NuScale Power

RAIO-0418-59476

April 09, 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. 364 (eRAI No. 9248) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 364 (eRAI No. 9248)," dated February 07, 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 Questions from NRC eRAI No. 9248:

- 15.06.05-3
- 15.06.05-4

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 364 (eRAI No. 9248). 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 Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Samuel Lee, NRC, OWFN-8G9A
Rani Franovich, NRC, OWFN-8G9A
Prosanta Chowdhury NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9248, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9248, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0418-59477

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9248, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9248, nonproprietary

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

eRAI No.: 9248
Date of RAI Issue: 02/07/2018

NRC Question No.: 15.06.05-3

Title 10 of the Code of Federal Regulations, Part 50, Appendix A, General Design Criterion (GDC) 35, “Emergency Core Cooling,” requires a system that provides abundant emergency core cooling. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts. Section 15.6.5 of NUREG- 0800, "Standard Review Plan" provides guidance for complying with GDC 35. It states that the results of the large and small break post-loss of coolant accident (LOCA) long-term cooling analyses should have an acceptable model employed to identify the timing for boric acid precipitation for all LOCA scenarios.

NuScale developed a long-term cooling analysis methodology in which a mixing volume approach is used in the boron precipitation analysis with the assumption that perfect mixing occurs in the core and riser regions. During the long-term cooling period of a postulated LOCA, the unborated water enters the reactor pressure vessel through the reactor recirculation valve (RRV) and boiling occurs in the core region. An axial boron concentration gradient could develop, resulting in locally higher boron concentrations than predicted by the perfect mixing volume approach. Boron precipitation could happen in the area close to the two-phase level in the riser and upper part of the core causing potential subsequent coolant channel blockage.

Provide additional information to quantify the extent of boron concentration gradient within the core and riser region and evaluate the impact on boron precipitation margin during the long-term cooling phase of a LOCA.

NuScale Response:

A study was conducted to determine the conservatism in the current NPM modeling of the boron precipitation phenomena and to evaluate the likelihood of the development of a boron concentration gradient which would have a significant effect on boron precipitation in light of the model's conservatism. The study concluded:

1. The experimental observations and sensitivities show that the conservatisms in the NuScale methodology significantly reduce the available margin, and further provide reasonable assurance that boron precipitation will not occur.
2. Regarding a potential axial boron concentration gradient, in addition to the observation that the experimental measurements suggest no, or a minimal gradient exists, it is expected that if an axial gradient were to occur, it would most likely occur late in the long term cooling phase of the LOCA when the source for diluted liquid (relative to concentrated liquid in the mixing volume) is condensate returning from the containment vessel. At this later time the liquid level above the top of active fuel (TAF) is relatively high, which provides additional margin between the core inlet temperature and the precipitation temperature, since the additional inventory acts to reduce the precipitation temperature limit predicted by the mixing volume model.
3. If it is hypothesized that the greatest concentration of boron occurs at the liquid/vapor interface, the likelihood of boron precipitation to cause negative impacts on core cooling in this region of the NPM are mitigated by the following: 1) This interface is typically the highest temperature region of the riser where boron precipitation is least likely to occur, and 2) This region of the mixing volume reflects the greatest cross-sectional area, which is the least likely candidate for flow blockage.

Bases for the above conclusions are discussed below.

Conservatism in the Boron Precipitation Model

The approach for evaluating boron precipitation during long term cooling is a simplified conservative approach (i.e., mixing volume with a uniform boron distribution) in concert with a conservative long term cooling methodology (i.e., minimum core inventory, and/or maximum cooldown). The purpose of the boron precipitation methodology during long term cooling is to provide reasonable assurance that boron precipitation does not occur. The conservative assumptions implemented in the analysis consist of the following.

A mixing volume is defined where all soluble boron in the reactor coolant system (RCS) is assumed to be present. The entire mixing volume is conservatively assumed to consist of only the core region and a portion of the riser (i.e., neglects downcomer, lower plenum, and containment). This small mixing volume assumption, which inherently increases the boron concentration, maximizes the temperature at which boron precipitation occurs (i.e., reduces the delta-T between the boron precipitation temperature and the core inlet temperature). Additionally, an initial boron concentration of 1800 ppm is used which reflects the maximum hot zero power concentration during normal operation. The maximum hot full power boron concentration is 1400 ppm, which is more applicable to the limiting hot full power LOCA calculation evaluated in this study.

Furthermore, the time-dependent transport of boron, to and from the liquid in the downcomer and containment vessel (CNV), is conservatively neglected. In reality, after the initial blowdown of fluid into containment, it would take time for the boron concentration in the core and riser region to increase. After the reactor vent valve (RVV) flow transitions to single phase vapor and recirculation flow from containment to the RCS is established through the RRVs, the boron concentration in the core/riser region increases due to boil-off. With low recirculation flows, it takes time to boiloff in the core and replace the liquid with liquid from the CNV, while diluting the liquid volume in the CNV due to condensation. Later in the long term cooling phase when boron concentration in the core and riser regions may be the highest, the RCS liquid level is higher than the minimum calculated liquid level which occurs soon after the initial blowdown. Accounting for the time dependent transport and higher liquid level when the boron concentration is highest, would result in additional margin to the precipitation temperature threshold.

The conservative mixing volume assumption for boron precipitation has been widely used within the nuclear industry. A literature search has shown that simplified methods have been adequate to conservatively evaluate boric acid precipitation or alternatively, the earliest time operator action must occur.

Using the boron precipitation mixing model, sensitivities were performed to quantify the conservatisms in NuScale's methodology. Sensitivities were performed which evaluated the mixing volume size assumption and the initial boron concentration. The mixing volume assumption, used for the calculations presented in Table 6-1 of Reference [1], was modified to include (1) the lower plenum fluid inventory and (2) both the lower plenum and downcomer fluid inventories. The initial boron concentration assumption was also evaluated to reflect the maximum hot full power boron concentration of 1400 ppm. As discussed in Reference [1], for the LOCA cases considered in the boron precipitation analysis, the lowest collapsed liquid level reached is 2.271 feet above the TAF, which is utilized as a reference point for comparisons.

Table 1 provides a comparison of the original simplified mixing volume assumption results (Ref. [1]), a sensitivity incorporating a mixing volume that includes the lower plenum inventory, and a sensitivity incorporating a mixing volume that includes both the lower plenum and downcomer fluid inventories. As shown, the additional fluid inventories correspond to a reduction in precipitation temperature from {{ }}$^{2(a),(c)}$, respectively.

Table 2 provides the results of the above mentioned sensitivities for an assumed initial boron concentration that reflects the maximum hot full power concentration of 1400 ppm. The boron precipitation temperature is reduced to {{ }}$^{2(a),(c)}$ for the original simplified mixing volume approach, {{ }}$^{2(a),(c)}$ when including the lower plenum inventory, and {{ }}$^{2(a),(c)}$ when including both the lower plenum and downcomer fluid inventories.

Figure 1 provides the boron precipitation temperature as a function of mixing volume for an initial boron concentration of 1800 ppm and 1400 ppm. The results are compared to the core inlet temperature for the limiting LOCA case. Figure 1 is a visual representation of Table 1 and Table 2.

It is further hypothesized in the RAI that the greatest concentration of boron will occur at the liquid/vapor interface. This interface is typically the highest temperature region of the riser where boron precipitation is least likely to occur. This region of the mixing volume has the greatest cross-sectional area and, is therefore the least likely candidate for flow blockage.

Table 1. Comparison of Boron Precipitation Studies - 1800 ppm

{{

}}$^{2(a),(c)}$

Table 2. Comparison of Boron Precipitation Studies - 1400 ppm

{{

}}$^{2(a),(c)}$

{{

}}$^{2(a),(c)}$

Figure 1. Boron Precipitation Temperature versus Mixing Volume - Comparison of Table 1 and Table 2 Results.

Post-LOCA Boric Acid Precipitation and Build-up in a Reactor Vessel Experiment

Reference [2] documents the results of an experiment which investigated post LOCA boric acid buildup in a reactor vessel. The experiment focused on boric acid concentrations within a reactor vessel and the resulting impact of boric acid precipitation. The pre-boron precipitation phase of the experiment is the focus in this study, since boric acid precipitation is not expected to occur in the NuScale Power Module.

The test described in Reference [2] was undertaken to demonstrate the effects of adding boric acid solution and boiling at atmospheric pressures, where core flushing is unavailable and core decay heat is removed by boil-off. Reference [2] further indicates that the experimental results show mixing and flow rates were very slow. The removal of decay heat by boil-off, relatively low flows, and natural circulation conditions generally reflect the NuScale conditions during post-LOCA long term core cooling.

In Reference [2], Combustion Engineering concluded that credit can be taken for mixing between the core and lower plenum when using a simplified mixing volume approach. It was observed that boric acid concentrations in the core and lower plenum increased at fairly similar rates, which supports the use of a uniform mixing volume approach, and further supports the assumption that the lower plenum can be considered as part of the simplified mixing volume assumption. It should be noted that the NuScale approach is even more conservative, in that the assumed mixing volume does not include the lower plenum. The similar rates of boric acid concentration increase in the core and lower plenum can be observed in Figure 1 of Reference [2], where the core, between plates, and flow skirt boron concentration measurements indicate a consistent trend. These trends also further suggest that an axial gradient is not present, or is minimal.

In addition to the observation that the experimental measurements suggest no, or a minimal gradient exists, it is expected that if an axial gradient were to occur it would most likely occur late in the long term cooling phase of the LOCA when the source for diluted liquid (relative to the concentrated liquid in the mixing volume) is condensate returning from the CNV. Late in the long term cooling phase the liquid level above the TAF is relatively high, which provides additional margin between the core inlet temperature and the precipitation temperature, since the additional inventory/level acts to reduce the precipitation temperature threshold.

References

1. TR-0916-51299-P, "*Long-Term Cooling Methodology*", Rev. 0.
2. Westinghouse, Post LOCA Boric Acid Mixing Experiment, ADAMS Accession No. ML11167A116.

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.: 9248
Date of RAI Issue: 02/07/2018

NRC Question No.: 15.06.05-4

Title 10 of the Code of Federal Regulations, Part 50, Appendix A, GDC 35, “Emergency Core Cooling,” requires a system that provides abundant emergency core cooling. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal- water reaction is limited to negligible amounts. Section 15.6.5 of NUREG-0800 "Standard Review Plan" provides guidance for complying with GDC 35. It states that the results of the large and small break post-LOCA long- term cooling analyses should have an acceptable model employed to identify the timing for boric acid precipitation for all LOCA scenarios.

NuScale developed a long-term cooling analysis methodology and documented it in technical report TR- 0916-51299-P, “Long-Term Cooling Methodology,” Revision 0 . In Section 3.317 of TR-0916-51299-P, the Phenomena Identification and Ranking Table (PIRT) ranks {{ }}$^{2(a),(c)}$ as a highly important phenomenon. However, no analysis of {{ }}$^{2(a),(c)}$ is described in the technical report. Scaled tests show that large amounts of {{ }}$^{2(a),(c)}$ can occur on metal surfaces exposed to boiling. Since boric acid is contained in the primary coolant, boric acid could be carried away in the two-phase flow entrained in vapor droplets. Therefore, following a LOCA, boiling in the core could produce a two-phase mixture containing boric acid, which can {{ }}$^{2(a),(c)}$ over time. The {{ }}$^{2(a),(c)}$ or impair their design function {{ }}$^{2(a),(c)}$. Reactor vessel internal pressure could increase and restrict the ability of the RRVs to provide adequate water addition to the vessel and preclude core uncovery.

Demonstrate, through analysis or by citing relevant experimental data, that {{ }}$^{2(a),(c)}$

NuScale Response:

The RAI raises a concern that during post-LOCA long term core cooling the liquid droplets with solute boron can be entrained from the free surface of the mixture level inside the riser section of the reactor pressure vessel. These liquid droplets can be carried with the steam generated by the core decay heat up to the reactor vent valves. The boron carried by the entrained liquid droplets from the riser section can potentially {{ }}$^{2(a),(c)}$ and hinder the core cooling capability during long term cooling phase of a LOCA. However, the analysis presented below shows that the amount of liquid droplet entrainment is negligibly small and is not considered to be sufficient to hinder the operation of the RVVs during the long term core cooling transient.

Mechanistic modeling of liquid droplet entrainment from a pool free surface with boiling and bubbling is given in Reference [1] based on a large amount of experimental data over a wide range of pressure for air-water and steam-water systems. Reference [1] also summarizes the current understanding of the phenomenon with previously developed models and experimental evidence. The liquid droplets which are suspended from the free pool surface are partly carried away with the streaming gas flow and partly returned back to the pool surface by gravity. The amount of liquid entrainment with the gas flow is shown to depend on the gas volumetric flux, j_g and axial distance from the pool free surface,h. Therefore, the droplet entrainment, E_{fg} is given by

$$E_{fg} \equiv \frac{\rho_f j_{fe}}{\rho_g j_g} = \frac{\text{entrained droplet mass flux}}{\text{gas mass flux}} = E_{fg}(j_g, h) \qquad (1)$$

Reference [1] describes experimental evidence of the pool entrainment characteristics in three distinct regimes depending on the amount of the gas volumetric flux at a given height:

1. Low gas-flux regime where the entrainment (E_{fg}) is small and fine droplets are generated. In this region, the entrainment (E_{fg}) is proportional to j_g.
2. Intermediate gas-flux regime where larger droplets are ejected from the pool surface. In this region, the entrainment (E_{fg}) is proportional to $j_g^{3\text{-}4}$.
3. High gas-flux regime where large gas slugs causes significant pool agitation and considerable amount of liquid can be entrained by splashing. In this region, the entrainment (E_{fg}) increases very rapidly with $j_g^{7\text{-}20}$.

Similarly, three distinct regions of pool entrainment are identified depending on the axial distance from the pool surface, h:

1. Near surface region where the entrainment amount is independent of both axial distance from the pool surface and gas flux
2. Momentum control region where the entrainment amount depends on the initial momentum of the entrained droplets and their terminal velocity. In this region, the

entrainment decreases with h or h^3 depending on the magnitude of the gas volumetric flux.

3. Deposition control region where the entrainment amount decreases with droplet deposition and approximately with decreasing h.

During long term core cooling when the equilibrium conditions are reached between the reactor and containment pressure vessel, the gas or steam volumetric flux can be conservatively calculated from a simple quasi-steady heat balance without accounting for any subcooling and heat losses through the core and riser wall as

$$\rho_g j_g \Delta i_{fg} A_R = \dot{Q}(t) \tag{2}$$

where A_R is the riser flow area,ρ_g is the gas density, Δi_{fg} is the latent heat of vaporization, and Q(t) is the core decay power. Figure 1 compares the gas volumetric flux calculated by Equation (2) to that from an NRELAP5 calculation of the long term core cooling evaluation (Reference [3]) at the middle of the riser with flow area of {{ $\}\}^{2(a),(c)}$ and diameter of {{ $\}\}^{2(a),(c)}$. As shown in Figure 1, a simple heat balance would reasonably and conservatively capture the trend in gas volumetric flux as compared to the NRELAP5 solution.

Reference [1] provides a correlation for the pool entrainment based on mechanistic modeling via taking into account the droplet size distribution, initial velocity of droplets and their motion. The resulting model considers the different mechanisms and regions as previously described. The transition criterion between low and high gas flux regimes are given in terms of dimensionless gas flux and axial distance from the pool free surface such that if

$$\frac{j_g^*}{h^*} \leq 6.39 \times 10^{-4} \tag{3}$$

is satisfied, the entrainment in the low gas flux regime is given by

$$E_{fg} = 2.21 N_{\mu_g}^{1.5} D_H^{*1.25} \left(\frac{\Delta\rho}{\rho_g}\right)^{0.31} \frac{j_g^*}{h^*} \tag{4}$$

The dimensionless quantities in Equation (4) are defined as follows:

$$j_g^* \equiv \frac{j_g}{\left(\frac{\sigma g \Delta\rho}{\rho_g^2}\right)^{1/4}} \tag{5}$$

where σ is the surface tension, $\Delta\rho = \rho_f - \rho_g$ is the density differential between liquid and gas.

$$h^* \equiv \frac{h}{\left(\frac{\sigma}{g\Delta\rho}\right)^{\frac{1}{2}}} = \frac{h}{\mathrm{La}} \tag{6}$$

where La is the Laplace length,

$$N_{\mu_g} \equiv \frac{\mu_g}{\left(\rho_g \sigma \mathrm{La}\right)^{1/2}} \tag{7}$$

is the gas viscosity number, and

$$D_H^* \equiv \frac{D_H}{\mathrm{La}} \tag{8}$$

is the dimensionless hydraulic diameter of the vessel. The plot on the left-hand-side of Figure 2 shows the variation of j_g^*/h^*, and given the criterion in Equation (3), it is shown that the droplet entrainment is in the low gas flux regime. The height from the pool surface is measured from the equilibrium collapsed level to the bottom of the pressurizer baffle plate neglecting the additional distance from the baffle plate to the top of the pressurizer where the RVVs are located. Section 9.2 of Reference [2] demonstrates that the equilibrium collapsed level for various LOCA break sizes is about {{ }}$^{2(a),(c)}$ above the top of the active fuel. The height in Equation (6) is taken as the distance from the equilibrium collapsed level to the bottom of the pressurizer baffle plate ignoring the volume of the pressurizer to account for the difference between collapsed and mixture levels. Figure 2 also shows the calculated entrainment (E_{fg}) during the long term cooling transient where it reaches about {{ }}$^{2(a),(c)}$ by the end of 72 hour. When the liquid droplet mass flow rate is calculated from the entrainment amount, it can be shown that the droplet flow rate is in the order of {{ }}$^{2(a),(c)}$ kg/s which is significantly small compared to the flow rate at about {{ }}$^{2(a),(c)}$ per single RVV during long term cooling. The estimated amount of droplet flow rate represents the liquid droplets reaching the baffle plate.

Another important aspect of the long term cooling transient is related to the release of stored energy from the RPV structures such as the riser wall, pressurizer baffle plate, pressurizer wall, and additional heat structures such as control rod drive mechanisms (CRDMs) inside the riser. These are the heat structures where the entrained droplets within the steam need to travel before they possibly reach the RVVs. Figure 3 shows the temperature difference between the wall and steam at three different location, i.e. middle of the riser, pressurizer baffle plate, and pressurizer wall inside the reactor pressure vessel. As it is shown in Figure 3, considerable amount of temperature difference for the wall heat transfer exists to provide heat transfer for creating superheated dry steam along the flow path. It is important to note that the NRELAP5 modeling of two-phase flow does not explicitly account for the entrained liquid droplets as a separate field. The NRELAP5 calculations utilized here predicts single-phase vapor flow above the mixture level inside the riser all the way to the reactor vent valves at the top of the pressurizer during the long term core cooling phase. After the first fifty hours, the solid structures reach essentially thermal equilibrium with the steam above the bubbling pool level. As it was shown previously, the estimated liquid droplet entrainment is significantly lower compared to the initial hours into the transient where the stored energy release is substantial.

In summary, the pool entrainment phenomenon was studied to estimate the amount of liquid droplet entrainment from the bubbling pool surface inside the riser during the long term core cooling transient. The gas volumetric flux estimated from the heat balance and the axial distance from the pool surface to the pressurizer baffle plate was conservatively used to estimate the amount of droplet entrainment, which was shown to be quite small (Figure 2). Furthermore, it was shown that there is significant temperature difference between the heat structure surface and steam such that the small amount of liquid droplets that may survive in the steam would evaporate before reaching the RRVs as these heat structures provide significant hot surfaces along the flow path. Therefore, there is little potential to {{ }}$^{2(a),(c)}$ from liquid droplets {{ }}$^{2(a),(c)}$ during long term core cooling will not be significantly degraded during the long term cooling phase.

References:

[1] Kataoka, I. and Ishii, M. “Mechanistic Modeling of Pool Entrainment Phenomenon”, *Int. J. Heat Mass Transfer,* Vol. 11, pp. 1999-2014, 1984.

[2] TR-0516-49422-P, “Loss-of-Coolant Accident Evaluation Model”, Revision 0, December 2016.

[3] TR-0916-51299-P, “Long-Term Cooling Methodology”, Revision 0, January 2017.

{{

}}$^{2(a),(c)}$

Figure 1. Volumetric Gas Flux during Long Term Core Cooling

{{

}}$^{2(a),(c)}$

Figure 2. Ratio of Dimensionless Gas Flux and Height above Pool Surface (LEFT), Entrainment as a fraction of Total Gas Mass Flux (RIGHT)

{{

}}$^{2(a),(c)}$

Figure 3. Temperature Difference between Wall and Steam at Different Locations

Impact on DCA:

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

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0418-59477

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 method by which NuScale develops its long term cooling capability.

    NuScale has performed significant research and evaluation to develop a basis for this method 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 RAI No. 364, eRAI No. 9248. 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 4/9/2018.

Zackary W. Rad