RAIO-0818-61577

August 28, 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. 167 (eRAI No. 8964) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 167 (eRAI No. 8964)," dated August 12, 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 Question from NRC eRAI No. 8964:

- 03.08.05-2

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
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8964

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8964

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

eRAI No.: 8964
Date of RAI Issue: 08/12/2017

NRC Question No.: 03.08.05-2

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4 and 5 provide the regulatory requirements for the design of the seismic Category I structures. DSRS Section 3.8.5 provides review guidance pertaining to design of foundations.

In FSAR Tier 2, Section 3.8.5.6.7, “Basemat Soil Pressures along Basemat Edges (Toe Pressures),” the applicant performed analyses to determine the edge bearing pressures (or toe pressures) along the edges of the seismic Category I structure basemats (RXB and CRB). In FSAR Tier 2, Section 3.8.5.5.5 “Settlement Approach,” the applicant considered a condition of the soil stiffnesses that are further reduced by 50 percent to amplify the effect of settlements. Therefore, provide information on associated settlements due to soft soil stiffnesses along the edges of the seismic Category I structure.

NuScale Response:

The foundation displacement results from the static, flexible-base triple building model are presented. The displacements, due to soft soil stiffness, are presented for selected nodes along the foundation edge of the RXB, CRB, and RWB in Table 1 and Table 2 for uncracked and cracked conditions, respectively. The location of the nodes are shown in Figure 1.

The displacement results and associated figure have been added to FSAR Tier 2, Section 3.8.5.

Table 1 - Displacements at Bottoms of Foundations of Uncracked Triple Building Model

Building	Node Location	Node No.	Coordinates (inch)			Displacement (inch)		
			X	Y	Z	U1(EW)	U2(NS)	U3(Vert)
RWB	West	41173	-2460	-825	570	-0.1	0.01	**-0.6**
		41189	-2460	96	570	-0.1	0.01	**-0.61**
		41206	-2460	1149	570	-0.08	0.02	**-0.52**
	Middle	41887	-1380	-825	570	-0.11	0.01	**-1.04**
		41903	-1380	96	570	-0.1	0.01	**-1.04**
		41920	-1380	1149	570	-0.09	0	**-0.9**
	East	42517	-300	-825	570	-0.12	0.01	**-1.63**
		42533	-300	96	570	-0.11	0.01	**-1.62**
		42550	-300	1149	570	-0.12	0.03	**-1.46**
RXB	West	129	0	-873	0	-0.02	-0.03	**-1.75**
		140	0	0	0	-0.03	0	**-1.81**
		151	0	873	0	-0.02	0.04	**-1.75**
	Middle	801	1872	-873	0	-0.01	-0.01	**-1.89**
		812	1872	0	0	-0.02	0.01	**-2.05**
		823	1872	873	0	-0.01	0.03	**-1.88**
	East	1616	4092	-873	0	0.02	-0.02	**-1.95**
		1627	4092	0	0	0.02	0.02	**-2**
		1638	4092	873	0	0.01	0.05	**-1.94**
CRB	West	31066	4470	-705	345	0.15	0.01	**-1.75**
		31078	4470	-8	345	0.15	0.01	**-1.78**
		31089	4470	705	345	0.15	0.02	**-1.73**
	Middle	31327	4980	-705	345	0.16	0.01	**-1.36**
		31339	4980	-8	345	0.16	0.01	**-1.36**
		31350	4980	705	345	0.16	0.02	**-1.34**
	East	31559	5406	-705	345	0.16	0.01	**-1.04**
		31571	5406	-8	345	0.16	0.01	**-1.05**
		31582	5406	705	345	0.17	0.02	**-1.02**

Table 2 - Displacements at Bottoms of Foundations of Cracked Triple Building Model

Building	Node Location	Node No.	Coordinates (inch)			Displacement (inch)		
			X	Y	Z	U1(EW)	U2(NS)	U3(Vert)
RWB	West	41173	-2460	-825	570	-0.1	0.01	**-0.6**
		41189	-2460	96	570	-0.1	0.01	**-0.61**
		41206	-2460	1149	570	-0.08	0.03	**-0.53**
	Middle	41887	-1380	-825	570	-0.11	0.01	**-1.04**
		41903	-1380	96	570	-0.1	0.01	**-1.04**
		41920	-1380	1149	570	-0.09	0	**-0.89**
	East	42517	-300	-825	570	-0.12	0.01	**-1.64**
		42533	-300	96	570	-0.11	0.01	**-1.63**
		42550	-300	1149	570	-0.12	0.03	**-1.46**
RXB	West	129	0	-873	0	-0.02	-0.04	**-1.75**
		140	0	0	0	-0.03	0	**-1.81**
		151	0	873	0	-0.02	0.04	**-1.75**
	Middle	801	1872	-873	0	-0.01	-0.01	**-1.89**
		812	1872	0	0	-0.02	0.01	**-2.06**
		823	1872	873	0	-0.02	0.03	**-1.88**
	East	1616	4092	-873	0	0.02	-0.02	**-1.95**
		1627	4092	0	0	0.02	0.02	**-2**
		1638	4092	873	0	0.01	0.05	**-1.94**
CRB	West	31066	4470	-705	345	0.14	0.01	**-1.75**
		31078	4470	-8	345	0.14	0.01	**-1.78**
		31089	4470	705	345	0.15	0.02	**-1.74**
	Middle	31327	4980	-705	345	0.15	0.01	**-1.36**
		31339	4980	-8	345	0.15	0.01	**-1.36**
		31350	4980	705	345	0.16	0.02	**-1.34**
	East	31559	5406	-705	345	0.16	0.01	**-1.04**
		31571	5406	-8	345	0.16	0.01	**-1.05**
		31582	5406	705	345	0.16	0.02	**-1.02**

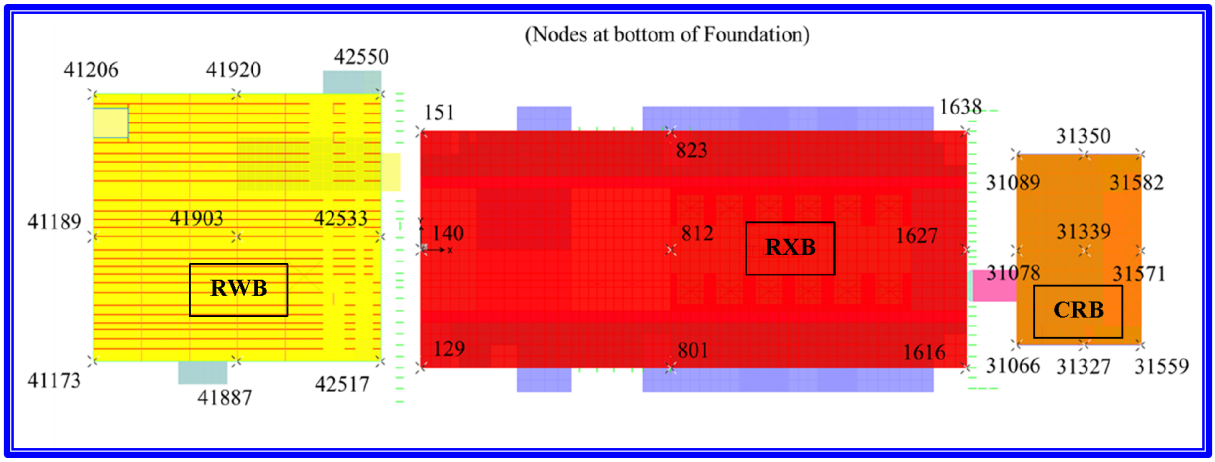

Figure 1 - Edge and Center Nodes at Bottom of Foundations Selected for Building Settlement Assessment

Impact on DCA:

FSAR Tier 2, Section 3.8.5.6.4 has been revised as described in the response above and as shown in the markup provided in this response.

3.8.5.6.4 Settlement

RAI 02.03.01-2, RAI 03.08.05-2

Displacement values are provided for selected nodes in the foundation in Table 3.8.5-8. The location of these nodes is shown in Figure 3.8.5-10. As can be seen from the values in ~~Table 3.8.5-8~~Table 3.8.5-8a and Table 3.8.5-8b, total settlement at any foundation node, tilt settlement, and differential settlement are minimal. The maximum allowable differential settlement between the RXB and CRB, and between the RXB and RWB is 0.5 inch.

RAI 02.03.01-2

The RXB settles approximately 1¾ inch on the west end and approximately 2 inches on the east end. The tilt settlement of 0.25" is less than 1" as cited in Section 3.8.5.6.1. There is negligible tilt north to south. The east end of the building contains the pool and the NPMs.

RAI 02.03.01-2, RAI 03.08.05-22S2

The CRB settles approximately 1¾ inch on the west end and approximately 1 inch on the east end. The tilt settlement of 0.75" is less than the 1" limit cited in Section 3.8.5.6.2. North to south tilt is negligible. The CRB tilts toward the RXB. Differential settlement between the two buildings is on the order of ¼ inch. The displacements at the four corners of the tunnel foundation calculated for the cracked concrete condition are provided in Table 3.8.5-18, and the rotation of the tunnel foundation is –0.0361°, as shown in Table 3.8.5-19. The tunnel foundation has negligible differential settlement in the north-south direction, and the differential settlement over 50 ft length in the east-west direction is -0.36."

The Seismic Category II Radioactive Waste Building settles approximately ½ inch on the west end and approximately 1½ inch on the east end. The RWB tilts toward the RXB. The RWB tilts approximately 1/5 inch in the north-south direction. Differential settlement between the RWB and the RXB is also on the order of ¼ inch.

3.8.5.6.5 Thermal Loads

During normal operation, a linear temperature gradient across the RXB foundation may develop.

An explicit analysis considering these loads has not been performed, as thermal loads are a minor consideration. Thermal loads are, by nature, self-relieving by means of concrete cracking and moment distribution. This is especially true of the NuScale RXB, as it is not a traditional pre-stressed/post-tensioned, cylindrical containment vessel, but, rather, a rectangular reinforced concrete building with several members framing into the roof, external walls, and basemat.

3.8.5.6.6 Construction Loads

The entire RXB basemat is poured in a very short time. The building is essentially constructed from the bottom up. The main loads (the reactor pool and the NPMs)

RAI 03.08.05-2

Table 3.8.5-8: Settlement values for the RXB, CRB and RWB

Building	Node No.	Displacements (inch)								
		Uncracked			Cracked			Coordinates (inch)		
		EW	NS	Vertical	EW	NS	Vertical	X	Y	Z
RWB	41173	-0.101	0.006	-0.598	-0.099	0.006	-0.599	-2460	-825	570
	41206	-0.086	0.025	-0.525	-0.081	0.027	-0.526	-2460	1149	570
	42517	-0.122	0.008	-1.633	-0.121	0.007	-1.635	-300	-825	570
	42552	-0.126	0.030	-1.418	-0.126	0.031	-1.419	-300	1317	570
RXB	129	-0.022	-0.035	-1.749	-0.021	-0.037	-1.750	0	-873	0
	151	-0.023	0.039	-1.750	-0.022	0.040	-1.750	0	873	0
	857	-0.009	-0.008	-1.887	-0.009	-0.009	-1.888	2019.5	-873	0
	879	-0.014	0.026	-1.880	-0.014	0.027	-1.880	2019.5	873	0
	1616	0.017	-0.023	-1.948	0.017	-0.024	-1.949	4092	-873	0
	1638	0.010	0.053	-1.944	0.010	0.055	-1.944	4092	873	0
CRB	31066	0.143	0.008	-1.753	0.139	0.009	-1.754	4470	-705	345
	31089	0.152	0.022	-1.735	0.148	0.022	-1.737	4470	705	345
	31559	0.163	0.007	-1.037	0.159	0.007	-1.037	5406	-705	345
	31582	0.167	0.021	-1.020	0.163	0.021	-1.020	5406	705	345

RAI 03.08.05-2

Table 3.8.5-8a: Displacement at Bottoms of Foundations of Uncracked Triple Building Model

Building	Node Location	Node No.	Coordinates (inch)			Displacement (inch)		
			X	Y	Z	U1(EW)	U2(NS)	U3(Vert)
RWB	West	41173	-2460	-825	570	-0.1	0.01	**-0.6**
		41189	-2460	96	570	-0.1	0.01	**-0.61**
		41206	-2460	1149	570	-0.08	0.02	**-0.52**
	Middle	41887	-1380	-825	570	-0.11	0.01	**-1.04**
		41903	-1380	96	570	-0.1	0.01	**-1.04**
		41920	-1380	1149	570	-0.09	0	**-0.9**
	East	42517	-300	-825	570	-0.12	0.01	**-1.63**
		42533	-300	96	570	-0.11	0.01	**-1.62**
		42550	-300	1149	570	-0.12	0.03	**-1.46**
RXB	West	129	0	-873	0	-0.02	-0.03	**-1.75**
		140	0	0	0	-0.03	0	**-1.81**
		151	0	873	0	-0.02	0.04	**-1.75**
	Middle	801	1872	-873	0	-0.01	-0.01	**-1.89**
		812	1872	0	0	-0.02	0.01	**-2.05**
		823	1872	873	0	-0.01	0.03	**-1.88**
	East	1616	4092	-873	0	0.02	-0.02	**-1.95**
		1627	4092	0	0	0.02	0.02	**-2**
		1638	4092	873	0	0.01	0.05	**-1.94**
CRB	West	31066	4470	-705	345	0.15	0.01	**-1.75**
		31078	4470	-8	345	0.15	0.01	**-1.78**
		31089	4470	705	345	0.15	0.02	**-1.73**
	Middle	31327	4980	-705	345	0.16	0.01	**-1.36**
		31339	4980	-8	345	0.16	0.01	**-1.36**
		31350	4980	705	345	0.16	0.02	**-1.34**
	East	31559	5406	-705	345	0.16	0.01	**-1.04**
		31571	5406	-8	345	0.16	0.01	**-1.05**
		31582	5406	705	345	0.17	0.02	**-1.02**

RAI 03.08.05-2

Table 3.8.5-8b: Displacement at Bottoms of Foundations of Cracked Triple Building Model

Building	Node Location	Node No.	Coordinates (inch)			Displacement (inch)		
			X	Y	Z	U1(EW)	U2(NS)	U3(Vert)
RWB	West	41173	-2460	-825	570	-0.1	0.01	**-0.6**
		41189	-2460	96	570	-0.1	0.01	**-0.61**
		41206	-2460	1149	570	-0.08	0.03	**-0.53**
	Middle	41887	-1380	-825	570	-0.11	0.01	**-1.04**
		41903	-1380	96	570	-0.1	0.01	**-1.04**
		41920	-1380	1149	570	-0.09	0	**-0.89**
	East	42517	-300	-825	570	-0.12	0.01	**-1.64**
		42533	-300	96	570	-0.11	0.01	**-1.63**
		42550	-300	1149	570	-0.12	0.03	**-1.46**
RXB	West	129	0	-873	0	-0.02	-0.04	**-1.75**
		140	0	0	0	-0.03	0	**-1.81**
		151	0	873	0	-0.02	0.04	**-1.75**
	Middle	801	1872	-873	0	-0.01	-0.01	**-1.89**
		812	1872	0	0	-0.02	0.01	**-2.06**
		823	1872	873	0	-0.02	0.03	**-1.88**
	East	1616	4092	-873	0	0.02	-0.02	**-1.95**
		1627	4092	0	0	0.02	0.02	**-2**
		1638	4092	873	0	0.01	0.05	**-1.94**
CRB	West	31066	4470	-705	345	0.14	0.01	**-1.75**
		31078	4470	-8	345	0.14	0.01	**-1.78**
		31089	4470	705	345	0.15	0.02	**-1.74**
	Middle	31327	4980	-705	345	0.15	0.01	**-1.36**
		31339	4980	-8	345	0.15	0.01	**-1.36**
		31350	4980	705	345	0.16	0.02	**-1.34**
	East	31559	5406	-705	345	0.16	0.01	**-1.04**
		31571	5406	-8	345	0.16	0.01	**-1.05**
		31582	5406	705	345	0.16	0.02	**-1.02**

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Figure 3.8.5-10: ~~Nodes Selected for Settlement Values~~Edge and Center Nodes at Bottom of Foundations Selected for Building Settlement Assessment