RAIO-0618-60602

June 25, 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. 133 (eRAI No. 8936) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 133 (eRAI No. 8936)," dated August 05, 2017
2. NuScale Power, LLC Response to NRC Request for Additional Information No. 133 (eRAI No. 8936) on the NuScale Design Certfication Application, dated August 30, 2017 (ML17242A281)
3. NuScale Power, LLC Response to NRC Request for Additional Information No. 133 (eRAI No. 8936) on the NuScale Design Certfication Application, dated October 03, 2017 (ML17276B886)
4. NuScale Power, LLC Response to NRC Request for Additional Information No. 133 (eRAI No. 8936) on the NuScale Design Certfication Application, dated January 31, 2018 (ML18031B204)

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. 8936:

- 03.07.02-10

The response to RAI Question 03.07.02-12 was previously provided in Reference 2. The responses to RAI Questions 03.07.02-8, 03.07.02-9 and 03.07.02-11 were previously provided in Reference 3. The response to question 03.07.02-7 was previously provided in Reference 4. This completes all responses to eRAI 8936.

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 133 (eRAI No. 8936). 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. The technical report TR-0916-51502, "NuScale Power Module Seismic Analysis" contained export controlled information. The markup pages in the enclosed RAI response for TR-0916-51502 are therefore labeled "Export Controlled," although these markup pages do not contain any export controlled information. 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.

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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

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. 8936, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 8936, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0618-60603

Enclosure 1:

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

eRAI No.: 8936
Date of RAI Issue: 08/05/2017

NRC Question No.: 03.07.02-10

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.

On Page 3A-1 of the FSAR, the staff noted that a detailed dynamic analysis of the NPM subsystem is performed using a more detailed NPM model and the input time histories obtained from the SSI analysis of the reactor building which included a simplified NPM to account for the coupling of NPMs and the reactor building. The applicant is requested to provide in the FSAR a comparison of the seismic demands (forces and moments) at the NPM upper and bottom support locations interfacing with the RXB obtained from the SASSI analysis of the RXB system model and from the ANSYS analysis of the detailed 3D NPM system model. The applicant should explain any significant differences and confirm that the loads used for the NPM support designs are conservative.

NuScale Response:

The simplified model provides an approximate static and dynamic representation of the NuScale Power Module (NPM) within the Reactor Building (RXB) structure. The simplified beam model is developed because of the computational limitations of the soil-structure interaction (SSI) software used for the building seismic analysis. Three SSI analysis cases have been prepared in order to compare reaction forces from the 3-D NPM (ANSYS) model with the simplified NPM beam (SASSI) model. The cases have been selected because, typically, they are the bounding for design:

- Case 1: Soil Type 7, cracked concrete, 4% concrete damping, no frequency shifting of NPM, Capitola input.
- Case 2: Soil Type 7, uncracked concrete, 4% concrete damping, no frequency shifting of NPM, Capitola input.
- Case 3: Soil Type 7, cracked concrete, 4% concrete damping, frequency of NPM reduced 15%, Capitola input.

There are two key differences between the simplified beam model and the 3-D detailed model, which may account for slight variations in reaction forces at the building support locations:

	3D Detailed Model	Simplified Beam Model
1.	Incorporates non-linear behavior at the skirt location, allowing a more realistic representation of module uplift.	Assumes linear-elastic connection at the base of the NPM, separation is not allowed at the skirt location.
2.	RXB pool water geometry and mass distribution is modeled explicitly using ANSYS fluid elements with contact surfaces.	The dynamic behavior of RXB pool water is approximated using distributed point masses at structural node locations.

Although the detailed 3-D model provides an accurate representation of the NPM and reaction forces on the NPM bay walls and basemat, an envelope of reaction forces is used to provide a conservative design.

A summary of the maximum reaction forces at the NPM1 and NPM6 locations in the 3D ANSYS model, and at all twelve NPM locations in the SASSI model, is provided in Table 1. The two horizontal force components are combined using SRSS for the design of the containment vessel (CNV) skirt and skirt support. An envelope of the demand forces is used as the minimum design input for the CNV skirt, skirt support and NPM bay wall lug restraints. Additionally, Table 1 includes the seismic reaction force used for the design calculation, as well as the controlling demand/capacity ratios.

The results of the parametric studies have been added to the technical report TR-0916-51502, referenced in FSAR Appendix 3A, and summarized in the FSAR Section 3.7.2. In addition, demand/capacity ratios have been added to FSAR Sections 3B2.7.3, 3B.2.7.4 and 3B.2.7.4.2

Table 1: Summary comparison between 3-D detailed model and simplified NPM beam model of maximum reaction forces at the concrete interface with skirt and lug restraints, 4% damping.

NPM Model	SRSS Skirt Horizontal ($x10^3$ kips)	Vertical Skirt ($x10^3$ kips)	East Lug ($x10^3$ kips)	West Lug ($x10^3$ kips)	North Lug ($x10^3$ kips)
3D Detailed ANSYS	1.20	1.62	3.15	2.24	3.68
Simplified Beam SASSI	1.59	1.86	2.18	2.3	2.82
	CNV Skirt Locations		NPM Lug Restraint		
Controlling D/C Ratio	0.92[1]		0.82[2]		

Notes:

[1] Maximum D/C ratio identified at CNV skirt support interface with RXB basemat.

[2] Maximum D/C ratio identified at NPM lug support with a capacity of 4,500 kips.

Impact on DCA:

The FSAR Tier 2, Section 3.7.2.1, Section 3B.2.7, Table 3B-27 and technical report TR-0916-51502 Section 3.1.4, Section 3.1.5, and Table 8-6 have been revised as described in the response above and as shown in the markup provided with this response.

The lug and lug restraint combination is shown in Figure 3.7.2-22. Figure 3.7.2-23 shows the top view of a restrained NPM. The placement of the twelve NPMs in the model of the RXB is shown in Figure 3.7.2-24. An enlarged view of the NPM pool region is shown in Figure 3.7.2-25.

Figure 3.7.2-26 shows a view of the RXB model with twelve NPMs within the support walls. The lug restraints can be seen near the mid-height of the NPMs in the figure. Figure 3.7.2-27 shows a single NPM. In this figure, the lug restraint can be seen at the upper part of the NPM and the support skirt can be seen at the base of the NPM.

NuScale Power Module Model Included in the Reactor Building SASSI2010 Model

RAI 03.07.02-20, RAI 03.07.02-20S1, RAI 03.07.02-31S1, RAI 03.07.02-31S2

Within the SASSI2010 building model, the NPM is represented by a beam model as shown in Figure 3.7.2-28. The beam model was developed to have similar dynamic characteristics as a 3-D ANSYS model of a single NPM bay. To validate the NPM beam model, a modal analysis in three directions was performed in order to tune the simplified model to match the detailed 3-D model response~~, shown in Table 3.7.2-38~~. The skirt support at the base of the containment restricts horizontal and vertical movements. Eight rigid beams arranged like the legs of a spider are modeled to connect the NPM model containment skirt to nodes in the building model located at the interface of the skirt and pool floor. The RXB analysis produces local acceleration time histories that are used as input to the NPM seismic analysis. The seismic analysis of the NPM is discussed in Appendix 3A. Table 3.7.2-36 and Table 3.7.2-37 outline the NPM beam model to RXB model interface boundary conditions for the SASSI2010 and ANSYS models, respectively.

RAI 03.07.02-10

At the interface between the NPM and the RXB, the design loads for the skirt and lug supports are defined as the envelope between the SASSI2010 building model and the 3-D model discussed in Appendix 3A.

3.7.2.1.2.3 Reactor Building Crane

The RBC is a bridge crane used to transport modules between the operating locations and the refueling and disassembly area and the drydock. The RBC travels on rails on the top of the reactor pool walls at EL. 145'-6". When not in use, the RBC is parked over the refueling pool with the trolley at the north end near the dry dock gate. In this position, the RBC is not above either the SFP or the NPMs. The RBC is described in Section 9.1.5.

Reactor Building Crane Model Included in the Reactor Building SASSI2010 Model

RAI 03.07.03-1

operation. If the NPM impacts the passive support ring, the resulting upward vertical load will be resisted by the concrete anchors. Figure 3B-48 and Figure 3B-49 show the details of the passive support ring.

RAI 03.07.02-10, RAI 03.08.04-31

NuScale Power Module Model:

A separate ANSYS model is used to perform a non-linear dynamic analysis of the NPM. This model only includes the pool water and one NPM (1 or 6). The analysis results are based on the envelope of the six runs shown in Table 3B-52. The static reaction force, including the dead weight and the static buoyancy, is 1,090.4 kips in the vertical direction. The maximum vertical seismic reaction force, which does not include the static reaction force is 3,231 kips. The maximum uplift displacement, due to seismic, of the module from the floor is less than 0.125 inch.

Envelope Loads:

RAI 03.07.02-10, RAI 03.07.02-20, RAI 03.08.04-31

- Vertical downward load, P = 5,2273,859 kips. This load includes dead load, fluid pressure load, and seismic load. Dead load is the static buoyancy load described above and is equal to 1,090.4 kips. The fluid pressure load is determined by the product of the baseplate area (14.5' x 14.5'), the fluid density (62.4 pcf), and the normal operating reactor pool depth (69') and is equal to 905.3 kips. The enveloping downward seismic load is 3,2311,863 kips, as stated above.

RAI 03.07.02-20

- The vertical displacement is less than 0.125 inch. The passive support ring is 4.5 inches thick below the bevel, therefore, there will always be lateral support from the passive support ring.

RAI 03.07.02-10, RAI 03.07.02-20

- Lateral load:
  - East-West seismic load = 7031,144 kips
  - North-South seismic load = 1,1641,103 kips
  - Square Root Sum of Squares horizontal seismic load =

$$\sqrt{(1{,}144^2 + 1{,}103^2)} = 1{,}589 \text{ kips}$$

RAI 03.07.02-20

It is possible for the support ring and anchors to experience an upward vertical force if the NPM were to strike the support ring during a seismic event. Because this force is of extremely short duration and the contact surface small, only a limited amount of force is transferred to the support ring. A coefficient of friction value between wet steel and steel of 0.2 is multiplied by the square root sum of squares of east-west and north-south seismic loads to determine this force.

RAI 03.07.02-10, RAI 03.07.02-20

$$V_{uplift} = 0.2 \times 1{,}589 \text{ kips} = 318 \text{ kips}$$

Materials and Material Strength:

- Stainless Steel: The stainless steel used for the liner plate conforms to ASTM A-167 or ASTM A-240 Type 304L and has a 0.2 percent offset yield strength of 25 ksi, and ultimate tensile strength 70 ksi.

RAI 03.07.02-10, RAI 03.07.02-20

- Austenitic Stainless: The steel used for the 4-in.-thick bearing plate that supports the NPMs vertically is ASTM A965 Grade F304 with a yield strength of ~~23.6~~22.4 ksi and ultimate tensile strength of 61.~~4~~8 ksi at a design temperature of 300 degrees Fahrenheit.
- Concrete for Basemat: The concrete strength, f'_c is 5000 psi

RAI 03.07.02-20

A total of 36, 3/4 in. diameter, ASTM F1554, Grade 55 concrete anchors are used to anchor the passive support ring and embedded plate assembly. These anchors have a yield strength of 55 ksi and designations of S1 (weldable) and S4 (Charpy test).

RAI 03.07.02-20

A total of 30, 1.5 in. thread diameter, ASTM A479, Type UNS S21800 bolts fasten the passive support ring to the embedded plate.

Load Path:

RAI 03.07.02-20

- The vertical load is resisted by the 14.5 ft square, 4 in. thick bearing ring plate.

RAI 03.07.02-20

- The lateral load is resisted by bolts that connect the passive support ring to the embedded bearing plate. The bolts transfer the lateral load to the bearing plate, which, in turn, transfers the load, via bearing, to the concrete basemat.

Evaluation:

Vertical Load Bearing Capacity

RAI 03.07.02-10, RAI 03.07.02-20, RAI 03.08.04-31

- Area of concrete in bearing, A_{brg}, is 4310 in^2, therefore the bearing pressure (P_V/ A_{brg}) is ~~1.21~~0.90 ksi
- Allowable bearing pressure = (Φ)(0.85f'c) = 2.76 ksi [Φ = 0.65]

RAI 03.07.02-10, RAI 03.07.02-20, RAI 03.08.04-31

- Vertical bearing D/C Ratio: = ~~0.44~~0.33

RAI 03.07.02-10, RAI 03.07.02-20

- The maximum D/C ratio of the anchor bolts is due to concrete breakout in tension and is equal to ~~0.64~~0.74.

Lateral Load Resistance

RAI 03.07.02-10, RAI 03.07.02-20

- SRSS Lateral Load is ~~1,360~~1,589 kips

RAI 03.07.02-10, RAI 03.07.02-20

- The D/C ratio of the bolts in shear and tension is ~~0.68~~0.92.

RAI 03.07.02-10, RAI 03.07.02-20, RAI 03.08.04-31

- The maximum D/C ratio for concrete bearing due to lateral load transferred from the bearing plate is ~~0.71~~0.83.

3B.2.7.4 Nuscale Power Module Lug Restraint

The NPM lug restraint design consists of a stainless steel bumper comprised of 2″ thick plates with 2″ thick stiffener plates. The bumpers are welded to 2″ thick stainless steel liner plates. On the inside of the liner plate there are 3″ thick, 5″ wide (48″ depth) steel shear lugs to transfer the lateral shear loads into the wall. Finally, the two bumpers on either side of the lug on the pool walls are bolted together with through-bolts to withstand tensile loads due to moments from the eccentric lateral shear loads. The design layout for the support system for the NPM lug restraints is shown in Figure 3B-51.

The bumpers are Stainless Steel Type 630 - H1150, with a yield strength of 100.8 ksi, and an ultimate strength of 135 ksi. The shear lugs are carbon steel ASTM A572 GR 50, with a yield strength of 50 ksi, and an ultimate strength of 65 ksi. The through-bolts are ASTM A193 GR B7, with a yield strength of 105 ksi, and an ultimate strength of 125 ksi.

RAI 03.08.04-21S2

A separate SAP2000 model is created for the local analysis of the RXB lug support system. This lug restraint model is a comprehensive, finite-element model of half of a single NPM wing wall. Therefore, 2.5' of the wall thickness, with two lugs on one face of the wall, are included in the model. The load is distributed as point loads to one of the lugs. The wing wall is modeled with solid elements. The liner plate, the stainless steel lug, and the bumper built-up section are modeled with shell elements. The through bolts are not modeled explicitly; however, the axial tension of the shear lugs is used to determine the tension force in the through bolts. Because the shear lugs transfer the shear loads from the bumper to concrete, the through bolts are considered to be under tension only. All welds along the load path are CJP welds. This includes the bumper built-up section, the bumper to the liner plate, and liner plate to the shear lugs.

RAI 03.08.04-21S2

In this local model, an assumed horizontal load of 3500 kips is applied to determine the stresses in different components of the support. Different modes of failure for different lug components are checked, including tensile capacity of through-bolts, punching shear and concrete bearing, and bending stresses on the liner plate. The most controlling mode of failure is bearing against concrete with a D/C=0.777. Because this D/C occurs for an applied load of 3500 kips, the true capacity of the lug assembly, where D/C would reach a value of 1.0, occurs for a load of 3500 kips/0.777=4500 kips.

RAI 03.07.02-10, RAI 03.08.04-21S2

To check the adequacy of the lugs, the maximum seismic reaction on a lug from the NPM Seismic Analysis model is compared against the lug capacity calculated from the local lug model. The maximum demand reactions in the global RXB model are based on three Soil Type 7 (CSDRS) analysis cases:

RAI 03.07.02-10

- Case 1: Soil Type 7, cracked concrete, 4% concrete damping, no frequency shifting of NPM, Capitola input.

RAI 03.07.02-10

- Case 2: Soil Type 7, uncracked concrete, 4% concrete damping, no frequency shifting of NPM, Capitola input.

RAI 03.07.02-10

- Case 3: Soil Type 7, cracked concrete, 4% concrete damping, frequency of NPM reduced 15%, Capitola input.

RAI 03.07.02-10, RAI 03.08.04-21S2

The maximum lug reaction from the NPM Seismic Analysis model is provided in TR-0916-51502, NuScale Power Module Seismic Analysis (Reference 3B-6), and is less than the lug capacity of 4500 kips. This shows that the lugs are structurally qualified.

RAI 03.08.04-21,

A separate local SAP2000 model is used to analyze the support system for an assumed demand of 3500 kips. The NPM lug restraint model is a comprehensive finite element model of half of a single NPM wing wall. The wall is 2.5' thick and has one support lug for analysis. The load is distributed as point loads to one of the lugs. The wing wall is modeled with solid elements, the liner plate and the stainless steel lug are modeled with shell elements. The stiffeners are also modeled with shell elements.

The NPM bay walls and location of the NPM lugs is shown in Figure 3B-52. The NPM lug restraint model is shown in Figure 3B-53 and Figure 3B-54. The liner plate and shear lugs are modeled as shell elements and are shown in Figure 3B-55 and Figure 3B-56. In Figure 3B-57, the outside of the bumper is removed in order to display the stiffener plates inside.

RAI 03.08.04-21, RAI 03.08.04-21S1, RAI 03.08.04-21S2

The demand reactions are based on two cases of Soil Type 7 (CSDRS) and Soil Type 9 (CSDRS-HF). These two cases, in general, provide the highest structural responses. The capacity is based on the assumed value of 3500 kips, that the lugs are designed for, however, due to the extra margin in the design, the actual strength is 4500 kips which is higher than the maximum demand of 3726 kips. The demand to capacity ratios in calculations for the lug components are derived and shown to be less than one, which shows the lugs are qualified.

Section cuts were used to extract forces and moments for design of the NPM lug support. Table 3B-26 displays the forces and moments for the two 3500 kip load cases: W-Lug-PY+ (shown in Figure 3B-58) and W-Lug-PY+ (shown in Figure 3B-59). Figure 3B-60 shows the liner plate section cuts at the intersection of the inside face

RAI 03.08.04-36

From Table 3B-26, the maximum moment on the plate occurs at the shear lug at Y = 88.2" for lug load in the +Y direction. This moment produces a bending stress in the liner of 23.12 ksi. This is much less than the 100.8 ksi yield strength of the liner. The resulting D/C is 0.23.

3B.2.7.4.2 Overall Lug Restraint Reaction

RAI 03.07.02-10, RAI 03.08.04-36

Table 3B-27 presents the ~~maximum~~SASSI envelope lug reactions for all twelve bays using the three analysis cases with Soil Type 7 for Capitola input motion~~CSDRS and Soil Type 9 for CSDRS-HF using the cracked RXB model~~ with 4 percent structural damping in the RXB model. Since the~~se~~ maximum lug reactions are below the lug support design capacity of ~~3,500~~4,500 kips, the design is acceptable.

3B.3 Control Building

3B.3.1 Design Report

Structural Description and Geometry

The CRB is a Seismic Category I concrete structure at elevation 120'-0" and below, except as noted in Section 1.2.2.2. Above EL 120'-0" the CRB is a Seismic Category II steel structure. For a detailed description of the CRB, see Section 3.8.4.1.2. The CRB geometry and floor layout are shown in Figure 1.2-21 through Figure 1.2-27.

Structural Material Requirements

The CRB design is based on the following material properties:

- Concrete
  - Compressive Strength - 5 ksi
  - Modulus of Elasticity - 4, 031 ksi
  - Shear Modulus - 1,722 ksi
  - Poisson's Ratio - 0.17
- Reinforcement
  - Yield Stress - 60 ksi (ASTM A615 Grade 60 or ASTM A706 Grade 60)
  - Tensile Strength - 90 ksi (A615 Grade 60), 80 ksi (A706 Grade 60)
  - Elongation - See ASTMs A615 and A706
- Structural Steel
  - Grade - ASTM A992 (W shapes), ASTM A500 Grade B (Tube Steel), ASTM A36 (plates)

RAI 03.07.02-10

Table 3B-27: SASSI EnvelopeMaximum Lug Reactions for RXB Cracked Model using Soil Type 7 (Capitola input motionCSDRS) and Soil Type 9 (CSDRS-HF)

Enveloped Input Case	East Wing Wall N-S Lug Reaction (x 10^3 kips)	Pool Wall E-W Lug Reaction (x 10^3 kips)	West Wing Wall N-S Lug Reaction (x 10^3 kips)
Soil Type 7 CSDRS	1,8192.18	2,3202.82	1,9572.30
D/C ratio (to 3500 kip load)	0.520.49	0.660.63	0.560.51
Soil Type 9 CSDRS-HF	1,784	2,249	1,930
D/C ratio (to 3500 kip load)	0.51	0.64	0.55

3.1.4 Creation and Analysis of a Reactor Building Model in SASSI

The SAP2000 RXB model created in step 3.1.3 is converted to a SASSI model. The SASSI RXB model is then evaluated for SSI by analysis performed in the frequency domain. The results of this analysis are used for seismic analysis of the RXB; however, because only a simplified representation of the NPM is included, final seismic analysis of the NPM is not performed with this model. Results from this analysis are only used as inputs for seismic analysis of the detailed 3D model of the NPM, as described in a later step, and to compare the reaction forces at the NPM support locations to the detailed 3D model, ensuring a conservative design.Results from this analysis are used only as inputs for seismic analysis of the detailed 3D model of the NPM, as described in a later step. Results from the RXB seismic analysis include in-structure acceleration time histories at each NPM support, at centerline nodes of the CNV, and various locations on the RP walls and floor. In-structure response spectra are also calculated. The RXB analysis is repeated for multiple SSI analysis cases. The details and methodology used for the RXB SASSI model are discussed in the NuScale FSAR Section 3.7.2.

3.1.5 Creation and Analysis of Detailed Three-Dimensional NuScale Power Module Models in ANSYS (Entire Pool Model)

Detailed 3D finite element models of the NPM and RP fluid are created and used to perform seismic analysis. The 3D model created in the initial step of the seismic design process (see Section 3.1.1) is used and modified to include the entire RP volume (i.e., “entire pool model”). Multiple versions of the model are created to analyze the bounding NPM locations within the RXB. The detailed 3D models of the NPM are further described in Sections 4.0 and 5.0.

Seismic analyses of the models are performed by applying time history displacements from the Reactor Building SSI analysis to the NPM support locations, and time history accelerations to the RP fluid surfaces in contact with the RP floor and walls.

At acoustic fluid element surfaces, possible boundary conditions for transient dynamic analysis include either specified pressure or specified normal acceleration time histories. For the acoustic element surfaces, specified displacement is not an option provided by ANSYS. Acceleration time histories are applied on fluid boundaries at the reactor pool walls and floor and at fluid surfaces where NPM are not explicitly modeled. Zero pressure is specified on the top surface of the pool.

Displacement time histories are applied to structural supports where displacement degrees of freedom exist (NPM skirt support and lugs). Displacement time histories used for the structural supports are obtained by double integration of the acceleration time histories.

When acceleration time histories taken from SASSI are double integrated and input to the ANSYS analysis, drift or “baseline errors” may be introduced due to choice of the integration methods and initial conditions. The drift is eliminated by introducing a small adjustment to the accelerations at the beginning of each record. The drift correction has segment slot and the hole on the ledge it with which it interfaces. Node locations are listed in Table 8-3. See Appendix A for figures.

The maximum forces and moments for the representative component interfaces listed in Table 8-4 are provided in Table 8-7. 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. These forces are provided and compared to the reaction forces produced by the SASSI RXB model (Section 3.1.4) in Table 8-6. 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, are provided 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) (1)		
		FX (East-West)	FY (Vertical)	FZ (North-South)
1	CNV skirt (2)	{{		}}2(a),(c)
4	CNV lug +X	{{		}}2(a),(c)
5	CNV lug -X	{{		}}2(a),(c)
6	CNV lug -Z	{{		}}2(a),(c)

Notes: (1) Directions in global Cartesian coordinate system 0.
(2) 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.

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.

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0618-60603

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AFFIDAVIT of Zackary W. Rad

I, Zackary W. Rad, state as follows:

1. I am the Director, 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 seismic design and analyses.

    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. 133, eRAI No. 8936. 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 June 25, 2018.

Zackary W. Rad