September 29, 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. 144 (eRAI No. 8979) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 144 (eRAI No. 8979)," dated August 05, 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. 8979:

- 03.03.01-1
- 03.03.01-2

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
Samuel Lee, NRC, OWFN-8G9A
Marieliz Vera, NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8979

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8979

NuScale Power

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

eRAI No.: 8979
Date of RAI Issue: 08/05/2017

NRC Question No.: 03.03.01-1

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

In DCD Section 3.3.1.2 “Determination of Severe Wind Forces,” and 3.3.2.2 “Determination of Tornado and Hurricane Forces,” the applicant defines several factors used in the determination of wind, tornado, and hurricane forces.

a. The applicant states that the velocity pressure coefficient used is not less than 0.85; however, the SRP Section 3.3.1 recommends a velocity pressure coefficient of not less than 0.87. The staff requests the applicant to justify the use of a velocity pressure coefficient of less than 0.87.

b. The applicant defines z as the building height. The staff requests the applicant to provide a reference for the building height, i.e. “above the ground level”.

c. The applicant states that the gust-effect factor, G, is greater than or equal to 0.85. The staff requests the applicant to clarify if the gust factor is greater than 0.85 and if so, was it calculated using the formula in ASCE 7-05.

d. The applicant defines Cp as the external pressure coefficient equal to 1.0; however, the coefficient for the leeward walls and side walls could be negative and/or different values. Also, the applicant defines GCp as the internal pressure coefficient equal to 0.18, however, the value could be positive or negative as determined in ASCE 7-05. Therefore, the staff requests the applicant to clarify if the values are computed in accordance with ASCE 7-05.

NuScale Response:

Responses related to FSAR Tier 2, Section 3.3.1.2, "Determination of Severe Wind Forces," and FSAR Tier 2, Section 3.3.2.2, "Determination of Tornado and Hurricane Forces" are provided as follows:

a. The velocity pressure exposure coefficient, in Sections 3.3.1.2 and 3.3.2.2, has been revised to 0.87. This value conforms with SRP Section 3.3.1 and NuScale's Civil and Structural Design Criteria.

b. The variable, z, defined in Sections 3.3.1.2 and 3.3.2.2 as the building height, is above the ground level.

c. The gust-effect factor, G, is equal to 0.85, as stated in Section 6.5.8.1 of ASCE-7-05. It was not calculated using the formula in ASCE 7-05.

d. The design wind pressure for low-rise buildings is calculated conservatively by combining the absolute sums of the external pressure and internal pressure together to create the worst case enveloping wind load condition. The external pressure coefficient is added to the absolute internal pressure coefficient for a combined pressure coefficient of 1.18.

Impact on DCA:

FSAR Tier 2, Section 3.3.1.2 and Section 3.3.2.2 have been revised as described in the response above and as shown in the markup provided in this response.

where,

RAI 03.03.01-1

K_z = velocity pressure exposure coefficient evaluated at height "z", as defined in ASCE/SEI 7-05, Table 6-3, but not less than 0.875. For simplicity and conservatism, z is assumed to be the building height,

K_{zt} = topographic factor equal to 1.0,

K_d = wind directionality factor equal to 1.0,

V_w = maximum wind speed equal to 145 mph, and

I = importance factor equal to 1.15 for the RXB, CRB, and RWB.

Design wind loads on the RXB, CRB, and RWB are determined in conformance with ASCE/SEI 7-05 (Reference 3.3-1), Equation 6-17:

$$p = qGC_p - q_i (GC_{pi}) \text{ (lb/ft}^2\text{)}$$

where,

G = gust factor equal to 0.85 or greater,

C_p = external pressure coefficient equal to 1.0,

GC_{pi} = internal pressure coefficient equal to 0.18,

q = velocity pressure, and

q_i = internal velocity pressure.

3.3.2 Extreme Wind Loads (Tornado and Hurricane Loads)

3.3.2.1 Design Parameters for Extreme Winds

Tornado wind loads include loads caused by the tornado wind pressure, tornado atmospheric pressure change effect, and tornado-generated missile impact. Hurricane wind loads include loads due to the hurricane wind pressure and hurricane-generated missiles.

The parameters for the design basis tornado are the most severe tornado parameters postulated for the continental United States as identified in RG 1.76, Rev. 1.

- Maximum wind speed .... 230 mph
- Maximum translational speed............. 46 mph
- Maximum rotational speed .... 184 mph

- Radius of maximum rotational speed . . . . . . 150 ft
- Maximum pressure drop . . . . 1.2 psi
- Rate of pressure drop . . . . 0.5 psi/s

The wind speed for the design basis hurricane is the highest wind speed postulated for the continental United States as identified in Figures 1 - 3 of RG 1.221, Rev. 0, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants."

- Maximum wind speed . . . . 290 mph

Refer to Section 3.5 for a description of hurricane and tornado wind-generated missiles.

3.3.2.2 Determination of Tornado and Hurricane Forces

Tornado and hurricane wind velocities are converted into effective pressure loads in accordance with ASCE/SEI 7-05 (Reference 3.3-1), Equation 6-15, as follows:

q_z=0.00256 K_z K_{zt} K_d V_w^2 I (lb/ft^2)

where,

RAI 03.03.01-1

K_z = velocity pressure exposure coefficient evaluated at height "z", as defined in with ASCE/SEI 7-05, Table 6-3, but not less than 0.875. (For tornados, wind speed is not assumed to vary with height.) For simplicity and conservatism, z is assumed to be the building height.

K_{zt} = topographic factor equal to 1.0,

K_d = wind directionality factor equal to 1.0,

V_w = maximum wind speed (mph) (For tornadoes, V_w is the resultant of the maximum rotational speed and the translational speed), and

I = importance factor equal to 1.15 for the RXB, CRB, and RWB.

Extreme wind loads on the RXB, CRB, and RWB are determined in conformance with ASCE/SEI 7-05, Equation 6-17:

p=qGC_p – q_i (GC_{pi}) (lb/ft^2)

where,

G = gust factor equal to 0.85 or greater,

C_p = external pressure coefficient equal to 1.0,

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

eRAI No.: 8979
Date of RAI Issue: 08/05/2017

NRC Question No.: 03.03.01-2

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

In DCD Section 3.3.3 "Interaction of Non-Seismic Category I Structures with Seismic Category I Structures," the applicant stated that the seismic Category II portion of the CRB was analyzed with the seismic Category I portion of the structure and can withstand the severe and extreme winds. The staff requests the applicant to clarify whether the seismic Category II portion of the CRB was evaluated for severe and extreme wind loads using the same methodology as the seismic Category I portion of the structure.

NuScale Response:

FSAR Tier 2, Section 3.7.2.8 states that Non-Seismic Category I structures are assessed to ensure that there is no credible potential for adverse interactions with Seismic I Category Structures. Therefore, FSAR Tier 2, Section 3.3.3 is removed, as it is stated in Section 3.7.2.8.

The Seismic Category II portions of the control building (CRB) have been evaluated for the same severe and extreme wind pressure load and methodology as the Seismic Category I portions of the CRB.

However, there are other differences in application of extreme wind loading between the Seismic Category II portions of the CRB and the Seismic Category I portions of the CRB. These differences are:

- The metal siding on the CRB is not designed to withstand extreme wind loading (hurricane and tornado loading).
- The Seismic Category II portions of the CRB are not designed to resist tornado or hurricane generated missiles.
- The CRB structural steel above EL 120.0' is designed for the full extreme wind pressure

loading and tornado air pressure drop loading as if the metal siding is in place.

- The structural steel above EL 120.0’ will have local structural damage due to missile impact loading, but will not collapse due to redistribution of load and redundancy of members.

Impact on DCA:

FSAR Tier 2, Section 3.3.3 has been revised as described in the response above and as shown in the markup provided in this response.

3.3.2.3 Combination of Forces

The most adverse of the following combinations are considered for the total hurricane or tornado load:

$W_t = W_p$

$W_t = W_w + 0.5\,W_p + W_m$

where,

W_t = total load,

W_w = load from wind effect,

W_p = load from tornado atmospheric pressure change effect ($W_p = 0$ for hurricanes), and

W_m = load from missile impact effect.

RAI 03.03.01-2

~~3.3.3 Interaction of Non-Seismic Category I Structures with Seismic Category I Structures~~

~~A failure of a nearby structure could adversely affect the Seismic Category I RXB and Seismic Category I portions of the CRB. These nearby structures are assessed (or analyzed if necessary) as described below to ensure that there is no credible potential for adverse interactions. 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]]~~
- ~~[[Annex Building (Seismic Category III), adjacent to RXB]]~~

~~The Seismic Category II portion of the CRB was analyzed along with the Seismic Category I portion of the structure and can withstand the severe and extreme winds.~~

~~The RWB has been evaluated for severe and extreme wind loads using the methodology in Section 3.3.1.2 and Section 3.3.2.2 and can withstand the severe and extreme winds.~~

COL Item 3.3-1: A COL applicant that references the NuScale Power Plant design will confirm that nearby structures exposed to severe and extreme (tornado and hurricane) wind loads will not collapse and adversely affect the RXB or Seismic Category I portion of the CRB.