment located in harsh conditions will be monitored and managed throughout plant life. This description will include methodology to ensure equipment located in harsh environments will remain qualified if the measured dose is higher than the calculated dose.	3.11
COL Item 3.12-1:	A COL applicant that references the NuScale Power Plant design certification may use a piping analysis program other than the programs listed in Section 3.12.4.1; however, the applicant will implement a benchmark program using the models for the NuScale Power Plant standard design.	3.12
COL Item 3.12-2:	A COL applicant that references the NuScale Power Plant design certification will confirm that the site-specific seismic response is within the parameters specified in Section 3.7. A COL applicant may perform a site-specific piping stress analysis in accordance with the methodologies described in this section, as appropriate.	3.12
COL Item 3.13-1:	A COL applicant that references the NuScale Power Plant design certification will provide an in-service inspection program for ASME Class 1, 2 and 3 threaded fasteners. The program will identify the applicable edition and addenda of ASME Boiler and Pressure Vessel Code, Section XI and ensure compliance with 10 CFR 50.55a.	3.13
COL Item 4.2-1	A COL applicant that references the NuScale Power Plant design certification and wishes to utilize non-baseload operations will provide justification for the fuel performance codes and methods corresponding to the desired operation.	4.2
COL Item 5.2-1:	Not used	
COL Item 5.2-2:	A COL applicant that references the NuScale Power Plant design certification will provide a certified Overpressure Protection Report in compliance with American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section III, Subarticles NB-7200 and NC-7200 to demonstrate the reactor coolant pressure boundary and secondary system are designed with adequate overpressure protection features, including low temperature overpressure protection features.	5.2
COL Item 5.2-3:	Not Used	5.2
COL Item 5.2-4:	A COL applicant that references the NuScale Power Plant design certification will develop and implement a Strategic Water Chemistry Plan. The Strategic Water Chemistry Plan will provide the optimization strategy for maintaining primary coolant chemistry and provide the basis for requirements for sampling and analysis frequencies, and corrective actions for control of primary water chemistry consistent with the latest version of the Electric Power Research Institute Pressurized Water Reactor Primary Water Chemistry Guidelines.	5.2

4.2 Fuel System Design

The NuScale Power, LLC fuel system is designed to satisfy the following criteria:

- The fuel system will not be damaged as a result of normal operation and anticipated operational occurrences (AOOs) [General Design Criterion (GDC) 10].
- Fuel damage during postulated accidents will not be severe enough to prevent control rod insertion when it is required [Principal Design Criteria (PDC) 27].
- Core coolability is always maintained, even after postulated accidents (PDC 35 and 10 CFR 50.34).
- The number of fuel rod failures is not underestimated for postulated accidents (10 CFR 100).

The NuScale fuel assembly design features are similar to those of existing pressurized water reactor (PWR) 17x17 fuel assemblies. The only significant difference between the NuScale fuel design and other PWRs is the shorter fuel assembly length. The effect of the length on fuel design analyses is tested in full-scale fuel assembly tests and analyzed using NRC-approved methods. The results summarized in this section show that the NuScale fuel design, with its shorter length, demonstrates acceptable fuel performance consistent with the other proven features that make up the NuScale fuel design. Because this is a new application of a proven fuel design, post-irradiation inspection will be performed during the initial three cycles of operation of the first licensed module, as described in Section 4.2.4.6.

Section 4.2.1 presents the design bases for the cladding, fuel material, fuel rod performance, spacer grids, fuel assembly structural design, control rod assembly (CRA), and the surveillance programs that will confirm the adequacy of the design. Section 4.2.2 provides a detailed description of the fuel, the components that comprise the fuel assembly, and the CRA. Section 4.2.3 provides the detailed design evaluation that demonstrates how the design bases are met. Section 4.2.4 discusses fuel and CRA testing and inspection.

RAI 04.02-1S1

The fuel system design evaluations include a fuel rod cladding fatigue analysis that considers power maneuvering in Table 4-3 of Reference 4.2-1. Additional analysis will be performed as part of the detailed design of the cycle-specific core using the methodologies described in Technical Specification 5.6.3. This analysis will include the effects of power maneuvers on CRA absorber depletion, fission gas release, fuel melt limits, transient strain limits, fuel rod components (other than cladding), and guide tube and CRA wear.

RAI 04.02-1S2

COL Item 4.2-1: [A COL applicant that references the NuScale Power Plant design certification and wishes to utilize non-baseload operations will provide justification for the fuel performance codes and methods corresponding to the desired operation.](#)

4.2.1 Design Bases

The fuel rod and fuel assembly design bases establish the performance requirements and damage criteria to satisfy the criteria in Section 4.2 of the NUREG-0800 Standard Review Plan.