RAIO-0119-64380

January 31, 2019

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. 202 (eRAI No. 8911) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 202 (eRAI No. 8911)," dated August 25, 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 Questions from NRC eRAI No. 8911:

- 03.09.02-43
- 03.09.02-45

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 202 (eRAI No. 8911). 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,

Carrie Fosaaen
Supervisor, Licensing
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Distribution: Gregory Cranston, NRC, OWFN-8H12
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8911, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 8911, nonproprietary

Enclosure 3: Affidavit of Thomas A. Bergman, AF-0119-64381

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8911, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 8911, nonproprietary

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

eRAI No.: 8911
Date of RAI Issue: 08/25/2017

NRC Question No.: 03.09.02-43

10 CFR 50, Appendix A, GDC 2 requires systems, structures, and components important to safety be designed to withstand appropriate combinations of the effects of normal and accident conditions with the effects of natural phenomena including earthquake. TR-0916-51502-P, Rev. 0, Section 8.4.3 states that maximum uplift displacements of the NPM were calculated for each of the six analysis runs. The maximum uplift occurred in the run representing the Capitola time history, soil type 7, with cracked RXB concrete, on the NPM in operating bay 6 with a nominal stiffness. As stated in Section 8.0, for the cracked RXB concrete case, two NPM stiffness were considered. Section 7.4 of the report states that uncertainty in the input and assumptions used in the finite element models of the NPM is accounted for by considering multiple analyses using ±30 percent variations of the stiffness properties of the model. Therefore, in calculation of the maximum NPM uplift, the NRC staff considers that the case of 130% of the NPM stiffness for the cracked RXB concrete case should be considered. Increasing the NPM stiffness may bring the NPM dominant frequency closer to the cracked RXB frequency. The results of 77% NPM stiffness could be non-conservative. The applicant is requested to provide the maximum NPM uplift in the cracked RXB concrete case with an adjustment of +30 percent variation of the NPM stiffness (i.e., 130% NPM stiffness). Alternatively, provide justification for not performing a cracked RXB concrete case with 130% of the NPM stiffness.

Include the requested information in the NPM Seismic Report or in separate reports.

NuScale Response:

NuScale performed the new seismic runs requested in this question. The uplift values are presented in the Seismic Analysis Technical Report TR-0916-51502 Table 8-9.

The content of this response was further discussed with the NRC in periodic public FSAR Section 3.7/3.8 RAI Closure Plan meetings. Specifically, the response is also to address:

1. Listing the six SASSI analysis cases that are used in the NPM seismic analysis.

2. Description of the enhanced method of modeling the hydrodynamic mass and determining the hydrodynamic load for bay walls, walls in the refueling area, pool walls and floor.

3. Comparison of the NPM support loads obtained from the new analyses (SASSI and ANSYS 3D NPM) with the corresponding support loads used for the design of the NPM supports.

4. The final response spectra corresponding to the seismic input for the NPM seismic analysis.

Sub-questions 1 through 4 are addressed as follows:

1. The NPM model in the entire pool is analyzed for the following:

- one seed input (Capitola)
- one soil type (Soil 7)
- two RXB concrete conditions (cracked and uncracked)
- three NPM stiffness conditions ([1] NPM stiffness adjustment = 1/1.3 = 77% of nominal stiffness, [2] nominal stiffness; i.e. no adjustment to NPM stiffness, and [3] NPM stiffness adjustment = 130% of nominal stiffness).

Details of the NPM seismic analysis are documented in the Seismic Analysis Technical Report TR-0916-51502 Section 8.0.

2. The seismic runs incorporate an enhanced methodology for modeling hydrodynamic mass in the pool area, as detailed in Section 6.6.6 (Hydrodynamic Mass) of the TR. This modeling uses harmonic analysis, modal analysis, and hand calculations to determine the hydrodynamic loading for the bay walls, walls in the refueling area, and the pool walls and floor.

The hydrodynamic mass approach, along with the 12 detailed NPM beam models, has been incorporated into the RXB SAP2000 model, and subsequently the cracked and uncracked RXB SASSI models. This modeling method was discussed during the NRC Technical Audit for FSAR Sections 3.7 and 3.8 held in Rockville, MD the week of December 3, 2018. During that discussion it was understood that while the models of the reactor building were updated for this

hydrodynamic mass, the FSI correction factor described in Section 3.7.2 of the FSAR would not be changed. In addition, NuScale stated that the design of the pool walls remain the same.

3. The NPM support loads obtained from the analyses (SASSI and ANSYS 3D NPM) were compared to the corresponding support loads used for the design of the NPM supports. TR Table 8-6 (Maximum seismic forces on NuScale Power Module supports) summarizes the reaction forces on the bottom of the NPM (CNV Skirt) and CNV wall lugs.

4. The bounding response spectra corresponding to the seismic input for the NPM seismic analysis were generated and submitted as a part of RAI 8974 Question 03.08.04-23, NuScale letter RAIO-0119-64084 dated January 11, 2019.

Impact on DCA:

The NPM Seismic Analysis technical report TR-0916-51502 has been revised as described in the response above and as shown in the markup provided with the response to question 03.09.02-45.

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

eRAI No.: 8911
Date of RAI Issue: 08/25/2017

NRC Question No.: 03.09.02-45

10 CFR 50, Appendix A, GDC 2 requires systems, structures, and components important to safety be designed to withstand appropriate combinations of the effects of normal and accident conditions with the effects of natural phenomena including earthquake. TR-0916-51502-P, Rev. 0, Appendix C, Table C-1 (Summary of NuScale Power Module Component Interfaces) states that the reflector blocks and lower core plate are stacked and restrained in the horizontal direction with alignment pins. The reflector blocks and lower core plate are not restrained in the vertical direction other than by gravity. Tolerances and deformation between the mating parts allow some sliding to take place between parts. On the interface between the upper riser and lower riser, Table C-1 states that the lower riser conical section seats within the upper riser conical section. There are tolerances between the two interfacing components allowing them to pitch slightly. The upper riser is not restrained in the vertical direction other than by gravity and compression of the bellows which keeps the interface closed. The description is insufficient for staff to reach a safety finding. The applicant is requested to provide the following information:

1. Figure B-18 (vertical ISRS at top of the lower core plate) indicates that the maximum vertical acceleration at top of the lower core plate is about 1.6 g (i.e., spectral acceleration at the high frequency end of the ISRS) that exceeds gravity acceleration. Provide a discussion on the possibility of uplift between the reflector blocks as well as between the reflector blocks and the lower core plate under the maximum vertical acceleration and their consequence.

2. Provide the vertical ISRS and the maximum vertical acceleration at the interface between the upper riser and the lower riser. Provide a discussion on the possibility of uplift of the upper riser from the lower riser under the maximum vertical acceleration and their

consequence.

Include the requested information in the NPM Seismic Report.

NuScale Response:

Appendix C was removed in the NPM Seismic Analysis Technical Report TR-0916-51502, Revision 1. Details pertaining to interfaces have been added to the main body of the TR (see the markup pages included with this response).

The two sub-questions are addressed individually as follows.

1. In the NPM detailed 3D ANSYS model used for time history analysis, the reflector blocks were modeled separate from the rest of the lower RVI. The model accounts for potential uplift, and is documented in the TR Section 4.1.3.3.

The maximum uplift between the first reflector block and the lower core plate is calculated to be {{ }}2(a),(c) (TR Table 8-9). This amount of uplift produces an increased vertical response spectrum for the lower core plate in the range from {{ }}2(a),(c) (TR Figure B-21) and an associated vertical impact force on the lower core plate of {{ }}2(a),(c) (TR Table 8-8). However, only a fraction of this vertical impact force {{ }}2(a),(c) is transmitted to the fuel (TR Table 8-8).

The effect of the changes on the fuel is presently being evaluated, and new margins are being established. The results are to be provided in a revision to the NuFuel-HTP2™ Fuel and Control Rod Assembly Designs technical report, TR-0816-51127.

2. In the NPM detailed 3D ANSYS model, the upper and lower risers are not connected in the vertical direction, as described in the response to eRAI 9310 Question 03.09.02-64, Sub-question 2 (NuScale letter RAIO-1018-62129, October 15, 2018). Details of the physical interface between the URVI and LRVI have now been added to TR Figure 4-14.

The maximum relative displacement between the upper and lower risers is determined by the output of the NPM detailed 3D ANSYS transient analysis. This maximum relative displacement is {{ }}2(a),(c) as discussed in TR Section 8.4.3. This relative displacement is negligible and, when taking into consideration the bellows stiffness, preload, and the mass of the upper

riser beneath the bellows, the force exerted on the lower riser by the bellows due to this amount of uplift is also negligible. Seismic uplift is therefore inconsequential.

The vertical response spectrum for the bottom of the upper riser is added as TR Figure B-27.

Impact on DCA:

The NPM Seismic Analysis technical report TR-0916-51502 has been revised as described in the response above and as shown in the markup provided with this response.

A modal analysis of the lower RVI was performed to verify the modes of the fuel assembly match the modes calculated by the fuel vendor. The entire lower RVI model except the fuel assembly was restrained for this analysis. The modal results are shown in Table 4-10.

Table 4-10 Fuel assembly modal results validation

Mode	Frequency (Hz)	
	NuScale Results	Fuel Vendor Results
1	{{	}}2(a),(c)
2	{{	}}2(a),(c)
3	{{	}}2(a),(c)
Vertical	{{	}}2(a),(c)

4.1.3.3 Lower Reactor Vessel Internals Boundary Conditions

In separate submodels for the Lower RVI and the RPV, pilot nodes are created using the detailed methodology described in Section 4.1.2.2. The four lower core plate tabs on the lower RVI are coupled to the four lower core support blocks of the RPV submodel in the circumferential and vertical directions using these pilot nodes scoped to the surfaces of each mating pair. The pilot nodes are located at the centers of the socket head cap screws (Figure 4-8), acting to prevent uplift of the lower core plate from the lower core support block assemblies. Circumferential loads are carried by the alignment dowels, not the socket head cap screws, given the tolerances of the assembly.

The vertical connection is modeled using spring elements with an axial stiffness of {{ }}2(a),(c), which is calculated from K=EA/L, with a {{ }}2(a),(c) screw length (the thickness of the lower core plate). The {{ }}2(a),(c) screw length is used because an uplifting force applied to the bottom of a socket head by the lower core plate develops tension only between the socket head and the first threads engaged in the core support block top plate.

To model the interface while in compression, frictionless contact pairs are created between the lower core block assemblies and the lower core plate tabs. This prevents bending of the protruding lower core plate tabs during compression at this interface.

There are no nonlinear effects, such as gaps, in the connection between the lower RVI core plate tabs and the core support blocks on the RPV, as the actual connection consists of socket head cap screws and shear pins (Figure 4-8) that provide a circumferential and vertical restraint. The interfacing slotted holes on the lower core plate permit relative thermal growth of the core support and lower RPV at operating temperature. The radial direction restraint is therefore released in the NPM seismic model.

{{

}}2(a),(c)

Figure 4-8 Lower reactor vessel core support blocks and core support attachment

The upper core support blocks of the lower RVI are connected to the inner walls of the core region of the RPV submodel. This is done by coupling remote points scoped to the inside of the RPV and to the faces of the upper support blocks in the radial direction. The surfaces to which the remote points are scoped are shown in Figure 4-9.

~~The reflector blocks are connected to the inner surface of the core support barrel using a no-separation contact. "No-separation contact" means contact detection points that are either initially inside the pinball region or that once they involve contact, always attach to the target surface along the normal direction to the contact surface (sliding is permitted).~~

~~No friction coefficient is assigned to the elements. The no-separation contact is assigned using element types CONTA174 and TARGE170. These elements do not represent compression-only one-way springs.~~

~~The no-separation contact surfaces are indicated in Figure 4-5. The contact surface meshes are shown in Figure 4-10. Nonlinear effects are not considered for the radial gaps in the boundary conditions because the radial gaps are small (i.e. the gap between reflector blocks and core barrel is 0.125 inch). Therefore, they are modeled as linear supports that cause the components to move together (in the radial direction) during a seismic event.~~

For these ~~contact~~ surfaces, the effect of additional energy dissipation due to Coulomb friction is neglected. The primary load path for resisting external seismic loads is through the contact forces normal to the interfaces. By setting the coefficient of friction to zero, Coulomb friction is not used to provide additional resistance to external seismic loads through a secondary load path, which can relieve forces acting on the primary load path. The exclusion of frictional resistance results in a conservative assessment of the normal seismic forces acting on the interface.

The natural frequency of the system is a characteristic of the linear system. Frictional forces render the dynamic response nonlinear and act to perturb the dynamic response. When friction is included, the response is not characterized by modal analysis or changes in component natural frequency. The effect of friction in perturbing the dynamic response is addressed by the inclusion of uncertainty in the analysis of the NPM dynamic response for a range of stiffness values. The inclusion of uncertainty in the dynamic analysis encompasses numerous causes of uncertainty, including the effect of neglecting friction at these interfaces.

Internal boundary between upper support blocks and the lower RPV shell:

The upper support blocks and RPV radially coupled remote point scoped surfaces ~~and the RPV shell no-separation contact surfaces~~ are shown on Figure 4-9. In the hot condition, the gap between these components is less than {{ }}2(a),(c), and it is treated as a linear connection. Neglecting friction, the contact forces act only in the radial direction. The components slide vertically and circumferentially relative to each other due to relative deflections of the lower RPV and the lower RVI shells.

Transfer of load across this interface is assumed to occur through radial forces alone. Therefore, the primary load path and resistance provided by this interface is in the radial direction. Additional resistance due to frictional circumferential forces is neglected. In the vertical direction the primary load path is through the core barrel. The secondary support path due to vertical friction at the core support blocks is neglected.

Large dissipative Coulomb friction forces are expected. Energy dissipation due to Coulomb friction forces is neglected by setting the coefficient of friction to zero.

{{

}}2(a),(c)

Figure 4-9 Upper support blocks to RPV shell remote point scoped surfaces

Internal boundary between lower RVI and reflector:

The lower RVI-to-reflector ~~no-separation~~rough contact surfaces are used to account for potential uplift, and are shown ~~on~~ in Figure 4-11. No sliding is allowed when the mating faces are in contact. The CONTA174 element key options and real constants are modified within command objects for each contact pair to enforce impact constraints, update contact stiffness on each iteration with a nominal refinement, and select a suitable penetration tolerance factor. ~~Neglecting friction, the contact forces act only in the radial direction, therefore, t~~The primary load path provided by this interface is in the ~~radial~~ vertical direction.

The reflector blocks and core barrel are physically separated by a water filled annular gap. The fluid filled gap is nominally {{ }}2(a),(c) thick. This fluid gap is modeled using six Fourier nodes, one for each reflector block. See Section 4.1.8.5 for a description of the Fourier node method for the gap between RVI and upper RPV. The same methodology is applied to generate the constraint equations applied to the inner surface of the core barrel and outer surface of each reflector block. A sectioned view of the Fourier Nodes used to model this interface is shown in Figure 4-10. Coulomb friction does not act on the interface between the reflector and core barrel because relative displacements do not cause ~~unless~~ the gap to close~~s due to relative displacements.~~

Viscous forces acting due to the fluid do not cause significant damping and are conservatively neglected.

For horizontal seismic loads, the primary load path for forces acting on the reflector blocks is through alignment pins between each stacked block and between the lowest block and lower core plate. Additionally, the outer rim of the top of each of the first five reflector blocks is raised to form an inset that provides a horizontal load path between the blocks. A secondary load path for horizontal loads is through the action of inertial and viscous forces resulting from fluid within the annular gap.

In order to model the constraints imparted by the reflector block alignment pins (total of nine pins between the lower core plate and the first reflector block, and one pin between each of the blocks), as well as the raised outer edge between each block, all but the vertical degree of freedom are constrained between remote points scoped to the edges of the bottom of each block and the mating face beneath it. The edges used for scoping the remote points of these constraints are shown on the left of Figure 4-11. Figure 4-11 is an exploded view of the reflector blocks and lower core plate, with other components removed. This ensures that the rough contact elements on the surface of the reflector blocks shown on the right of Figure 4-11 do not overlap with the edges and create an over-constraint condition.

For vertical loads, the primary load path is between stacked blocks and the lower core plate. The reflector blocks are connected to the lower core plate and to each other using frictionless contact, to account for potential uplift. In order to prevent rigid body motion of the reflector blocks, rotation about the vertical axis is coupled between remote points scoped to the edges of the bottom of each block and to the lower core plate. These rotational constraints model the effect of the reflector block alignment pins. Forces due to Coulomb friction occur only if deflection isdo not occur because uplift of the blocks is not sufficient to close the vertical gap above the reflector blocks and below the upper core plate and do not provide a primary load path for resisting vertical seismic load.

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}}2(a),(c)

Figure 4-9 Upper support blocks to RPV shell contact meshes

{{

}}2(a),(c)

Figure 4-10 Fourier nodes of fluid gap between reflector blocks and core barrel

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}}2(a),(c)

Figure 4-11 Lower RVI to Reflector contacts and contact meshes

4.1.3.4 Lower Reactor Vessel Internals Materials

The lower RVI is assigned material properties of Type 304 stainless steel. The elastic modulus is taken at the average RCS temperature of 550 degrees F. The density is taken at the as-built temperature of 70 degrees F.

4.1.4 Upper Reactor Vessel Internals Submodel

4.1.4.1 Upper Reactor Vessel Internals Geometry, Mesh and Mass

The upper RVI geometry is based on the upper riser drawings. The upper RVI assembly is primarily composed of the upper riser shell. The upper riser shell is a long cylindrical structure that is approximately {{ }}2(a),(c) The bottom of the upper riser shell is attached to a cone that

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}}2(a),(c)

Figure 4-14 Constraint equations and physical interface between URVI and LRVI

8.0 Three-Dimensional Seismic Model Analysis

This section analyzes the NPM for seismic loading using the non-linear 3D ANSYS finite element models. Seismic time history data from the RXB are used as inputs to the model. Outputs of the model include ISRS, time history data, relative displacements, and forces and moments within the NPM.

The results were obtained using the entire pool seismic models described in Section 5.0 and for the lower reactor vessel in the reactor flange tool in Section 5.2. Results are included for both 'NPM 1 in the entire pool,' and 'NPM 6 in the entire pool' models, as well as the lower RPV in the RFT (limited to ISRS results).

The scope of this calculation includes analyzing the NPM for various seismic inputs, and generating time histories, relative displacements, ISRS, and forces and moments. The inputs include seismic time history data from the RXB seismic analysis for certified seismic design response spectra (CSDRS) input.

The NPM model in the entire pool is analyzed for the following:

- one seed input location (Capitola)
- one soil type (Soil 7)
- two RXB concrete conditions (cracked and uncracked)
- two modules (NPM 1 and NPM 6)
- one case nominalthree NPM stiffness conditions for the uncracked case, and two three NPM stiffness conditions for the cracked case ([1] NPM stiffness adjustment = 1/1.3=77% of nominal stiffness, and [2] nominal stiffness; i.e. no adjustment to NPM stiffness, and [3] NPM stiffness adjustment = 130% of nominal stiffness)

This gives 6 12 runs in total for the NPM models. The six twelve runs are:

1. NPM 1 and entire pool, Cracked Concrete Properties, Nominal NPM stiffness
2. NPM 1 and entire pool, Cracked Concrete Properties, 77% of Nominal NPM stiffness
3. NPM 1 and entire pool, Cracked Concrete Properties, 130% of Nominal NPM stiffness
3.4. NPM 1 and entire pool, Uncracked Concrete Properties, Nominal NPM stiffness
5. NPM 1 and entire pool, Uncracked Concrete Properties, 77% of Nominal NPM stiffness
6. NPM 1 and entire pool, Uncracked Concrete Properties, 130% of Nominal NPM stiffness
4.7. NPM 6 and entire pool, Cracked Concrete Properties, Nominal NPM stiffness
5.8. NPM 6 and entire pool, Cracked Concrete Properties, 77% of Nominal NPM stiffness
9. NPM 1 and entire pool, Cracked Concrete Properties, 130% of Nominal NPM stiffness

10. NPM 6 and entire pool, Uncracked Concrete Properties, Nominal NPM stiffness

11. NPM 6 and entire pool, Uncracked Concrete Properties, 77% of Nominal NPM stiffness

6.12. NPM 6 and entire pool, Uncracked Concrete Properties, 130% Nom. NPM stiffness

The analysis cases were performed using inputs derived from the SASSI analysis of the RXB with soil profile 7 (Hard rock) and a CSDRS compatible control motion based on the Capitola recording.

Outputs from the post-processing include:

- time-history displacement and acceleration data for 33 points within the NPM
- broadened ISRS for the same 33 points within the NPM
- maximum forces and moments at 83 interfaces between NPM components
- maximum forces and moments within 22 NPM component sections
- maximum forces at 4 NPM support locations

For each location, direction, and damping value, the response spectra were calculated for the six twelve seismic analysis runs. Using each set of six twelve response spectra, an envelope spectrum was constructed by finding the maximum of the six twelve response values at each spectral frequency point. The envelope of the six twelve spectra was then broadened by ±15% to produce the design ISRS (see example Figure 8-10 for the 4% damping curve in Figure B-14).

8.1 Transient Analysis

The input file (and subsequent APDL files that it executes) are set up to run CSDRS inputs.

The input files load the combined model as explained previously. The file has an option to reduce or increase stiffness of the NPM material properties and springs when not running the nominal stiffness cases. The commands in the file create a rigid floor and apply contact between the floor pilot node and the CNV skirt pilot node. This captures any uplift of the NPM.

The file then sets up the transient solution options, applies the table loads, and solves. Alpha-beta damping is used for the analysis, and a 4 percent damping value is applied to the frequency range of {{ }}2(a),(c). This frequency range covers the major modes in Table 8-2, and the range is adjusted for the soft and stiff models. The composite 4 percent structural damping is used, as it is the lowest specified damping value for the SSE event for welded steel or bolted steel structures with friction connections in Regulatory Guide 1.61, Table 1. The RG 1.61 Revision 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

displacement (uplift) from the lower core plate and between each block interface Node locations are listed in Table 8-3. See Appendix A for figures.

The bounding vertical displacement at the upper riser bellows is the maximum relative vertical displacement of CRDS Grid 5 (Table 8-3 location 29 in the upper riser) vs. CRDS Grid 6 (Table 8-3 location 30 in the lower riser), or {{ }}2(a),(c). The displacement at the upper and lower riser interface was approximated using the time histories of these two grid locations.

The maximum forces and moments for the representative component interfaces listed in Table 8-4 are provided in Table 8-7 and Table 8-8. Maximum reaction forces were generated for four NPM support locations (CNV skirt and three CNV shear lugs) corresponding to nodes 1, 4, 5, and 6 of Table 8-3, at the top of the lower core plate for the reflector block and the fuel assemblies, and at the bottom of the upper core plate for the fuel assemblies (nodes 18 and 19 of Table 8-3). The NPM support location forces are provided and compared to the reaction forces produced by the SASSI RXB model (Section 3.1.4) in Table 8-6. There were no reaction moments at the support locations.

Bounding and enveloped ISRS plots were generated for the nodes listed in Table 8-3. One set of ISRS plots was generated bounding the CSDRS runs. Due to the large number of plots, representative plots are presented in Appendix B.

Table 8-6 Maximum seismic forces on NuScale Power Module supports

Location ID	Description	Maximum force (lbf)					
		East-West		Vertical		North-South	
		3D Detailed model	SASSI RXB model	3D Detailed model	SASSI RXB model	3D Detailed model	SASSI RXB model
1	CNV Skirt (1)	{{					}}2(a),(c)
4	CNV East Lug	{{					}}2(a),(c)
5	CNV West Lug	{{					}}2(a),(c)
6	CNV North Lug	{{					}}2(a),(c)

Notes: (1) The NPM seismic model does not consider eccentricity of the vertical force at the CNV skirt that should be considered in the design. The CNV skirt outer radius, which is 70.6 in., can be conservatively used as the maximum eccentricity.

Table 8-7 Maximum seismic reactions at RPV Upper Supports (cylindrical coordinates)

ID	Description	Maximum force (lbf)		
		FR Radial	FY Vertical	Fθ Circumferential
4	RPV upper support - segment -X+Z	{{		}}2(a),(c)
5	RPV upper support - segment +X+Z	{{		}}2(a),(c)
6	RPV upper support - segment +X-Z	{{		}}2(a),(c)
7	RPV upper support - segment -X-Z	{{		}}2(a),(c)

Table 8-8 Maximum Seismic Reactions on Bottom of Reflector and at Fuel Assembly Supports

ID	Description	Maximum force (lbf)			Maximum Moment (in-lbf)			Coor-dinate System
		FX East-West	FY Vertical	FZ North-South	MX	MY	MZ	
17	Reflector, Lower Core Plate	{{						}}2(a),(c)
18	Fuel Assemblies, Lower Core Plate	{{						}}2(a),(c)
19	Fuel Assemblies, Upper Core Plate	{{						}}2(a),(c)

Maximum uplift displacements were calculated for each of the six twelve runs. The maximum uplift for the CNV skirt occurred in the run representing the Capitola time history, soil type 7, with cracked concrete, on the NPM in operating bay 1 6 with an increased reduced stiffness.

Reflector block uplift is calculated with respect to the top of the lower core plate. The maximum uplift for the reflector blocks occurred in the run representing the Capitola time history, soil type 7, with cracked concrete, on the NPM in operating bay 1 with a nominal stiffness.

The displacements and time are provided in Table 8-9.

Table 8-9 Maximum uplift displacements

Component	Max. Uplift Displacement (in)	Occurring Time (s)
CNV Skirt	{{	}}2(a),(c)
1st Reflector Block	{{	}}2(a),(c)

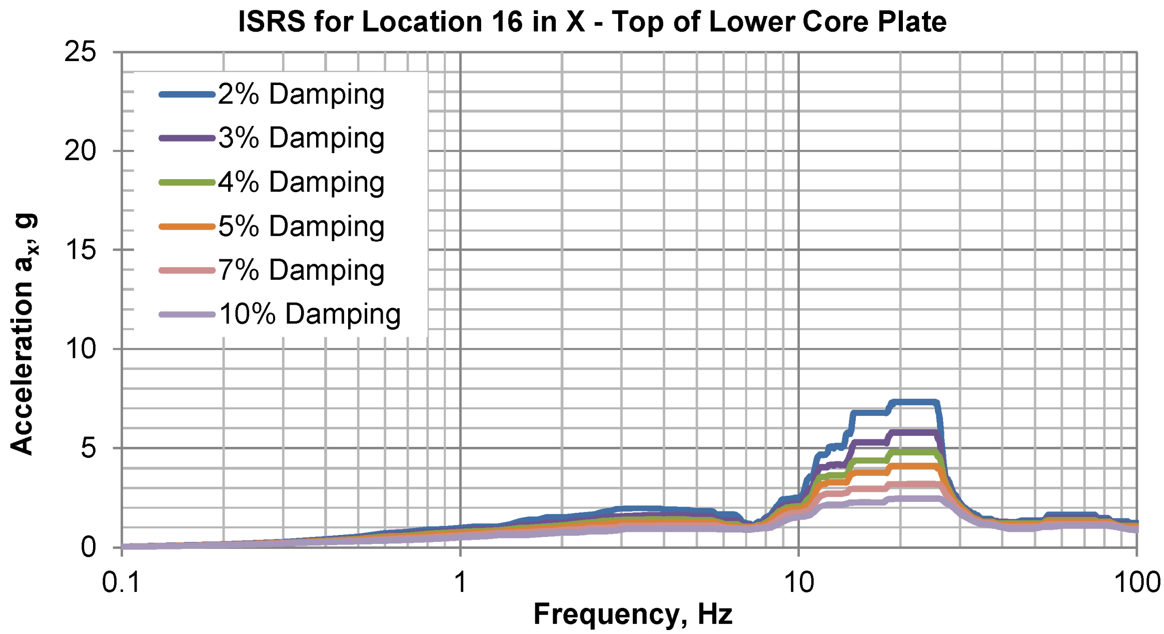

Figure B-19 Design ISRS, top of lower core plate, location 16, X-direction (east-west)

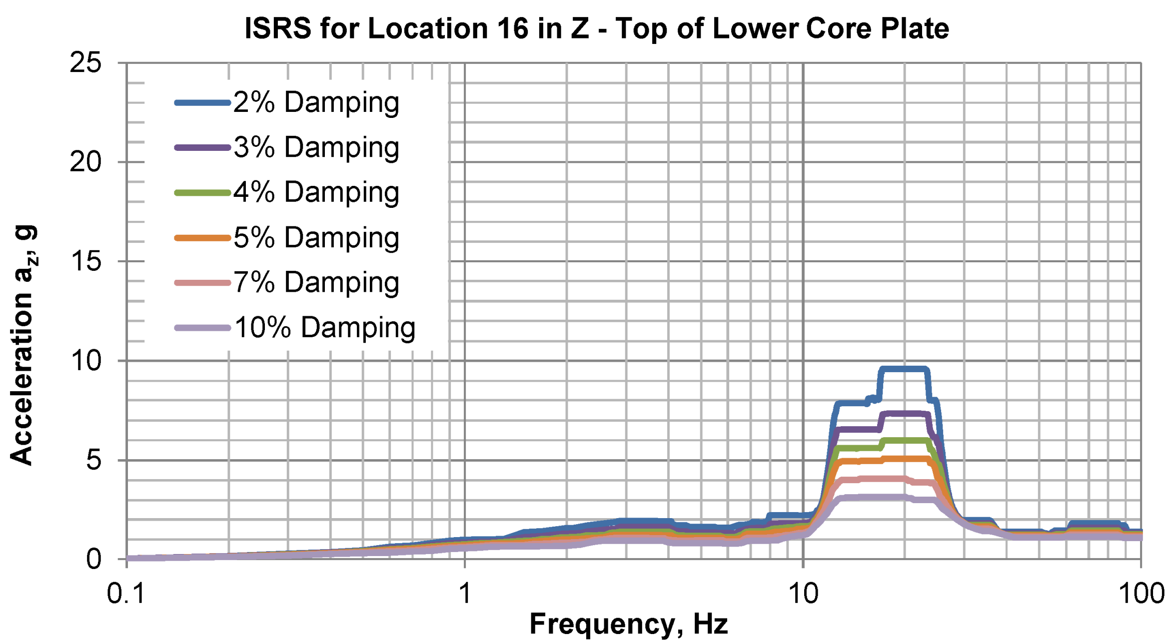

Figure B-20 Design ISRS, top of lower core plate, location 16, Z-direction (north-south)

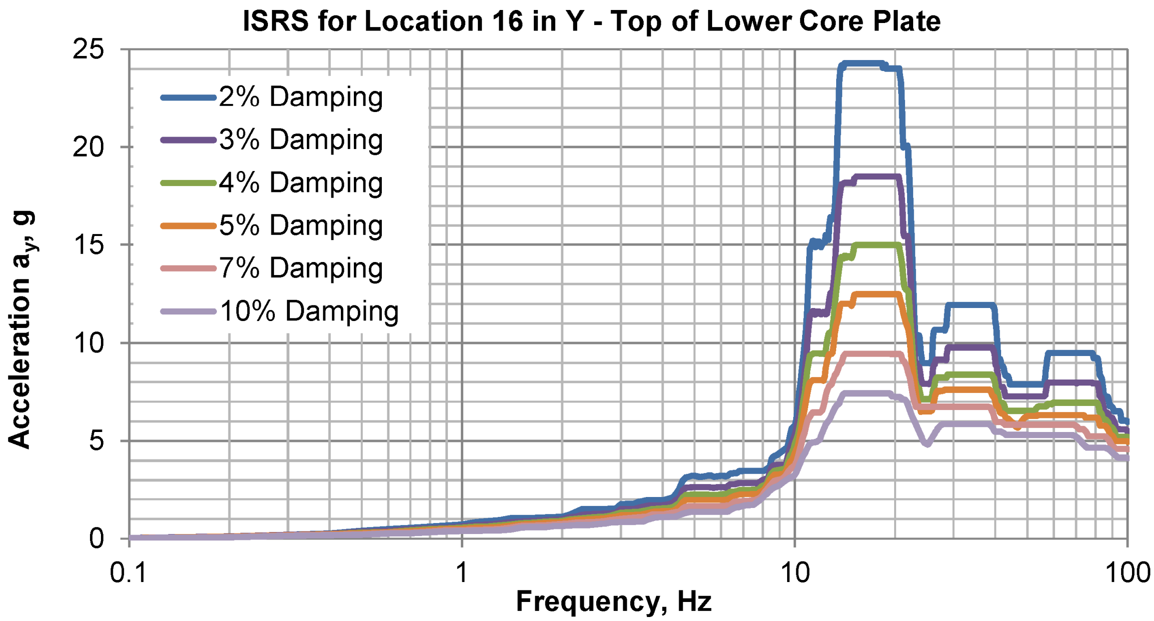

Figure B-21 Design ISRS, top of lower core plate, location 16, Y-direction (vertical)

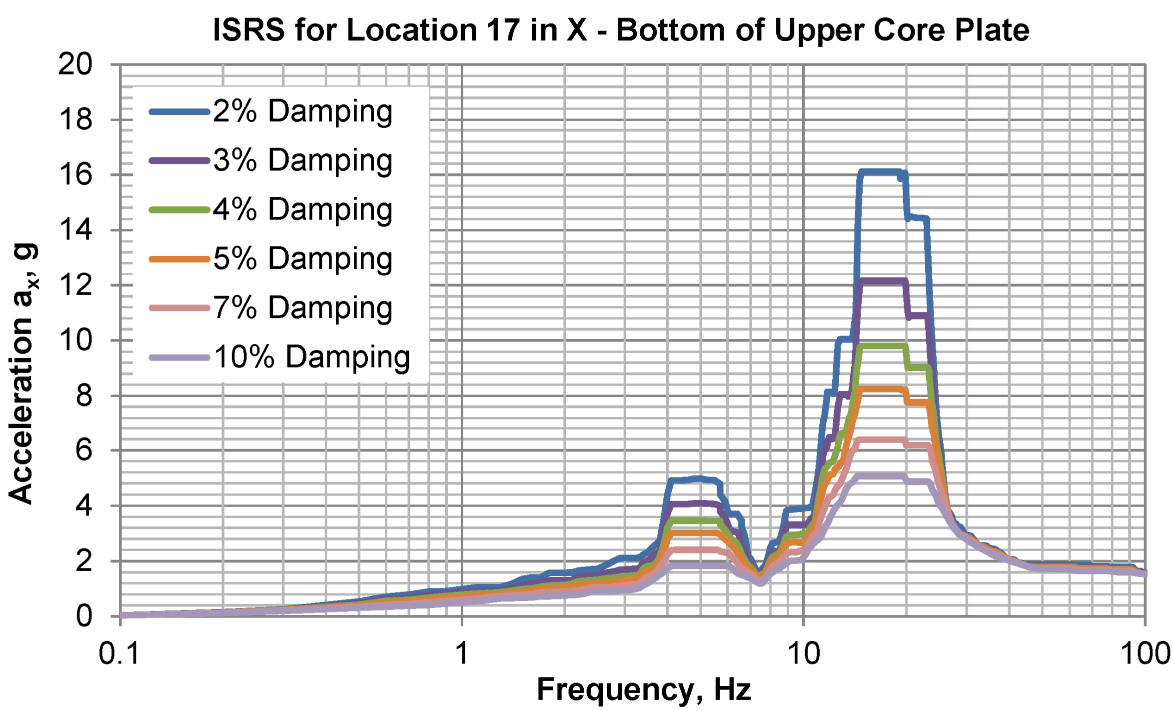

Figure B-22 Design ISRS, bottom of upper core plate, location 17, X-direction (east-west)

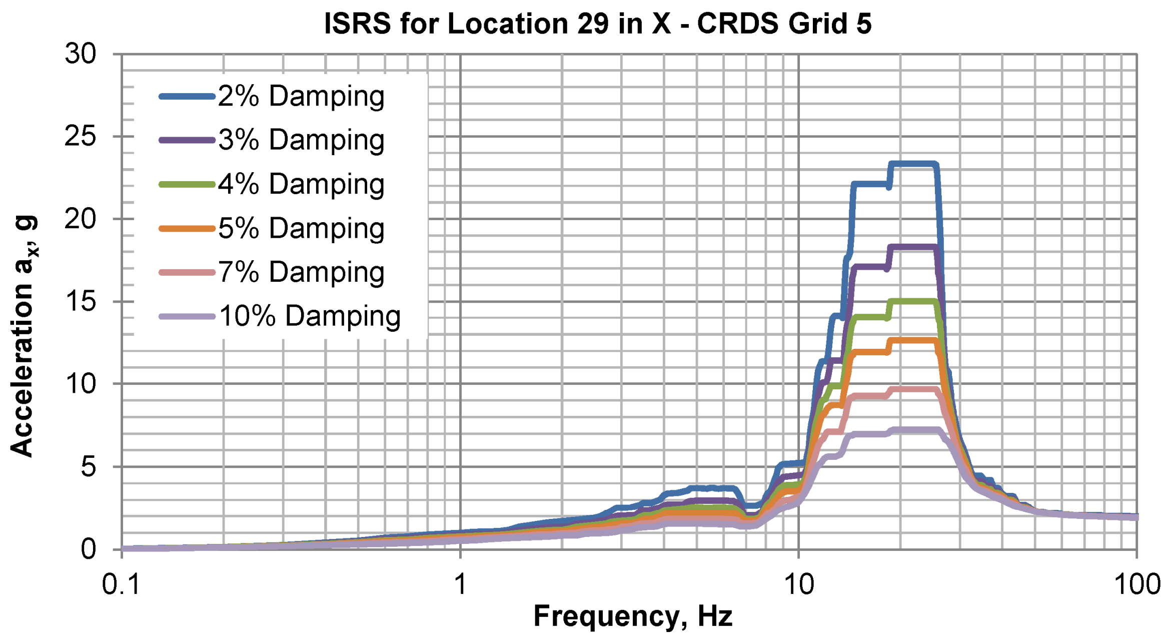

Figure B-25 Design ISRS, CRDS Grid 5 (upper riser), location 29, X-direction (east-west)

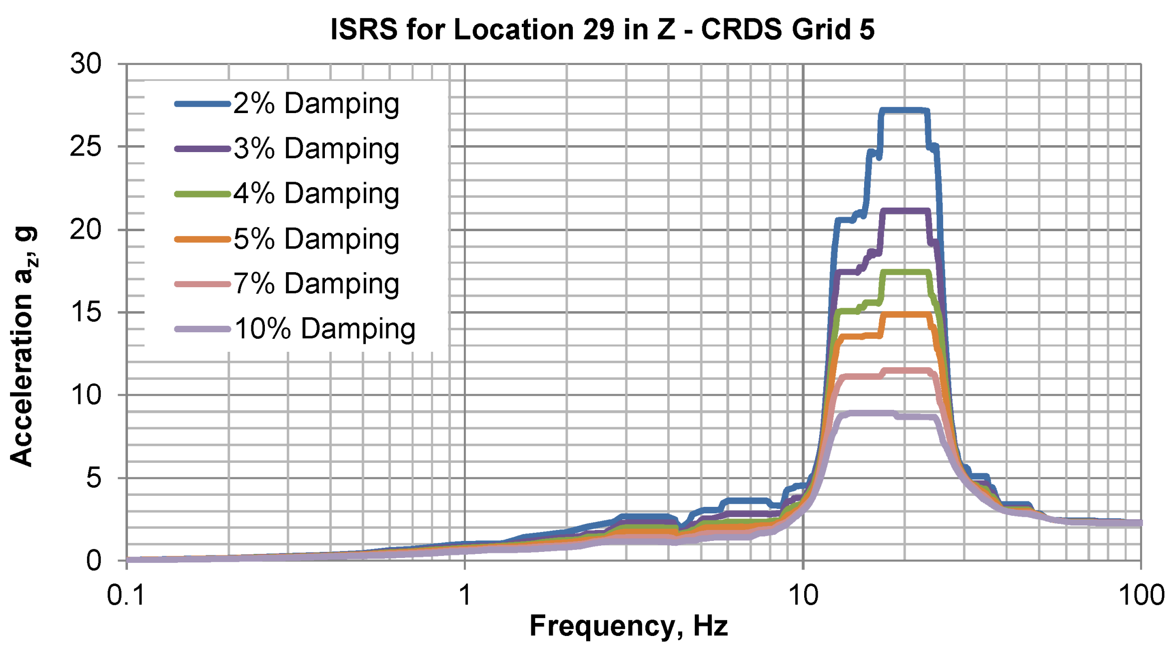

Figure B-26 Design ISRS, CRDS Grid 5 (upper riser), location 29, Z-direction (north-south)

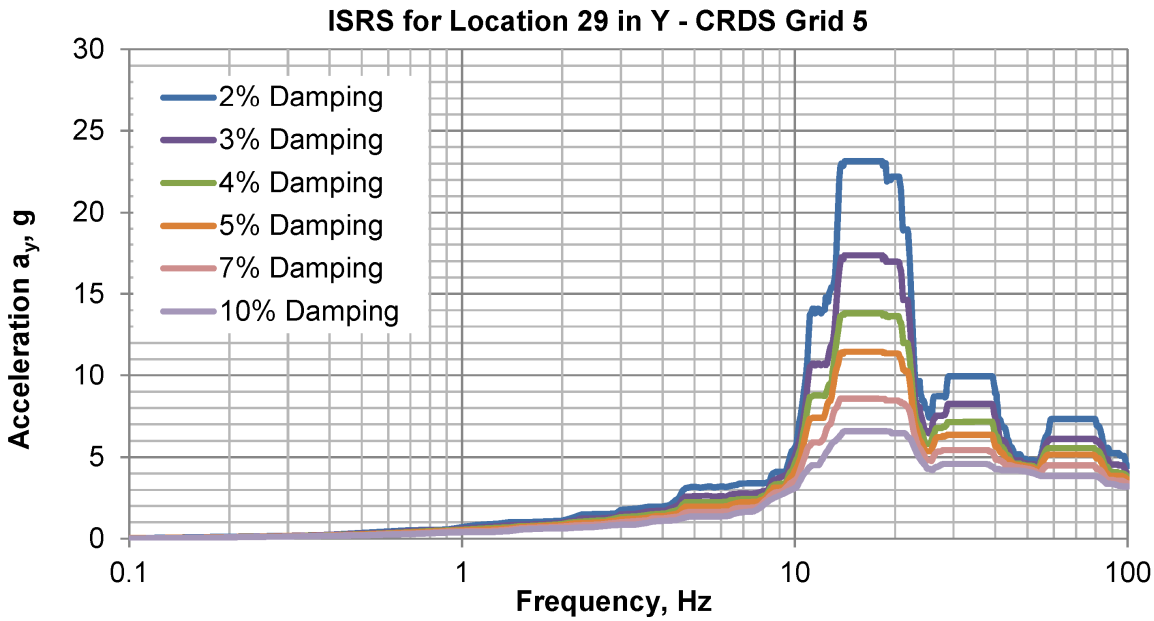

Figure B-27 Design ISRS, CRDS Grid 5 (upper riser), location 29, Y-direction (vertical)

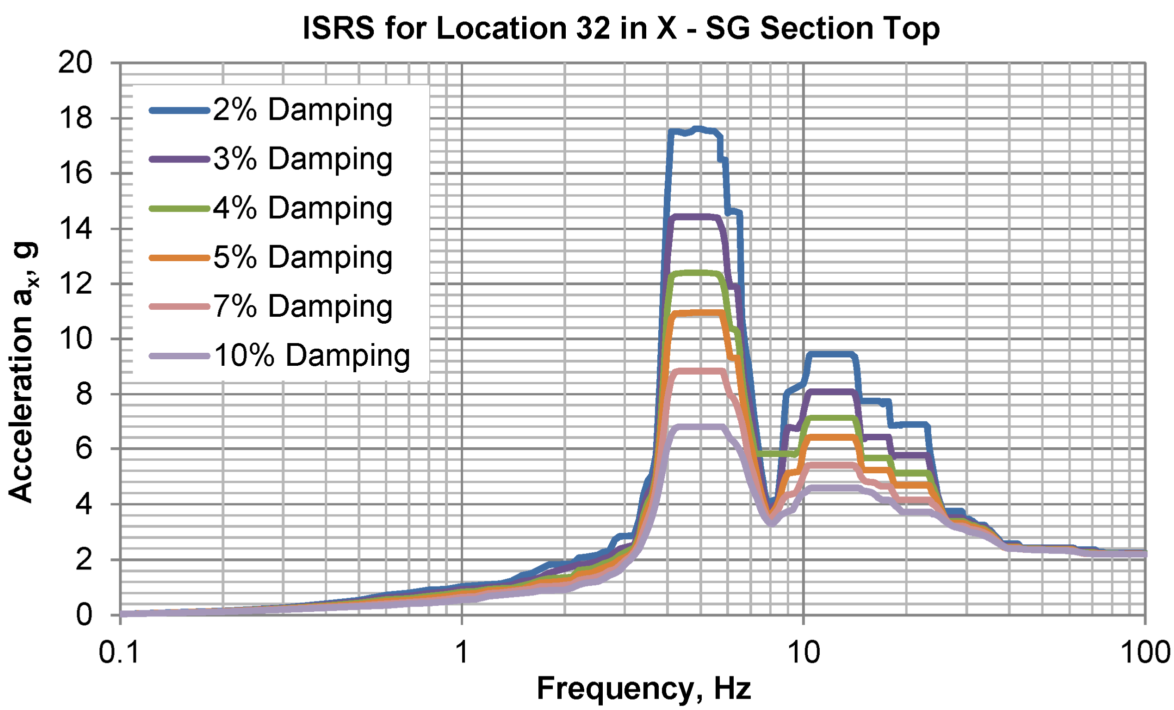

Figure B-28 Design ISRS, steam generator section top, location 32, X-direction (east-west)

Enclosure 3:

Affidavit of Thomas A. Bergman, AF-0119-64381

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 by which NuScale develops its power module seismic analysis.

    NuScale has performed significant research and evaluation to develop a basis for this method 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. 202, eRAI 8911. 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 January 31, 2019.

Thomas A. Bergman