RAIO-0818-61204

August 02, 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 Response to NRC Request for Additional Information No. 200 (eRAI No. 9021) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 200 (eRAI No. 9021)," dated August 25, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 200 (eRAI No.9021)," dated October 23, 2017

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

The Enclosures to this letter contain NuScale's response to the following RAI Question from NRC eRAI No. 9021:

- 03.09.03-2

The response to RAI Questions 03.09.03-1, 03.09.03-3, 03.09.03-4, 03.09.03-5, and 03.09.03-6, were previously provided in Reference 2. This completes all responses to eRAI 9021. Markups for NPM Seismic Analysis technical report TR-0916-51502 are not included with this RAI response. Revision 1 of TR-0916-51502 is in preparation and will be provided at a later date.

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 200 (eRAI No. 9021). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The enclosed affidavit (Enclosure 3) supports this request. Enclosure 2 is the nonproprietary version of the NuScale response.

This letter and the enclosed responses 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,

Jennie Wike
Manager, Licensing
NuScale Power, LLC

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

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9021, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9021, nonproprietary

Enclosure 3: Affidavit of Thomas A. Bergman, AF-0818-61205

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9021, proprietary

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9021, nonproprietary

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

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

eRAI No.: 9021
Date of RAI Issue: 08/25/2017

NRC Question No.: 03.09.03-2

10 CFR 50 Appendix S IV(a)(1)(iii) 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) ground motion through design, testing, or qualification methods. GDC 2 and 10 CFR 50, Appendix S, as they relate to safety-related structures and components being designed to withstand the effects of earthquakes combined with the effects of normal or accident conditions without loss of capability to perform their safety functions. Pursuant to GDC 2, mechanical components are designed to withstand the loads generated by natural phenomena as discussed Section 3.7.1.

For seismic loads, the applicant performed a detailed dynamic analysis of the nuclear power module (NPM) subsystem using a 3D NPM ANSYS model applying acceleration time histories resulting from composite reactor building (RXB) seismic analysis. The staff reviewed technical report TR-0916-51502, "NuScale Power Module Seismic Analysis." for the seismic loads and stresses. As a result, the applicant is requested to provide discussion and clarification for the following:

1. Considering a subsystem seismic analysis for NPM as stated above, based on RG 1.61, Table 6, Damping Values for Mechanical and Electrical Components, 3 percent damping should be used in lieu of 7 percent damping used in the TR, for pressure vessels (i.e., CNV and RPV). Therefore, the applicant is requested to provide justification or test data for use of higher than 3 percent damping for CNV and RPV for the SSE event as given in Table 6 of RG 1.61.

2. Provide the damping values used for the reactor pool water inside and outside the CNV and the basis using these damping values in the SSE analysis.

3. Confirm whether there is or is not uplift of CNV and RPV modules during the SSE event considering the buoyancy force and the bearing support at the bottom of CNV and RPV.

4. Discuss whether and how the condition of an SSE event is not considered for the design of CNV and RPV during the refueling outage, when the vessel halves are separated.

5. Describe boundary conditions of the 3-D NPM analysis at the supporting skirt location where the prescribed acceleration time histories were applied. Also to how the motion transmitting from the pool bottom to the skirt and to the NPM when the contact was sliding during SSE.

NuScale Response:

1. The lowest specified damping value for the SSE event is 4% for welded steel or bolted steel with friction connections rather than 3%. The composite damping value assigned to the NPM subsystem has been changed to 4%. NRC Regulatory Guide 1.61 Revision 1 emphasizes the distinction between “slip-critical” and “bearing-bolted” connections. The major difference between these types of joints is that in a slip-critical connection bolt forces are large enough to prevent joint sliding versus bearing-bolted type joints where the joint may slide and the bolts are loaded in shear. Conservatively, the lower damping value (4%) is used instead of 7% for the bearing-bolted connections. The Seismic Analysis technical report TR-0916-51502 has been updated accordingly. Section 8.1 (Transient Analysis) was revised, and Appendix C, discussing a higher NPM composite damping, was removed.

   This information is also included in the response to RAI 8911 Question 03.09.02-46, dated August 2, 2018.

2. Fluid damping is neglected in the seismic analysis because fluid damping is less significant than the structural damping (TR-0916-51502 Section 6.6.5.3). The reactor pool water has been assigned zero viscosity in the ANSYS models, and correspondingly exhibits no damping. The value has been included in TR-0916-51502 Table 4-4 as part of the response to RAI 8911 Question 03.09.02-22 (RAIO-1017-56790, October 24, 2017). No further changes are made to the DCA.

3. Potential uplift of the NPM is captured through nonlinear contact with the rigid floor surface. Seismic uplift displacements between the NPM skirt and reactor pool floor, and between the lower core plate and reflector blocks are discussed in TR-0916-51502 Section 8.4.2.6, and results are included in Table 8-8. The maximum relative displacement between lower core plate and reflector blocks has been added to Table 8-8.

   As stated in Section 6.0, the use of linear boundary conditions for the simplified beam model is justified if the vertical lift-off of the skirt as calculated by the detailed 3D model analysis is negligible (less than 1/8 inch). The maximum seismic uplift displacement between the NPM skirt and reactor pool floor is {{ }}$^{2(a),(c)}$.

4. The SSE event is analyzed for the lower RPV in the refueling flange tool (RFT) during an outage, when the fuel is exposed to the refueling pool environment for up to 70 hours. The TR-0916-51502 has been updated for the seismic analysis of the lower RPV in the RFT.

The durations of the NPM in the flange tools are taken from current operations procedures, and are listed in the tables below.

Lower RPV in Reactor Flange Tool	Duration hr
Detension reactor flange	6
Visual inspection of upper and lower RPV flanges	1
Move module to dry dock	2
Core Inspection	2
Defuel	8
Replace reactor flange metal O-ring seals	8
Inspect 20% of ISI welds, forgings, and surfaces	4
Inspect or replace reactor flange bolts	4
Refuel	8
Core verification	2
Align the module to the RPV flange tool guides	1
Lower module to establish a 4" flange gap	1
Using RPV tool camera, inspect flanges	1
Align upper RPV flange to lower then set	1
Tension RPV flange	12
Connect/test rod control and instrumentation	4
Latch and stroke test control rods	4
Disconnect rod control instrumentation	1
Total:	70

As stated in the response to RAI 9310 Question 03.09.02-59, the seismic response of the NPM components in refueling transition modes (i.e., when suspended by the building crane) is not evaluated. The presence of the module in the containment flange tool (CFT) is much shorter than in the RFT, and the fuel is protected in the RPV. Furthermore, the module is always suspended by the building crane. Given these considerations, the configuration of the module in the CFT is not seismically evaluated.

NPM in Containment Flange Tool	Duration hr
Ensure containment pressure is within limits	0.25
Detension containment flange	6
Tension containment flange	12
Leak check RPV flange seals	2
Leak check containment flange seals	2
Total:	22.25

Section 1.2 of TR-0916-51502 has been updated accordingly.

5. In the combined seismic model of the NPM and the entire pool, contact between the CNV skirt and pool floor is generated using a rigid surface below the NPM in the operating bay. The rigid surface is defined as a square of 50 feet, coincident with, and centered on, the base of the CNV skirt. Nonlinear contact is established via target elements on the floor and contact elements on the bottom surface of the CNV skirt support ring.

   The lateral seismic accelerations are applied to a remote point that is centered on, and scoped to, the bottom of the CNV skirt support ring. This allows sliding of the contact with the rigid floor surface during SSE, as permitted by the actual configuration (the CNV skirt engages with the passive support ring on the floor). The vertical seismic acceleration is applied to a coincident, but separate, remote point, to allow for nonlinear contact of the CNV skirt and rigid floor. Acceleration boundary condition data generation is described in the TR Section 5.1.

Sections 3.1.5 and 5.1 of the NPM Seismic Analysis technical report TR-0916-51502 have been updated accordingly.

Impact on DCA:

TR-0916-51502 has been revised as described in the response above and will be incorporated into Revision 1 of the NPM Seismic Analysis technical report.

Enclosure 3:

Affidavit of Thomas A. Bergman, AF-0818-61205

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

NuScale Power, LLC

AFFIDAVIT of Thomas A. Bergman

I, Thomas A. Bergman, state as follows:

1. I am the Vice President, Regulatory Affairs of NuScale Power, LLC (NuScale), and as such, I have been specifically delegated the function of reviewing the information described in this Affidavit that NuScale seeks to have withheld from public disclosure, and am authorized to apply for its withholding on behalf of NuScale.
2. I am knowledgeable of the criteria and procedures used by NuScale in designating information as a trade secret, privileged, or as confidential commercial or financial information. This request to withhold information from public disclosure is driven by one or more of the following:
    a. The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by NuScale competitors, without a license from NuScale, would constitute a competitive economic disadvantage to NuScale.
    b. The information requested to be withheld consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage, as described more fully in paragraph 3 of this Affidavit.
    c. Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.
    d. The information requested to be withheld reveals cost or price information, production capabilities, budget levels, or commercial strategies of NuScale.
    e. The information requested to be withheld consists of patentable ideas.
3. Public disclosure of the information sought to be withheld is likely to cause substantial harm to NuScale's competitive position and foreclose or reduce the availability of profit-making opportunities. The accompanying Request for Additional Information response reveals distinguishing aspects about the method and analyses by which NuScale develops its power module seismic analysis.

    NuScale has performed significant research and evaluation to develop a basis for this method and analyses and has invested significant resources, including the expenditure of a considerable sum of money.

    The precise financial value of the information is difficult to quantify, but it is a key element of the design basis for a NuScale plant and, therefore, has substantial value to NuScale.

    If the information were disclosed to the public, NuScale's competitors would have access to the information without purchasing the right to use it or having been required to undertake a similar expenditure of resources. Such disclosure would constitute a misappropriation of NuScale's intellectual property, and would deprive NuScale of the opportunity to exercise its competitive advantage to seek an adequate return on its investment.

4. The information sought to be withheld is in the enclosed response to NRC Request for Additional Information No. 200, eRAI No. 9021. The enclosure contains the designation "Proprietary" at the top of each page containing proprietary information. The information considered by NuScale to be proprietary is identified within double braces, "{{ }}" in the document.
5. The basis for proposing that the information be withheld is that NuScale treats the information as a trade secret, privileged, or as confidential commercial or financial information. NuScale relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC § 552(b)(4), as well as exemptions applicable to the NRC under 10 CFR §§ 2.390(a)(4) and 9.17(a)(4).
6. Pursuant to the provisions set forth in 10 CFR § 2.390(b)(4), the following is provided for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:
    a. The information sought to be withheld is owned and has been held in confidence by NuScale.
    b. The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, chief technology officer or other equivalent authority, or the manager of the cognizant marketing function (or his delegate), for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside NuScale are limited to regulatory bodies, customers and potential customers and their agents, suppliers, licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or contractual agreements to maintain confidentiality.
    c. The information is being transmitted to and received by the NRC in confidence.
    d. No public disclosure of the information has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or contractual agreements that provide for maintenance of the information in confidence.
    e. Public disclosure of the information is likely to cause substantial harm to the competitive position of NuScale, taking into account the value of the information to NuScale, the amount of effort and money expended by NuScale in developing the information, and the difficulty others would have in acquiring or duplicating the information. The information sought to be withheld is part of NuScale's technology that provides NuScale with a competitive advantage over other firms in the industry. NuScale has invested significant human and financial capital in developing this technology and NuScale believes it would be difficult for others to duplicate the technology without access to the information sought to be withheld.

I declare under penalty of perjury that the foregoing is true and correct. Executed on August 2, 2018.

Thomas A. Bergman