RAIO-1217-57930

December 28, 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 Supplemental Response to NRC Request for Additional Information No. 124 (eRAI No. 8981) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 124 (eRAI No. 8981)," dated August 04, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 124 (eRAI No.8981)," dated September 29, 2017

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

The Enclosure to this letter contains NuScale's supplemental response to the following RAI Question from NRC eRAI No. 8981:

- 03.04.02-1

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,

Jennie Wike
Manager, Licensing
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8G9A
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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8981

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NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8981

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NuScale Power™

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

eRAI No.: 8981
Date of RAI Issue: 08/04/2017

NRC Question No.: 03.04.02-1

10 CFR 50, Appendix, GDC 2 requires, in part, that SSCs important to safety shall be designed to withstand the effects of natural phenomena such as floods, tsunami, and seiches without loss of capability to perform their safety functions.

a. The staff requests the applicant to provide the analysis procedures utilized to transform the static and dynamic effects of the highest flood and groundwater levels into effective loads applied to seismic Category I structures.

b. In DCD Section 3.4.2 “Protection of Structures against Flood from External Sources,” the applicant describes that the lateral hydrostatic pressures on the structures from the design flood, in conjunction with ground water and soil pressure, are factored into the structural design as discussed in Sections 3.7.1 and 3.8.4 of the DCD. The staff did not find the lateral hydrostatic pressures due to the design flood level in the DCD Section 3.7.1. Therefore, the staff requests the applicant to describe where this information is located in the DCD or supplement the DCD to include the lateral hydrostatic pressures due to the design flood level.

NuScale Response:

The analysis procedures, provided in NuScale's original response to RAI 8981 03.04.02-1, are added to FSAR Tier 2, Section 3.8.4.3.3, based on feedback received from the NRC Staff during a public meeting on November 29, 2017.

Impact on DCA:

FSAR Tier 2, Section 3.8.4.3.3 has been revised as described in the response above and as shown in the markup provided in this response.

3.8.4.3.3 Earth Pressure (H)

The embedded exterior walls of the buildings are subjected to lateral soil pressure loads induced by three types of loads as described below:

- Static Soil Pressure - induced by the weight of soil, hydrostatic pressure and a surcharge load at grade level.
- Dynamic Soil Pressure - induced due to an earthquake event, developed from the SASSI2010 analyses of the standalone RXB and CRB models.
- Structure-Soil-Structure-Interaction Dynamic Soil Pressure - soil pressure determined from the triple building SASSI2010 analysis using the RXB, CRB, and RWB.

RAI 02.05.04-3, RAI 02.05.04-3S1

For the static soil pressure, the lateral soil pressure is calculated assuming that the soil is completely confined and cannot move. The soil is also considered to be submerged for the total embedment depth since the water table is close to grade level. Therefore, the total horizontal pressure from the submerged soil is calculated as the sum of the hydrostatic pressure and the lateral soil pressure considering the buoyant effect. Because the water provides a buoyant effect, the effective pressure is calculated using the difference between the soil density and water density. For the Reactor Building (RXB), the embedment depth used in the mathematical model is 85'.

RAI 02.05.04-3, RAI 02.05.04-3S1

Maximum Hydrostatic Pressure

γ_ω = 62.4 pcf Unit weight of water, H = 85 ft Embedment depth, $u = \gamma_\omega H$ = 5304 psf

RAI 02.05.04-3, RAI 02.05.04-3S1

Effective Lateral Pressure

γ_{sat} = 130 pcf Unit weight of saturated soil, $\gamma_b = \gamma_{sat} - \gamma_\omega$ = 67.6 pcf Buoyant unit weight

RAI 02.05.04-3, RAI 02.05.04-3S1

H = 85 ft Embedment Depth, K_o = 0.5 Coefficient of pressure at rest, $p_{he} = K_o \gamma_b H$ = 2873 psf

RAI 02.05.04-3, RAI 02.05.04-3S1

Surcharge Loads

p_q = 250 psf Surcharge Load, $p_{hq} = K_o p_q$ = 125 psf

RAI 02.05.04-3, RAI 02.05.04-3S1

Total Maximum Lateral Soil Pressure

The total maximum lateral soil pressure at a depth H is the sum of the hydrostatic pressure, the effective lateral pressure, and the surcharge lateral pressures calculated above.

RAI 02.05.04-3, RAI 02.05.04-3S1

$p_h = u + p_{he} + p_{hq} = 8302$ psf

RAI 02.05.04-3, RAI 02.05.04-3S1

Figure 3.8.4-27 shows a diagram of the total lateral static soil pressure distribution. Seismic soil pressure is computed from the SASSI2010 Soil-Structure Interaction analysis. The normal stresses in the backfill soil solid elements, adjacent to the embedded portion of the RXB exterior walls, represent the soil pressure. For example, for the RXB, the following table provides the summary of total soil pressures on the four walls and total overturning moments induced by the soil pressures.

RAI 02.05.04-3, RAI 02.05.04-3S1

Wall ID	Total Soil Pressure on Walls (kips)	Total Overturning Moment (Kip-ft)
North Wall	570,991	8,911,955
South Wall	425,678	7,925,347
West Wall	188,731	2,614,131
East Wall	178,541	3,096,417

RAI 02.05.04-3, RAI 02.05.04-3S1

COL Items 2.5-1, 3.7-3, 3.7-5, 3.7-6, and 3.8-2 specify the site-specific geology and soil-structure interaction analysis requirements of the NuScale Power Plants.

3.8.4.3.4 Live Loads (L)

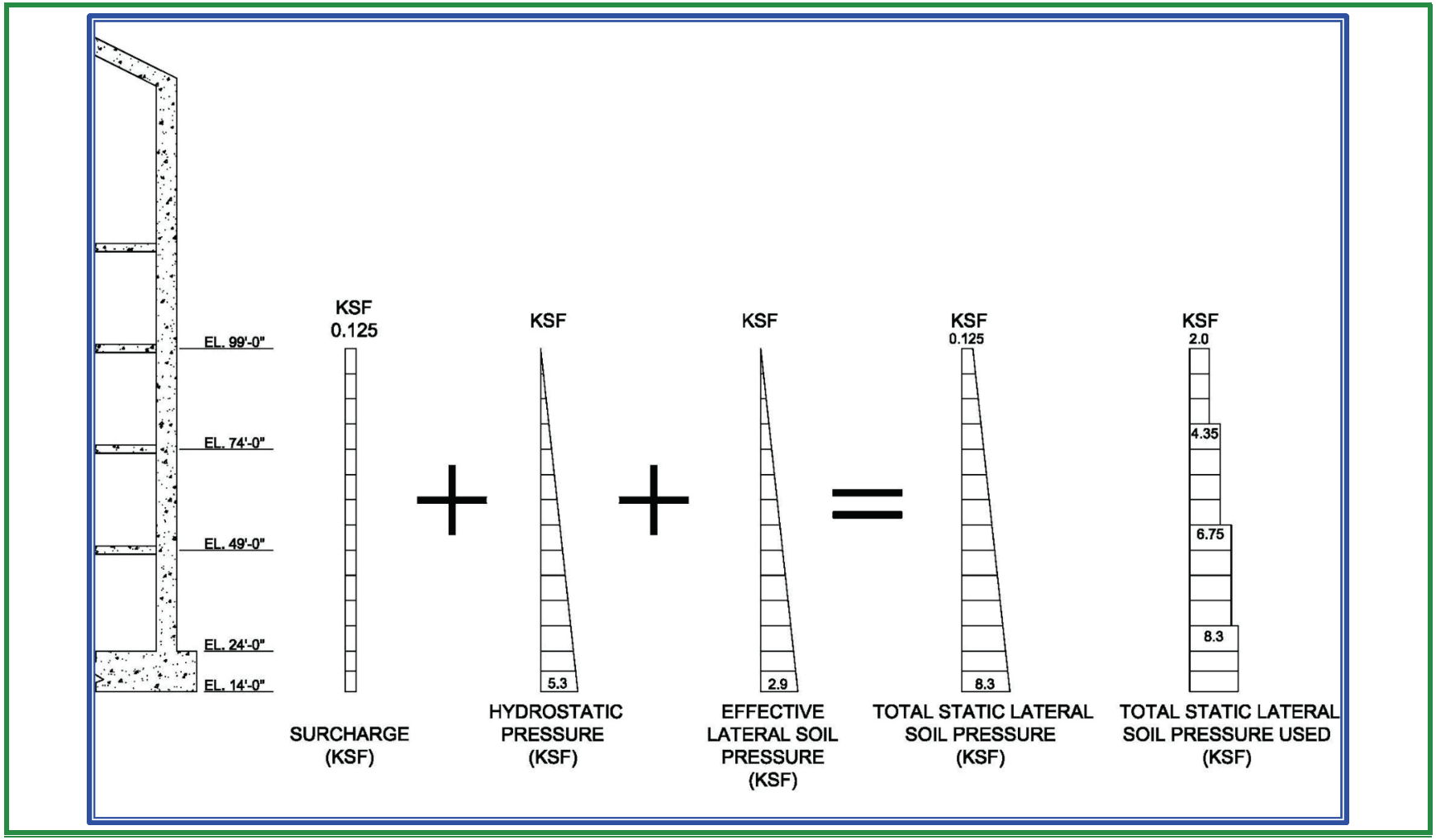
Live loads are a non-permanent weight based upon the maximum loads expected by the use and occupancy of the structure. RXB live loads include floor area loads, lay down loads, fuel transfer casks and equipment handling loads, and similar items.

The RXB uses a base live load of 100 psf, and a live load of 250 psf for the Nuclear Fuel Storage & Refueling Areas and for the portions of the EL. 50'-0" floor supporting the walkways at EL. 62'-0" and a live load of 200 psf for the portions of the EL. 75'-0" floor supporting walkways at EL 86'-0". The floor live loads are not applied on areas occupied by equipment, whose weight is specifically included as a uniform equipment load or a significant concentrated equipment load.

Floor beams, girders and slabs in the RXB are designed to withstand a 5000 lb concentrated load in locations that maximize moment and shear. Any location where permanent equipment is installed is not designed for this concentrated load. The concentrated loads will not be combined with load combinations that include seismic loads.

RAI 02.05.04-3, RAI 02.05.04-3S1

Figure 3.8.4-27: Total Static Lateral Soil Pressure Distribution (RXB)



COL Item 3.4-7: A COL applicant that references the NuScale Power Plant design certification will determine the extent of waterproofing and dampproofing needed to prevent groundwater and foreign material intrusion into the expansion gap between the end of the tunnel between the RXB and the CRB, and the corresponding RXB connecting walls.

RAI 03.04.02-1, RAI 03.04.02-1S1, RAI 03.04.02-3

The NuScale Power Plant design establishes a design basis flood level (including wave action) of one foot below the baseline top of concrete elevation at the ground level floor. Therefore, there are no dynamic flood loads on the RXB and CRB. The lateral hydrostatic pressures on the structures due to the design flood level, as well as ground water and soil pressure, are factored into the structural design as static and dynamic loads discussed in Sections ~~3.7.1 and~~ 3.8.4.3.3.

3.4.2.2 Probable Maximum Precipitation

The design utilizes bounding parameters for both rain and snow. The rainfall rate for roof design is 19.4 inches per hour and 6.3 inches for a 5 minute period and the design static roof load because of snow is 50 pounds per square foot. The extreme snow load is 75 pounds per square foot.

The roofs of the RXB and CRB prevent the undesirable buildup of standing water in conformance with Regulatory Guide 1.102 as described below:

- The RXB has a gabled roof, with the sloping portions to the north and south. There are no parapets on the top, flat section.

RAI 02.03.01-3

- The CRB roof is a sloped steel structure with scuppers in the parapet designed to allow rainfall to drain off the roof. An additional drainage pipe limits the average water depth on the CRB roof to a maximum of 4 inches.

The bounding rain and snow loads are used in the structural analysis described in Section 3.8.4.

3.4.2.3 Interaction of Non-Seismic Category I Structures with Seismic Category I Structures

Nearby structures are assessed, or analyzed if necessary, to ensure that there is no credible potential for interactions that could adversely affect the Seismic Category I RXB and CRB. Figure 1.2-2 provides a site plan showing the plant layout. The non-Seismic Category I structures that are adjacent to the Seismic Category I RXB and CRB are:

- RWB (Seismic Category II) adjacent to RXB
- CRB above elevation 120' (Seismic Category II), above Seismic Category I CRB and adjacent to RXB
- [[North and south Turbine Generator Buildings (Seismic Category III), adjacent to RXB]]
- [[Central Utilities Building (Seismic Category III), adjacent to CRB]]