



October 19, 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. 134 (eRAI No. 8934) on the NuScale Design Certification Application

- REFERENCES:**
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 134 (eRAI No. 8934)," dated August 05, 2017
 2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 134 (eRAI No.8934)," dated December 21, 2017
 3. NuScale Power, LLC Supplemental Response to NRC "Request for Additional Information No. 134 (eRAI No. 8934)," dated May 7, 2017
 4. NuScale Power, LLC Supplemental Response to NRC "Request for Additional Information No. 134 (eRAI No. 8934)," dated June 29, 2018
 5. NuScale Power, LLC Supplemental Response to NRC "Request for Additional Information No. 134 (eRAI No. 8934)," dated August 27, 2018
 6. NuScale Power, LLC Supplemental Response to NRC "Request for Additional Information No. 134 (eRAI No. 8934)," dated August 28, 2018

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. 8934:

- 03.07.02-15

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 Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC



RAIO-1018-62201

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
Marieliz Vera, NRC, OWFN-8G9A

Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI
No. 8934



Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8934

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

eRAI No.: 8934

Date of RAI Issue: 08/05/2017

NRC Question No.: 03.07.02-15

10 CFR 50 Appendix S requires that the safety functions of structures, systems, and components (SSCs) must be assured during and after the vibratory ground motion associated with the Safe Shutdown Earthquake (SSE) through design, testing, or qualification methods.

- a. On Page 3.7-30 of the FSAR, Eq. 3.7-14 represents the conversion of ANSYS FSI-based hydrodynamic pressure to SASSI2010 equivalent static pressure. In this process, ANSYS used the CSDRS-compatible Capitola time history input on a fixed-base model and SASSI2010 used the CSDRS-compatible Capitola time history input for Soil Types 7, 8, and 11, respectively. The applicant is requested to explain why FSI correction factors for the case of CSDRS-HF-compatible time history input for Soil Type 9 (hard rock) are not considered. Since the boundary conditions for an ANSYS fixed-base model and a SASSI model with Soil Type 9 (hard rock) are similar, it appears that FSI- correction factors developed for Soil Type 9 may be more representative.

- b. On Page 3.7-31 of the FSAR, the fourth paragraph, “The pressure at the bottom of the pool due to ...”, describes an approach the applicant took in taking into account the FSI effects on vertical water pressure estimation. The applicant is requested to provide a technical basis for the approach taken.



NuScale Response:

During a public meeting on October 2, 2018, the NRC requested NuScale submit a supplemental response to this RAI.

The staff noted that the development of the fluid-structure interaction (FSI) correction factor for the RXB pool is based on SASSI analyses using Soil Types 7, 8 and 11 and ANSYS analyses of a fixed-base model. For the DCA, NuScale obtained a bounding correction pressure of 4.2 psi (and the corresponding 0.28g gravity loading) added to the SAP2000 RXB model to account for the FSI effects. For a future COLA that references the NuScale DCD, the FSI correction value will depend on the site-specific design parameters.

COL Item 3.7-12 has been added to FSAR Section 3.7.2 and FSAR Table 1.8-2:

COL Item 3.7-12: A COL applicant that references the NuScale Power Plant design certification will perform an analysis that uses site-specific soil and time histories to confirm the adequacy of the fluid-structure interaction correction factor.

Impact on DCA:

The DCA has 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 03.04.01-4, 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 03.06.02-6, RAI 03.06.02-15, RAI 03.06.03-11, RAI 03.07.01-2, RAI 03.07.01-3, RAI 03.07.02-6S1, RAI 03.07.02-6S2, RAI 03.07.02-8, RAI 03.07.02-12, RAI 03.07.02-15S5, RAI 03.08.04-3S2, RAI 03.08.04-23S1, RAI 03.08.04-23S2, RAI 03.08.05-14S1, RAI 03.09.02-15, RAI 03.09.02-48, RAI 03.09.02-67, RAI 03.09.02-69, 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 04.02-1S2, RAI 05.02.03-19, RAI 05.02.05-8, RAI 05.04.02.01-13, RAI 05.04.02.01-14, RAI 06.02.06-22, RAI 06.02.06-23, RAI 06.04-1, RAI 09.01.01-20, 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 11.01-2, RAI 12.03-5S51, 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 14.02-7, RAI 19-31, RAI 19-31S1, RAI 19-38, RAI 20.01-13

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, 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

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

Item No.	Description of COL Information Item	Section
COL Item 3.7-11:	A COL applicant that references the NuScale Power Plant design certification will perform a site-specific analysis that, if applicable, assesses the effects of soil separation. The COL applicant will confirm that the in-structure response spectra in the soil separation cases are bounded by the in-structure response spectra shown in FSAR Figure 3.7.2-107 through Figure 3.7.2-122.	3.7
<u>COL Item 3.7-12:</u>	<u>A COL applicant that references the NuScale Power Plant design certification will perform an analysis that uses site-specific soil and time histories to confirm the adequacy of the fluid-structure interaction correction factor.</u>	<u>3.7</u>
COL Item 3.8-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site-specific program for monitoring and maintenance of the Seismic Category I structures in accordance with the requirements of 10 CFR 50.65 as discussed in Regulatory Guide 1.160. Monitoring is to include below grade walls, groundwater chemistry if needed, base settlements and differential displacements.	3.8
COL Item 3.8-2:	A COL applicant that references the NuScale Power Plant design certification will confirm that the site independent Reactor Building and Control Building are acceptable for use at the designated site.	3.8
COL Item 3.8-3:	A COL applicant that references the NuScale Power Plant design certification will identify local stiff and soft spots in the foundation soil and address these in the design, as necessary.	3.8
COL Item 3.8-4:	A COL applicant that references the NuScale Power Plant design certification will evaluate and document construction aid elements such as steel beams, Q-decking, formwork, lugs, and other items that are left in place after construction but that were not part of the certified design to verify the construction aid elements do not have an appreciable adverse effect on overall mass, stiffness, and seismic demands of the certified building structure. The COL applicant will confirm that these left in place construction aid elements will not have adverse effects on safety-related structures, systems, and components per Section 3.7.2.	3.8
COL Item 3.9-1:	A COL applicant that references the NuScale Power Plant design certification will provide the applicable test procedures before the start of testing and will submit the test and inspection results from the comprehensive vibration assessment program for the NuScale Power Module, in accordance with Regulatory Guide 1.20.	3.9
COL Item 3.9-2:	A COL applicant that references the NuScale Power Plant design certification will develop design specifications and design reports in accordance with the requirements outlined under American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section III (Reference 3.9-1). A COL applicant will address any known issues through the reactor vessel internals reliability programs (i.e. Comprehensive Vibration Assessment Program, steam generator programs, etc.) in regards to known aging degradation mechanisms such as those addressed in Section 4.5.2.1.	3.9
COL Item 3.9-3:	A COL applicant that references the NuScale Power Plant design certification will provide a summary of reactor core support structure ASME service level stresses, deformation, and cumulative usage factor values for each component and each operating condition in conformance with ASME Boiler and Pressure Vessel Code Section III Subsection NG.	3.9
COL Item 3.9-4:	A COL applicant that references the NuScale Power Plant design certification will submit a Preservice Testing program for valves as required by 10 CFR 50.55a.	3.9
COL Item 3.9-5:	A COL applicant that references the NuScale Power Plant design certification will establish an Inservice Testing program in accordance with ASME OM Code and 10 CFR 50.55a.	3.9
COL Item 3.9-6:	A COL applicant that references the NuScale Power Plant design certification will identify any site-specific valves, implementation milestones, and the applicable ASME OM Code (and ASME OM Code Cases) for the preservice and inservice testing programs. These programs are to be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a in accordance with the time period specified in 10 CFR 50.55a before the scheduled initial fuel load (or the optional ASME Code Cases listed in Regulatory Guide 1.192 incorporated by reference in 10 CFR 50.55a).	3.9
COL Item 3.9-7:	Not Used.	

The pressure at the bottom of the pool due to gravity loading of the water is approximately 30 psi ($62.4 \text{ lb/ft}^3 * 69 \text{ ft depth} * 1/144 \text{ ft}^2/\text{in}^2$). Consequently, the average pressure on the wall is half this amount, or 15 psi. The pressure of 4.20 psi is 28 percent of the average pressure ($4.20 \text{ psi}/15 \text{ psi} = 0.28$). Therefore, a 1.28g vertical static loading was added to the SAP2000 model to ensure this additional pressure is accounted for in the design. See Figure 3.7.2-129. Increasing the downward acceleration by a factor of 1.28 corrects for the underestimated fluid pressure, due to mass lumping, in the SSI model. Analyses have been performed that confirm that the 1.28 x gravity load bounds a 4.2 psi pressure profile.

RAI 03.07.02-15S1, RAI 03.07.02-15S2

The total hydrodynamic load consists of the lumped-mass hydrodynamic load from the SASSI2010 analysis (which underestimates the hydrodynamic load) and the fluid-structure-interaction correction load from the ANSYS analysis. The effects of the lumped-mass-based hydrodynamic pressures on the pool walls and floor are included in the determination of forces on the walls and floor from the SSI analysis. These hydrodynamic effects from SASSI2010 are included in the E_{ss} term of the governing load combination (see FSAR Section 3.8.4.3.16 for the definition of E_{ss}). The “missing” hydrodynamic load is added to the hydrostatic load to determine the total fluid pressure on the RXB walls and foundation.

RAI 03.07.02-15S5

COL Item 3.7-12: [A COL applicant that references the NuScale Power Plant design certification will perform an analysis that uses site-specific soil and time histories to confirm the adequacy of the fluid-structure interaction correction factor.](#)

3.7.2.1.2.5 Control Building

A general discussion of the CRB and the major features and components is provided in Section 1.2.2.2. Architectural drawings, including plan and section views are provided in Figure 1.2-21 through Figure 1.2-27.

The CRB is located approximately 34 feet to the east of the RXB and its primary function is to house the Main Control Room and the Technical Support Center.

The CRB is a reinforced concrete building with an upper steel structure supporting the roof. The reinforced concrete portion of the building is Seismic Category I. The SSC on the top floor have no safety-related or risk-significant functions. The walls and roof above this floor are provided for weather protection/climate control. This part of the structure is not required to be Seismic Category I. However, to ensure it will not fail and affect the Seismic Category I portion of the building, or the Seismic Category I RXB, the steel portion of the building is classified and analyzed as a Seismic Category II structure.