RAIO-0917-56253

September 27, 2017

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. 110 (eRAI No. 8932) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 110 (eRAI No. 8932)," dated July 30, 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 Enclosure to this letter contains NuScale's response to the following RAI Questions from NRC eRAI No. 8932:

- 03.07.02-2
- 03.07.02-3

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

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. 8932

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8932

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

eRAI No.: 8932
Date of RAI Issue: 07/30/2017

NRC Question No.: 03.07.02-2

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 3.7-20 of the FSAR, in the third paragraph, the applicant states, “The building models have element sizes that are similar to the 6.25 feet layers that were used to determine the wave passage frequency of the soil. There are instances where development of the model required individual elements to have a dimension as large as 12 feet in the RXB and as large as 20 feet in the CRB. However, the typical element size is approximately 6 feet. Therefore the wave passage frequencies of both buildings is above the cut-off frequencies used for the analysis.” For elements that have a dimension of 12 ft or 20 ft, the applicant is requested to provide the elements locations in the building, and explain how the presence of these coarse elements do not affect the results of seismic demand analyses for the RXB and CRB.

NuScale Response:

FSAR Tier 2, Section 3.7.2.1.1.3 describes element sizes used in the SASSI2010 models. In the control building (CRB) model, the elements with large dimensions or aspect ratios are non-structural areas or membrane elements used for the purpose of applying wind loads to the steel beams and columns of the steel frame structure above elevation 120 ft. The 20 ft elements are located on the north and south walls whereas the 12 ft elements are located on the east and west walls above elevation 120 ft. Similar surface area loads are applied to the CRB roof to evenly distribute applied loads. The loads are applied as surface pressure on these areas and then transferred to the structural elements through the shared nodes. These coarse elements are not present in the seismic analyses and will therefore not affect the seismic demand results. FSAR Tier 2, Figures 3.7.2-59 through 3.7.2-61 show the surface elements used to distribute the applied loads. The elements in grey represent the surface areas in the North-South and East-West direction and the orange elements represent the surface areas used in the CRB roof. The locations have been identified in Figures 1 through 3 of this response.

In the reactor building (RXB) model, there are 24 elements with approximate dimensions of 12 ft x 6 ft at the pool floor, as shown on Figure 4. These are transition solid elements beginning in the top layer of solid elements used to model the basemat, as shown in Figure 4. The mesh transitions into the uniform soil mesh, matching the soil interaction nodes at the base elevation of the basemat, with an average element size of approximately 6.25 ft. The single layer of coarse basemat transition elements have minimal or no effect on the seismic analysis results.

Figure 1: Isometric View of South Side of Triple SAP2000 Model (Looking Northeast)

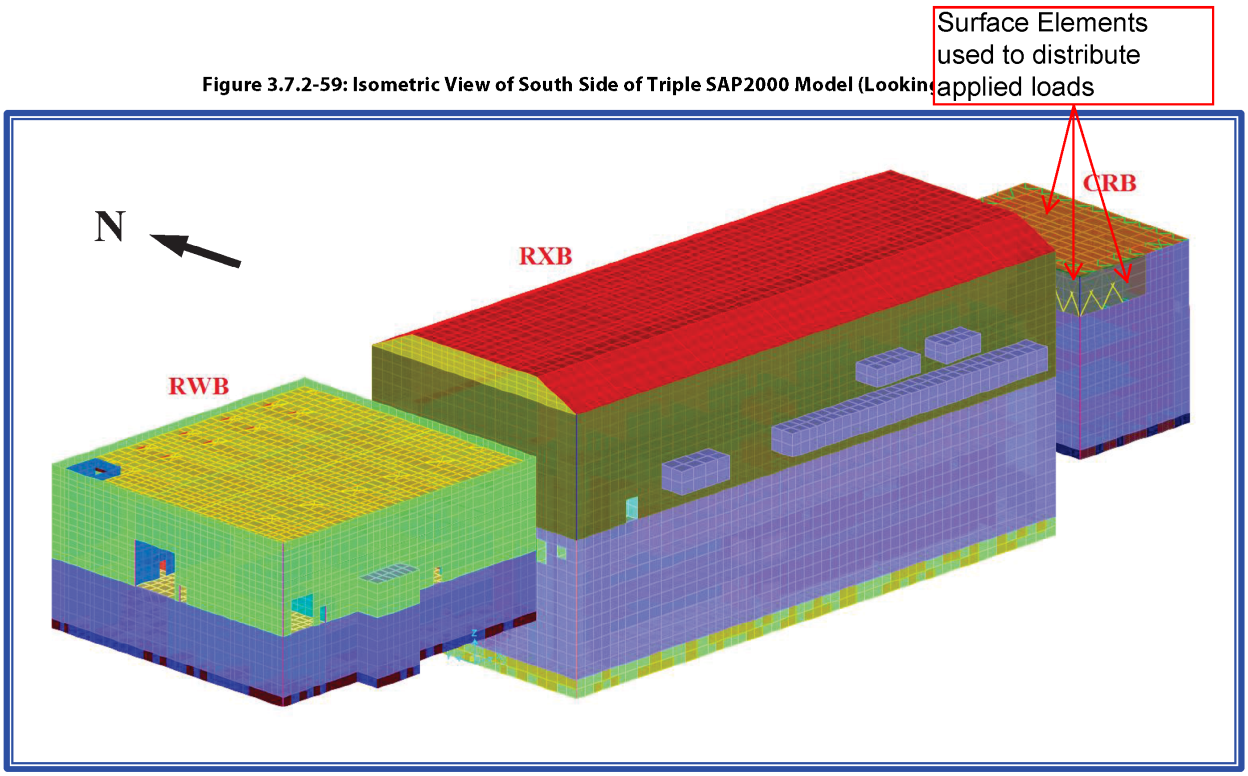


Figure 2: Isometric View of South Side of Triple SAP2000 Model (Looking Northwest)

Figure 3.7.2-60: Isometric View of South Side of Triple Building SAP2000 Model (Looking Northwest)

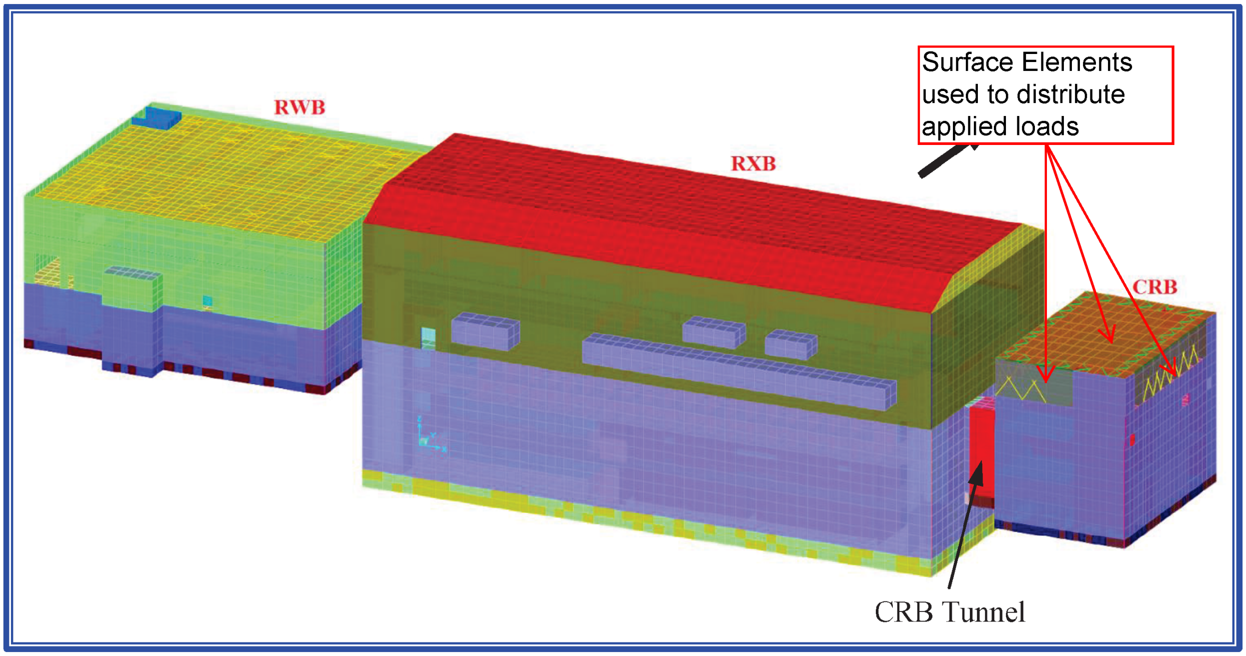


Figure 3: Isometric View of North Side of Triple SAP2000 Model (Looking Southwest)

Figure 3.7.2-61: Isometric View of North Side of Triple Building SAP2000 Model (Looking Southwest)

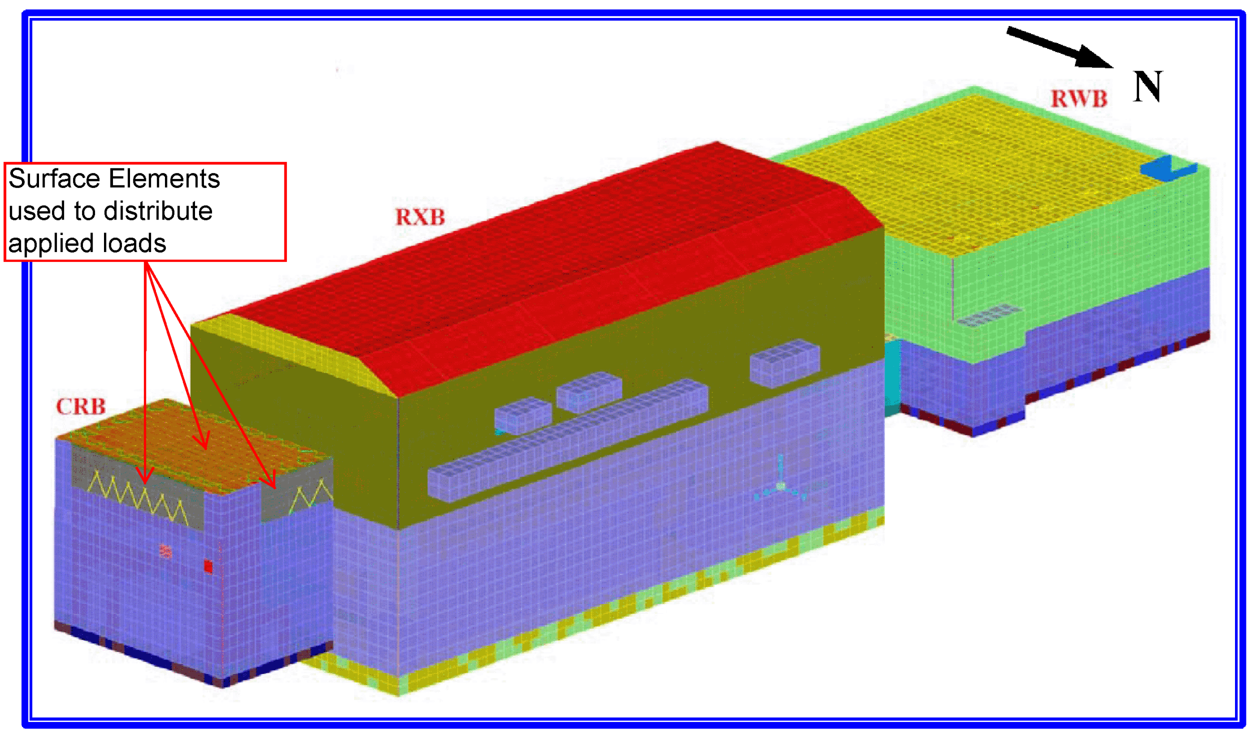
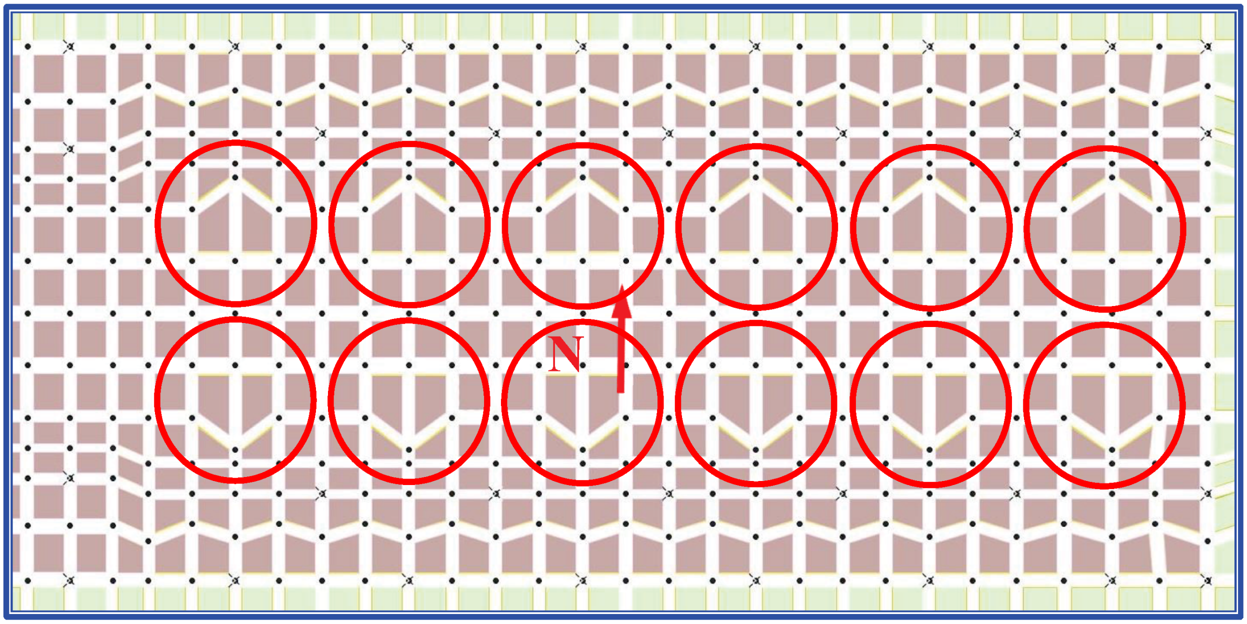


Figure 4: Nodes at NPM Pool Floor (EL. 25'0")

Figure 3.7.2-95: Nodes Used for ISRS for NPM Bay Walls at the Pool Floor (EL. 25' 0")



Impact on DCA:

There are no impacts to the DCA as a result of this response.

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

eRAI No.: 8932
Date of RAI Issue: 07/30/2017

NRC Question No.: 03.07.02-3

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 3.7-20 of the FSAR, in the first paragraph, the applicant states, “For the analysis of Soil Types 7, 8 and 11 with the CSDRS the cut-off frequency was established at 52 Hz. This is higher than the wave passing frequency of the soft soil profile (Soil Type 11) but less than the passing frequency of the other two soils (see Table 3.7.1-20).” Table 3.7.1-20 shows 12 Hz as the passing frequency of Soil Type 11. Tables 3.7.2-18 and 19 indicate the transfer functions (TFs) are calculated for frequencies up to 52 Hz (cut-off frequency) for Soil Type 11. The applicant is requested to justify the validity of the TF calculations for frequencies beyond the passing frequency for Soil Type 11.

b. On Page 3.7-20 of the FSAR, in the first paragraph, the applicant states, “For the analysis of Soil Types 7, 8 and 11 with the CSDRS, the cut-off frequency was established at 52 Hz.” However, in Table 3.7.2- 19, for Soil Type 7 with the CSDRS, a cut-off frequency of 72 Hz is used. The applicant is requested to clarify the inconsistency.

c. On Page 3.7-20 of the FSAR, in the second paragraph, the applicant states, “For the analysis with the rock profiles (Soil Type 7 and 9) and the CSDRS-HF, the cut-off frequency was established at 72 Hz.” However, in Table 3.7.2-21, for Soil Type 9 with the CSDRS-HF, a cut-off frequency of 52 Hz is used. The applicant is requested to clarify the inconsistency. Also, Table 3.7.2-21 does not provide analysis frequencies for Soil Types 8 and 11 with CSDRS and for Soil Type 7 with CSDRS-HF. Please explain why these frequencies are not provided.

d. In Figure 3.7.2-20 in the FSAR, The applicant is requested to clarify if the bottom two layers represent the basemat which is to be considered as part of the RXB and color-coded accordingly (in blue). The figure also appears to show mixed coloring for certain elements in the bottom two layers. Please explain what the mixed colors represent for these elements.

NuScale Power

NuScale Response:

Responses pertaining to FSAR Tier 2, Section 3.7.2.1.1.3, SASSI 2010, are provided as follows:

a. The wave passing frequency is the maximum frequency for a seismic shear wave to propagate through a layered soil medium. The soil-structure interaction in the analysis will be filtered out at frequencies higher than this cutoff. As a result, the frequencies above this cutoff may result in a damped structural response for Soil Type 11. However, this will not negatively affect the overall calculation of transfer functions, which are bounded by firm and hard rock soil cases in the high frequency range.

b. The cutoff frequency for Soil Type 7 with the certified seismic design response spectra (CSDRS) is established at 52 Hz. For the reactor building (RXB) from the Triple Building Model, additional frequencies were added to ensure all of the seismic input motion was captured and to ensure there were no peaks in the transfer functions.

c. FSAR Section 3.7.2.4.6 states, "The control building (CRB) analysis did not include all the triple building model cases. For the triple building model, Soil Type 7 was evaluated with the CSDRS and Soil Type 9 was evaluated with the high frequency certified seismic design response spectra (CSDRS-HF)." Soil Types 8 and 11 with the CSDRS and Soil Type 7 with the CSDRS-HF are not considered for the design because, in general, the controlling case for the CRB is the Soil Type 7 with CSDRS.

   The contents of Table 3.7.2-21, "Frequencies Used in Transfer Function Calculation for CRB with Triple Building CRB Model", are used to study the structural response of the CRB where high frequencies are expected to be non-damaging and have been limited to 52 Hz.

   Section 3.7.2.5.2 states: "The structure-soil-structure interaction of the triple model has an effect on the in-structure response spectra (ISRS) of the RXB. Other than the ISRS at top of basemat, the ISRS of the standalone model are higher than those of the triple building model. The reduction in the ISRS of the triple building model is attributed to the extra damping effect provided by the close presence of the RWB and the CRB on the sides of the RXB.

   This can be seen in Figure 3.7.2-103, Figure 3.7.2-104 and Figure 3.7.2-105.

   ISRS from the triple building model were not created for the CRB."

   For the ISRS analyses, where the response spectra from the Standalone CRB Model controls, the cutoff frequency is taken to 72 Hz, as shown in Table 3.7.2-20. The higher cutoff for the ISRS of the Standalone CRB Model will adequately capture the high frequency content required for equipment and component design.

d. The 10 ft thick RXB basemat foundation is modeled by two 5 ft thick layers of Solid elements. The RXB outer walls, pool walls, and all the walls connected to the foundation are modeled as shell elements and start at the bottom of the foundation level. Similarly, all pilasters (Beam elements) start at the bottom of the foundation. All groups of Solid elements are shown in green, groups of Shells are shown in blue, and Beam elements are shown in red. The backfill soil and foundation Solid elements are, therefore, all green. Due to the limited capabilities of the SASSI2010 model geometry plotting program, the graphical perspective views of the finite element analysis (FEA) model may cause color overlapping. FSAR Tier 2, Figure 3.7.2-20 is revised to include a legend for the Shell, Solid, and Beam elements.

Impact on DCA:

FSAR Tier 2, Figure 3.7.2-20 has been revised as described in the response above and as shown in the markup provided in this response.

RAI 03.07.02-3

Figure 3.7.2-20: Half of Reactor Building SASSI2010 Model without Hidden Lines