October 31, 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. 503 (eRAI No. 9596) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 503 (eRAI No. 9596)," dated September 10, 2018

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. 9596:

- 03.05.03-4

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 503 (eRAI No. 9596). 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. 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.

If you have any questions on this response, please contact Carrie Fosaaen at 541-452-7126 or at cfosaaen@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. 9596, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9596, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-1018-62390

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9596, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9596, nonproprietary

NUSCALE
Power for all humankind

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

eRAI No.: 9596

Date of RAI Issue: 09/07/2018

NRC Question No.: 03.05.03-4

General Design Criterion 4, "Environmental and Dynamic Effects Design Bases," of Appendix A, "General Design Criteria for Nuclear Power Plants," to Title 10 of the *Code of Federal Regulations*, Part 50, "Domestic Licensing of Production and Utilization Facilities" (10 CFR Part 50) (Ref. 1), requires, in part, that structures, systems, and components important to safety be appropriately protected against the effects of missiles that might result from equipment failures. Failures that could occur in the large steam turbines of the main turbine-generator sets have the potential to produce large high-energy missiles.

Regulatory Guide (RG) 1.115 Revision 2 describes methods that are acceptable to the staff for implementing NRC regulations to protect essential SSCs against both high-trajectory and low-trajectory turbine missiles resulting from the failure of main turbine-generator sets. Plants can protect essential SSCs against turbine-generated missiles by four different approaches, one of which is barriers constructed to protect all essential SSCs. Although the Design Certification Application describes a probabilistic approach to address the protection of essential SSCs from turbine-generated missiles, the applicant subsequently proposed an approach that relies on using barrier alone to protect essential SSCs from turbine-generated missiles. The staff's guidance for using barriers to protect essential SSCs is provided in Sections C.2.d and C.3 of RG 1.115.

The applicant in response to eRAI No. 9058 (ML 17355A168) committed to provide changes to Tier 1 and Tier 2 of the Nuscale Final Safety Analysis Report to support safeguarding essential SSCs from Turbine missile using barriers. The applicant in its letter: "NuScale Power, LLC Submittal of Changes to Tier 1 and Tier 2 of the NuScale Final Safety Analysis Report to Support Safeguarding Essential SSC for Turbine Missiles Using Barriers", dated June 25, 2018, (ML18176A394) submitted changes to FSAR for the staff’s review. The applicant in its submittal stated that the results of their analysis showed that essential SSCs are protected by barriers alone and that the reactor building and the control building provide adequate protection against turbine-generated missiles for essential SSCs contained therein. In Enclosure 2 of the submittal, the applicant stated that "the exterior walls and roof of the reactor building (RXB) and control building (CRB) are heavily reinforced concrete structures. These structures are sufficient to prevent turbine missile perforation and back-face scabbing assuming minimal credit being taken to reduce the velocity of the missile as it penetrates the turbine generator casing."

The applicant in its submittal did not provide sufficient information in order for the staff to review the barriers design credited for providing adequate protection against turbine-generated missiles for essential SSCs contained therein. The staff requests the following additional information to complete their review of the applicant's approach of using barrier alone to protect essential SSCs from turbine missiles.

1. In order to demonstrate that the damage potential to concrete and steel barriers from the turbine-generated missiles is bounded by the design basis tornado and hurricane missiles, the applicant is requested to provide parameters (i.e. mass, velocity, impact area, shape and hardness of missile) for the spectrum of both high-trajectory and low- trajectory turbine-generated missiles and compare them with the parameters provided for the design basis tornado and hurricane missiles in FSAR Table 3.5-1. Note that since the NuScale turbine does not credit an independent turbine overspeed protection system, nor rotor material and processing, fracture toughness, preservice and inservice inspection and testing for minimizing turbine missiles, the spectrum of turbine missiles may not be based on current operating experience of nuclear turbines that do credit these items such the material properties, inspection, and overspeed protection in minimizing turbine missiles. Therefore, since the quality of the turbine rotor is not credited nor overspeed protection, the spectrum of turbine missiles would include up to half of the last stage of the rotor with the blades attached. Also, since there is no longer an independent and redundant turbine overspeed protection, the speed of the missile should be based on the design speed of 3600 rpm up to destructive overspeed.

2. The applicant in Tier 2, FSAR Section 1.2.2.5.1, 'Turbine Generator Building', states that NuScale Power Plant has two separate turbine generator buildings and each building houses six turbine generator sets. The applicant is requested to clarify if the structural barrier is designed to protect it against the spectrum of turbine-generated missile associated with the failure of a single turbine and provide a technical justification for not considering the missiles due to multiple turbine failure, , given that the turbine speed is twice of a typical turbine used on a nuclear power plant and they don’t have independent

and diverse over speed protection system.

3. In the event missile parameters (i.e. mass, velocity, impact area, shape and hardness of missile) for the turbine-generated spectrum of missiles are not bounded and are different in comparison with the corresponding parameters for design basis tornado and hurricane missiles parameters provided in FSAR Table 3.5-1, the applicant is requested to provide a justification for the applicability of the penetration, perforation and scabbing equations in FSAR Section 3.5.3, "Barrier Design procedures".

4. The applicant is requested to provide dimensioned plan and elevation layout drawings which include information on wall or slab thicknesses and materials of pertinent structures (turbine building, reactor building, and control building) that are considered in barrier evaluation for the turbine-generated missiles.

5. The applicant in Enclosure 1 of the submittal stated that "because NuScale's design already contained barriers meeting the requirements for protection against aircraft and vehicle impact, NuScale considered it reasonable that those same barriers might also be credited for protection against turbine-generated missiles." The applicant is requested to provide technical basis for crediting the aircraft impact -a 'beyond design basis' event- for the protection against the turbine generated missiles that is a design basis event.

6. The applicant is requested to provide a summary of the structural analysis of all barriers for the local and overall damage due to the impact of the spectrum of turbine-generated missiles and demonstrate that barriers are sufficiently thick enough to prevent back face scabbing to protect the essential SSCs if the missile characteristics are not bounded by those of wind born missiles.

NuScale Response:

A few of the questions (questions #1, #3, #5) asked by the Staff indicate that there may be some misunderstanding regarding NuScale’s barrier analysis for protection against turbine-generated missiles and how it relates to protection against missiles generated from tornadoes and hurricanes, or from aircraft and vehicle impacts. While NuScale is crediting the same concrete structures as was credited for other missile hazards, the analysis that was performed for turbine-generated missiles was stand-alone, completely separate from, and independent of, the other design basis and beyond design basis missile analyses. The assumptions used in the analysis were specific to a turbine design that a COL applicant might select.

Question 1

For a postulated turbine blade missile impact:

A 60 inch-thick, 7000 psi design strength concrete wall barrier was evaluated. A 32-pound blade traveling at 784 mph based on 120% overspeed of a 3600-rpm turbine, assuming minimal credit of the turbine casing to slow the blade (8.3% reduction in velocity), made from ASTM A403 SS is the impactor on the concrete barrier wall. Analyses showed that a rigid blade at 784 mph would penetrate approximately 40 inches into the 60 inch-thick reactor building (RXB) wall and a deformable blade would penetrate 16.5 inches into the 60-inch-thick wall.

The Modified Defense Research Committee formulas for perforation and scabbing were evaluated using the calculated 16.5-inch penetration depth of the deformable blade. {{

}}[2(a),(c)] The bounding required thickness for perforation is 24.4 inches. The scabbing calculation results in required thicknesses of 28.6 inches for the 3.0-inch diameter missile. Applying the factor of 1.2 times largest required wall thickness to prevent scabbing and perforation (Reference 1, Section F7), 28.6 inches resulted in a required barrier thickness of 34.3 inches. Therefore the 60 inch-thick RXB wall provides an effective barrier against the postulated turbine accident against perforation and scabbing.

For a postulated turbine blade and rotor fragment impact:

The same 60 inch-thick, 7000 psi design strength concrete wall barrier was evaluated. The 52-pound blade and rotor disk fragment, made from ASTM A276 Type 403 stainless steel and ASTM A470 Class 4 respectively, traveling at 996 mph based on a postulated 160% overspeed of a 3600-rpm turbine, assuming no credit of the turbine casing to slow the missile, was the postulated credible missile on the concrete barrier wall. The 160% overspeed was considered a conservatively biased maximum estimate based on historical turbine blade accidents. The analyses showed that the blade and rotor disk fragment at 996 mph (160% overspeed) would penetrate approximately 22 inches into the 60 inch-thick RXB concrete wall. Incorporating these penetration depth results from the finite element analysis into empirical methods as per the US NRC Standard Review Plan, Section 3.5.3, and applying the factor of 1.2, a barrier thickness of 37.5 inches and 43.5 inches of concrete was required to prevent perforation and scabbing respectively. Therefore the 60 inch-thick RXB wall provides an effective barrier against this postulated turbine accident.

Additional analysis runs were performed up to 220% overspeed to demonstrate design margin beyond the postulated credible 160% overspeed. The resulting maximum penetration depth was determined from the analysis to be 28.0 inches into the 60 inch thick RXB concrete wall. Incorporating these penetration depth results from the finite element analysis into empirical methods as per the US NRC Standard Review Plan, Section 3.5.3, and applying the factor of 1.2, a barrier thickness of 46.4 inches and 53.3 inches of concrete is required to prevent perforation and scabbing respectively. Therefore, the 60 inch-thick RXB wall provides an effective barrier against the postulated turbine accident up to 220% overspeed.

Note: The turbine used in NuScale's analysis is specific to a 49 MW, 3600RPM multistage condensing steam turbine with an integrally forged rotor that is commercially available.

As already noted, both of the above analyses are conservatively biased as they take minimal allowance for a reduction in velocity as the blade impacts and penetrates through the steel turbine casing. Although not credited, an additional analysis was performed. In this analysis, the worst-case situation was determined to be the loss of a last stage low pressure turbine blade at 120% overspeed (highest energy, rigid blade with the thinnest, {{

}}$^{2(a),(c)}$). That analysis showed a 52% reduction in exit velocity.

The results of the above two analyses cannot be directly applied to the control building because the exterior walls are not as thick, nor does the concrete have the same strength rating. Therefore, penetration and/or scabbing of the exterior walls of the control building is expected. However, given the reduction in velocity as the turbine missile passes through the control building exterior wall, combined with the low angle of impact relative to the grade level slab once inside the control building, penetration and/or scabbing of the grade level slab (the final barrier) is not expected. The main control room and all safety related equipment are below this grade level slab, and thus fully protected from the postulated turbine missiles.

The Staff's request that the speed of the missile should be based on destructive overspeed because there is no longer an independent and redundant turbine overspeed protection fails to account for the state of the art of the turbine manufacturing industry. While it is true that NuScale decided not to credit an "independent and redundant" overspeed system, few, if any, turbine manufacturers provide skid-mounted turbines that do not include reliable overspeed protection systems. The Staff's assertion also appears to discount NuScale's commitment that the turbine design will include overspeed protection. As described in the revisions contained in NuScale's letter to the NRC (referenced in the RAI), turbines used in the NuScale design will have overspeed protection systems as described in FSAR Sections 10.1.2.4, 10.2.1, 10.2.2.3.3 and 10.2.2.5. As stated in Section 10.2.2.5, "the governor and overspeed protection system are tested and inspected as recommended by the manufacturer. The stop valve and control valves are exercised at a frequency recommended by the turbine vendor or valve manufacturer." (See also Table 14.2-33, Turbine Generator Test #33, viii)

NuScale's design calls for much smaller turbines than those used in commercial nuclear power plants. This gives the COL Applicant flexibility to choose from a host of designs offered by different vendors. (References 2 and 3) Few, if any, of these designs are first-of-a-kind and the majority of those in the 50 - 100 MW range are skid-mounted, "packaged" arrangements.

While there is little "nuclear-specific" operating experience (OE) on 3600 RPM turbines, OE does exist and should not be discounted just because it is not specific to nuclear. For example, Siemens has 34 turbine generators operating at 3600 RPM, 29 of these are located in the United States. Four have been in operation since the 1980's. Siemen's informed NuScale that they were unaware of any overspeed failures with any of their turbines using the current design. These turbines are designed per American Petroleum Institute (API) Standard 612, "Petroleum, Petrochemical, and Natural Gas Industries—Steam Turbines—Special-purpose Applications," to withstand overspeed trips. Each has a redundant trip system incorporating a 2 out of 3 electronic trip. The rotors are designed and built to be capable of safe operation without immediate maintenance intervention at the calculated momentary peak overshoot speed that follows an instantaneous complete loss of coupled inertia and load while operating at the rated conditions. These turbines are NOT manufactured to nuclear standards, yet have experienced no overspeed failures.

As described in its sales literature, Dresser-Rand has "thousands of steam turbine installations in more than 140 countries." Dresser-Rand manufactures "multi-stage steam turbines from 500kWe to 70 MW with speeds up to 17,000 RPM." (Reference 2) Siemens also manufactures "steam turbines from 10 kw to 1,900 MW" with a "fleet of more than 60,000 steam turbine world-wide." The Siemens EMD, SST-400, SST-500 class steam turbines operate at speeds ranging from 3,000 RPM to 17,000 RPM. (Reference 3)

Considering the number of turbines currently in use throughout the world of the type appropriate to NuScale's design, NuScale considers analyzing for the missile speeds provided in its analysis as adequate.

Question 2

Regarding the spectrum of missiles:

Since the turbines (potentially 12 in all) on a NuScale site are identical, the spectrum of missiles potentially generated from each should also be identical. From the spectrum of missiles a single turbine might generate, Regulatory Guide 1.115, Revision 2 (RG 1.115), identifies a blade and a blade with rotor fragment as being most limiting. This constituted the spectrum of NuScale's analyses.

Regarding multiple turbine failures:

It is conceivable that missiles generated during a turbine failure could cause the subsequent failure of one or more of the other five turbines located in the same turbine building. If a missile from one turbine were to strike another turbine, deflection would result in fragments that travel in different directions, striking different barrier locations. Multiple turbine fragments striking the same location are statistically unlikely and not credible. Therefore, it is unnecessary for the barrier analysis calculation for a single, turbine-generated missile strike to consider the additive or cumulative effects from other missile strikes.

In order for a low-trajectory missile generated in one turbine building to enter the other turbine building, it must penetrate the exterior wall of its building, pass through two exterior walls of the RXB and then penetrate the exterior wall of the other turbine building. This is not considered credible. As described in RG 1.115, Section B, "Protection against Turbine Missiles," for unfavorably oriented turbines, evaluation of high-trajectory missiles is not required because the probability of a high-trajectory missile exiting the casing at a trajectory that results in striking and damaging an essential SSC is much smaller than the equivalent probability for low-trajectory missiles.

NuScale's response regarding the operating speed of its turbines and the Staff's assertions regarding the lack of an independent and diverse over speed protection system are addressed in the response to question #1 above.

In summary, the structures credited for protecting essential structures, systems and components (SSCs) from the spectrum of turbine-generated missiles is considered adequate protection against multiple turbine failures.

Question 3

As mentioned in the opening paragraph, the analysis that was performed was stand-alone, completely separate from, and independent of other design basis missile analyses. The assumptions used in the analysis (i.e., specifics related to the turbine design used to support the analysis) could change depending on the turbine selected by the COL applicant. For that reason, COL Item 3.5-1 was revised to require the COL applicant to review the analysis against the "site-specific" turbine selected as part of the COL.

The regulatory requirements for the formulas used can be found in Paragraph 1.A under SRP 3.5.3 Acceptance Criteria. This section outlines the “specific criteria necessary to meet the relevant requirements of GDC 2 and 4” for local damage prediction for concrete. It states:

> “Several empirical equations, such as the modified National Defense Research Council (NDRC) formula; proposed in "A Review of Procedures for the Analysis and Design of Concrete Structures to Resist Missile Impact Effects," by R.P. Kennedy, Nuclear Engineering and Design 1976 Pages 183-203 are available to estimate missile penetration into concrete. These equations should be used to determine the required barrier thicknesses.”

The Modified Defense Research Committee formulas for perforation and scabbing were evaluated using the calculated 16.5-inch penetration depth of the deformable blade.

The finite element analysis of missile impact on reinforced concrete structures follows the guidelines outlined in NEI 07-13 Rev. 8, “Methodology for Performing Aircraft Impact Assessments for New Plant Designs.” Although the use of NEI 07-13 is endorsed in RG 1.217 and not in RG 1.115, its use was considered appropriate for this application. The document by R.P. Kennedy endorsed by RG 1.115 was written in 1975 before more advanced methods of structural analysis such as finite element analysis or non-linear analysis were commonly used in engineering practice. Additionally, the software used to perform this analysis was verified and validated by comparing it to missile barrier test data (similar to the test data used to develop the NDRC formula). This verification and validation work was audited by NuScale Quality Assurance to ensure compliance with applicable codes and standards.

Since NuScale’s methodology for protection against turbine missiles relies on concrete as a barrier, the criteria cited above was considered applicable.

Question 4

FSAR Figure 1.2-4, “Layout of a Multi-Module NuScale Power Plant,” provides a dimensioned layout of the turbine buildings relative to the RXB, the control building (CRB) and the radiation waste building.

The exterior walls of the RXB are credited for protection of essential SSCs located in the RXB. FSAR Figures 1.2-10 through 1.2-20 provide dimensioned plan and section view drawings with exterior wall thicknesses for the RXB. FSAR Section 1.2.2.1, “Reactor Building,” contains a description of the RXB, its contents and component locations.

The exterior walls and grade level slab of the CRB are credited for protection of essential SSCs located in the CRB. FSAR Figure 1.2-26, “Control Building North Section View,” and Figure 1.2-27, “Control Building West Section View,” provide dimensioned section views of the CRB with wall and slab dimensions. FSAR Section 1.2.2.2, “Control Building,” contains a description of the CRB, its contents and component locations.

Question 5

As described in the opening paragraph to this RAI response, NuScale’s design does not credit the aircraft impact event for protection against the turbine-generated missiles.

Question 6

For low-trajectory missiles, NuScale credits the RXB external walls for protection of essential SSCs located inside the RXB and the CRB external walls in conjunction with the CRB’s grade level slab for protection of essential SSCs located inside the CRB. A summary of the structural analysis describing the amount of back face scabbing is provided in question #1 above.

The RXB exterior walls are 5 feet thick reinforced concrete and have a concrete compressive strength of 7 ksi. FSAR Section 3B.2.1 provides detail regarding the structural description of RXB walls.

The CRB exterior walls are 3 feet thick reinforced concrete and have a concrete compressive strength of 5 ksi. The slab at grade level is either 2 or 3 feet thick, depending upon location. FSAR Sections 3B.3.1 and 3B.3.3.2 provide detail regarding the structural description of CRB walls and the CRB slab at grade level.

It is worth noting that NuScale’s barrier analysis for protection against turbine-generated missiles is conservative in that it does not account for the reinforcement of the concrete in walls or slab.

References

1. American Concrete Institute, ACI 349-06, “Code Requirements for Nuclear Safety-Related Concrete Structures and Commentary,” Farmington Hills, MI, 2006

2. Dresser-Rand Steam Turbine Solutions and Services, www.escosalesco.com/PDF/DresserrandSteam-Turbine-Solutions.pdf

3. Siemens Brochure, “Ingenuity for Life - Siemens Steam-Turbine Product Overview - 01-2018,” https://www.siemens.com/content/dam/webassetpool/mam/tag-siemens-com/smdb/power-and-gas/steamturbines/steam-turbine-product-overview-01-2018.pdf

Impact on DCA:

FSAR Section 3.5.1.3 andTable 1.8-2 have been revised as described in the response above and as shown in the markup provided with this response.

RAI 01-61, RAI 02.04.13-1, RAI 03.04.01-4, RAI 03.04.02-1, RAI 03.04.02-2, RAI 03.04.02-3, RAI 03.05.01.03-1, RAI 03.05.01.04-1, RAI 03.05.02-2, RAI 03.05.03-4, RAI 03.06.02-6, RAI 03.06.02-15, RAI 03.06.03-11, RAI 03.07.01-2, RAI 03.07.01-3, RAI 03.07.02-6S1, RAI 03.07.02-6S2, RAI 03.07.02-8, RAI 03.07.02-12, RAI 03.07.02-15S5, RAI 03.08.04-3S2, RAI 03.08.04-23S1, RAI 03.08.04-23S2, RAI 03.08.05-14S1, RAI 03.09.02-15, RAI 03.09.02-48, RAI 03.09.02-67, RAI 03.09.02-69, RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-6, RAI 03.09.06-16, RAI 03.09.06-16S1, RAI 03.09.06-27, RAI 03.11-8, RAI 03.11-14, RAI 03.11-14S1, RAI 03.11-18, RAI 03.13-3, RAI 04.02-1S2, RAI 05.02.03-19, RAI 05.02.05-8, RAI 05.04.02.01-13, RAI 05.04.02.01-14, RAI 05.04.02.01-19, RAI 06.02.01.01.A-18, RAI 06.02.01.01.A-19, RAI 06.02.06-22, RAI 06.02.06-23, RAI 06.04-1, RAI 09.01.01-20, RAI 09.01.02-4, RAI 09.01.05-3, RAI 09.01.05-6, RAI 09.03.02-3, RAI 09.03.02-4, RAI 09.03.02-5, RAI 09.03.02-6, RAI 09.03.02-8, RAI 10.02-1, RAI 10.02-2, RAI 10.02-3, RAI 10.02.03-1, RAI 10.02.03-2, RAI 10.03.06-1, RAI 10.03.06-5, RAI 10.04.06-1, RAI 10.04.06-2, RAI 10.04.06-3, RAI 10.04.10-2, RAI 11.01-2, RAI 12.03-55S1, RAI 13.01.01-1, RAI 13.01.01-1S1, RAI 13.02.02-1, RAI 13.03-4, RAI 13.05.02.01-2, RAI 13.05.02.01-2S1, RAI 13.05.02.01-3, RAI 13.05.02.01-3S1, RAI 13.05.02.01-4, RAI 13.05.02.01-4S1, RAI 14.02-7, RAI 19-31, RAI 19-31S1, RAI 19-38, RAI 20.01-13

Table 1.8-2: Combined License Information Items

Item No.	Description of COL Information Item	Section
COL Item 1.1-1:	A COL applicant that references the NuScale Power Plant design certification will identify the site-specific plant location.	1.1
COL Item 1.1-2:	A COL applicant that references the NuScale Power Plant design certification will provide the schedules for completion of construction and commercial operation of each power module.	1.1
COL Item 1.4-1:	A COL applicant that references the NuScale Power Plant design certification will identify the prime agents or contractors for the construction and operation of the nuclear power plant.	1.4
COL Item 1.7-1:	A COL applicant that references the NuScale Power Plant design certification will provide site-specific diagrams and legends, as applicable.	1.7
COL Item 1.7-2:	A COL applicant that references the NuScale Power Plant design certification will list additional site-specific piping and instrumentation diagrams and legends as applicable.	1.7
COL Item 1.8-1:	A COL applicant that references the NuScale Power Plant design certification will provide a list of departures from the certified design.	1.8
COL Item 1.9-1:	A COL applicant that references the NuScale Power Plant design certification will review and address the conformance with regulatory criteria in effect six months before the docket date of the COL application for the site-specific portions and operational aspects of the facility design.	1.9
COL Item 1.10-1:	A COL applicant that references the NuScale Power Plant design certification will evaluate the potential hazards resulting from construction activities of the new NuScale facility to the safety-related and risk significant structures, systems, and components of existing operating unit(s) and newly constructed operating unit(s) at the co-located site per 10 CFR 52.79(a)(31). The evaluation will include identification of management and administrative controls necessary to eliminate or mitigate the consequences of potential hazards and demonstration that the limiting conditions for operation of an operating unit would not be exceeded. This COL item is not applicable for construction activities (build-out of the facility) at an individual NuScale Power Plant with operating NuScale Power Modules.	1.10
COL Item 2.0-1:	A COL applicant that references the NuScale Power Plant design certification will demonstrate that site-specific characteristics are bounded by the design parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the COL applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its combined license application.	2.0
COL Item 2.1-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site geographic and demographic characteristics.	2.1
COL Item 2.2-1:	A COL applicant that references the NuScale Power Plant design certification will describe nearby industrial, transportation, and military facilities. The COL applicant will demonstrate that the design is acceptable for each potential accident, or provide site-specific design alternatives.	2.2
COL Item 2.3-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3
COL Item 2.4-1:	A COL applicant that references the NuScale Power Plant design certification will investigate and describe the site-specific hydrologic characteristics for Section 2.4.1 through Section 2.4.14, except Section 2.4.8 and Section 2.4.10.	2.4

Table 1.8-2: Combined License Information Items (Continued)

Item No.	Description of COL Information Item	Section
COL Item 2.5-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site-specific geology, seismology, and geotechnical characteristics for Section 2.5.1 through Section 2.5.5, below.	2.5
COL Item 3.2-1:	A COL applicant that references the NuScale Power Plant design certification will update Table 3.2-1 to identify the classification of site-specific structures, systems, and components.	3.2
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 Reactor Building or Seismic Category I portion of the Control Building.	3.3
COL Item 3.4-1:	A COL applicant that references the NuScale Power plant design certification will confirm the final location of structures, systems, and components subject to flood protection and final routing of piping.	3.4
COL Item 3.4-2:	A COL applicant that references the NuScale Power plant design certification will develop the on-site program addressing the key points of flood mitigation. The key points to this program include the procedures for mitigating internal flooding events; the equipment list of structures, systems, and components subject to flood protection in each plant area; and providing assurance that the program reliably mitigates flooding to the identified structures, systems, and components.	3.4
COL Item 3.4-3:	A COL applicant that references the NuScale Power plant design certification will develop an inspection and maintenance program to ensure that each water-tight door, penetration seal, or other "degradable" measure remains capable of performing its intended function.	3.4
COL Item 3.4-4:	A COL applicant that references the NuScale Power plant design certification will confirm that site-specific tanks or water sources are placed in locations where they cannot cause flooding in the Reactor Building or Control Building.	3.4
COL Item 3.4-5:	A COL applicant that references the NuScale Power Plant design certification will determine the extent of waterproofing and dampproofing needed for the underground portion of the Reactor Building and Control Building based on site-specific conditions. Additionally, a COL applicant will provide the specified design life for waterstops, waterproofing, damp proofing, and watertight seals. If the design life is less than the operating life of the plant, the COL applicant will describe how continued protection will be ensured.	3.4
COL Item 3.4-6:	A COL applicant that references the NuScale Power Plant design certification will confirm that nearby structures exposed to external flooding will not collapse and adversely affect the Reactor Building or Seismic Category I portion of the Control Building.	3.4
COL Item 3.4-7:	A COL applicant that references the NuScale Power Plant design certification will determine the extent of waterproofing and damp proofing needed to prevent groundwater and foreign material intrusion into the expansion gap between the end of the tunnel between the Reactor Building and the Control Building, and the corresponding Reactor Building connecting walls.	3.4
COL Item 3.5-1:	A COL applicant that references the NuScale Power Plant certified design will provide a missile analysis for the site-specific turbine generator which demonstrates that protection from turbine missiles is accomplished by using barriers.	3.5
COL Item 3.5-2:	A COL applicant that references the NuScale Power Plant certified design will address the effect of turbine missiles from nearby or co-located facilities.~~Not Used.~~	3.5
COL Item 3.5-3:	A COL applicant that references the NuScale Power Plant certified design will confirm that automobile missiles cannot be generated within a 0.5-mile radius of safety-related structures, systems, and components and risk-significant structures, systems, and components requiring missile protection that would lead to impact higher than 30 feet above plant grade. Additionally, if automobile missiles impact at higher than 30 feet above plant grade, the COL applicant will evaluate and show that the missiles will not compromise safety-related and risk-significant structures, systems, and components.	3.5
COL Item 3.5-4:	A COL applicant that references the NuScale Power Plant design certification will evaluate site-specific hazards for external events that may produce more energetic missiles than the design basis missiles defined in FSAR Tier 2, Section 3.5.1.4.	3.5

are ASME Class 1 or 2 and therefore not credible missile sources as discussed in Section 3.5.1.1.1.

A control rod drive mechanism (CRDM) housing failure, sufficient to create a missile from a piece of the housing or to allow a control rod to be ejected rapidly from the core, is non-credible. The CRDM housing is a Class 1 appurtenance per ASME Section III.

3.5.1.3 Turbine Missiles

RAI 10.02-3, RAI 10.02.03-1, RAI 10.02.03-2

The turbine generator building layout in relation to the overall site layout is shown on Figure 1.2-2. The turbine generator rotor shafts are physically oriented such that the RXB, CRB, and RWB are within the turbine trajectory hazard zone and considered to be unfavorably oriented with respect to the NPMs, as defined by RG 1.115, Revision 2. Appendix A of RG 1.115, Rev. 2 identifies SSC requiring protection from turbine missiles. The SSC that require protection from turbine missiles (high-trajectory and low-trajectory turbine rotor and blade fragments) are located in either the RXB, the CRB, the RWB, or underground.

RAI 10.02-3, RAI 10.02.03-1, RAI 10.02.03-2

Protection from turbine missiles is accomplished by using barriers instead of the statistical significance criteria outlined in Section 3.5.1. The Seismic Category I RXB and CRB provide protection from turbine missiles for SSC located within each building. The SSC located underground are protected by their depth below grade. The SSC located in the Seismic Category II RWB are not protected from the effects turbine missiles. However, any radioactive release that might result from the effects of a turbine missile is bounded by the failure of the gaseous radioactive waste system postulated in Section 11.3.3 and the resultant doses presented in Table 11.3-9.

RAI 03.05.03-4, RAI 10.02-3, RAI 10.02.03-1, RAI 10.02.03-2

COL Item 3.5-1: A COL applicant that references the NuScale Power Plant certified design will provide a missile analysis for the site-specific turbine generator which demonstrates that protection from turbine missiles is accomplished by using barriers.

RAI 03.05.01.03-1, RAI 10.02-3, RAI 10.02.03-1, RAI 10.02.03-2

COL Item 3.5-2: A COL applicant that references the NuScale Power Plant certified design will address the effect of turbine missiles from nearby or co-located facilities.~~Not used.~~

3.5.1.4 Missiles Generated by Tornadoes and Extreme Winds

Hurricane and tornado generated missiles are evaluated in the design of safety-related structures and risk-significant SSC outside those structures. The missiles used in the evaluation are assumed to be capable of striking in all directions and conform to the Region I missile spectrums presented in Table 2 of RG 1.76, Rev. 1, "Design-Basis Tornado and Tornado Missiles for Nuclear Power Plants" for tornado missiles and Table 1 and Table 2 of RG 1.221, Rev. 0, "Design-Basis Hurricane and Hurricane Missiles for Nuclear Power Plants," for hurricane missiles. These spectra are based on the design

Enclosure 3:

Affidavit of Zackary W. Rad, AF-1018-62390

NuScale Power, LLC

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 methods by which NuScale protects the plant from turbine missile impacts.

    NuScale has performed significant research and evaluation to develop a basis for this methods 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. 503, eRAI 9596. 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 October 30, 2018.

Zackary W. Rad