March 22, 2017 Docket: PROJ0769

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Submittal of Response to NRC Requests for Additional Information Letter No. 5, Letter No. 7, and Letter No. 9 for the Review of Topical Report TR-0915-17565, "Accident Source Term Methodology," Revision 1 (TAC No. RQ6004)

REFERENCES:

1. Letter from NuScale Power, LLC to U.S. Nuclear Regulatory Commission, "Accident Source Term Methodology," Revision 1, TR-0915-17565, dated April 8, 2016 (ML 16099A394)

2. NuScale Topical Report "Accident Source Term Methodology," TR-0915-17565, Revision 1, dated April 2015 (ML 16099A394)

3. Letter from U.S. Nuclear Regulatory Commission to NuScale Power, LLC, "Request for Additional Information Letter No. 5 for the Review of NuScale Topical Report TR-0915-17565, "Accident Source Term Methodology," Revision 1 (TAC No. RQ6004) dated November 1, 2016

4. Letter from U.S. Nuclear Regulatory Commission to NuScale Power, LLC, "Request for Additional Information Letter No. 7 for the Topical Report 0915-17565, "Accident Source Term Methodology," Revision 1 (TAC No. RQ6004) dated November 1, 2016 (ML 16306A046)

5. Letter from U.S. Nuclear Regulatory Commission to NuScale Power, LLC, "Request for Additional Information Letter No. 9 for the Topical Report 0915-17565, "Accident Source Term Methodology," Revision 1 (TAC No. RQ6004) dated November 1, 2016

In a letter dated April 8, 2016 (Reference 1), NuScale Power, LLC (NuScale) submitted the topical report entitled "Accident Source Term Methodology," Revision 1 (Reference 2). In letters dated November 1, 2016 (References 3, 4, and 5), the NRC Staff provided Requests for Additional Information (RAIs) regarding the subject topical report.

The purpose of this letter is to provide NuScale responses to the NRC RAIs. Enclosure 1 provides the proprietary version of the NuScale response to RAI Letter No. 5, RAI Letter No. 7, and RAI Letter No. 9.

Enclosure 2 provides the nonproprietary version of the NuScale response to RAI Letter No. 5, RAI Letter No. 7, and RAI Letter No. 9.

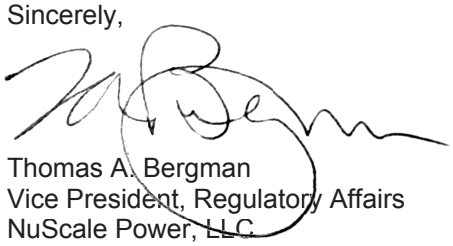
To assist the NRC review of these RAI responses, when a response necessitated a revision or change to the report, redline/strikeout pages of the TR-0915-17565, Revision 1, were generated for the affected pages. Enclosure 3 provides the proprietary redline/strikeout pages of TR-0915-17565,

Revision 1. Enclosure 4 provides the nonproprietary redline/strikeout pages of TR-0915-17565, Revision 1.

NuScale requests that the proprietary Enclosure 1 and Enclosure 3 be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The enclosed affidavit (Enclosure 5) supports this request.

This letter makes no regulatory commitments and no revisions to any existing regulatory commitments. Please feel free to contact Stephanie Seely at 980-349-4897 or at sseely@nuscalepower.com if you have any questions.

Sincerely,



Thomas A. Bergman
Vice President, Regulatory Affairs
NuScale Power, LLC

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Omid Tabatabai, NRC, TWFN-6E7
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Enclosure 1: NuScale Response to NRC Request for Additional Information Letter No. 5, Letter No. 7, and Letter No. 9, for TR-0915-17565, “Accident Source Term Methodology” Revision 1, proprietary version
Enclosure 2: NuScale Response to NRC Request for Additional Information Letter No. 5, Letter No. 7, and Letter No. 9, for TR-0915-17565, “Accident Source Term Methodology” Revision 1, nonproprietary version
Enclosure 3: Redline/strikeout pages of NuScale Topical Report TR-0915-17565, “Accident Source Term Methodology,” Revision 1, proprietary version
Enclosure 4: Redline/strikeout pages of NuScale Topical Report TR-0915-17565, “Accident Source Term Methodology,” Revision 1, nonproprietary version
Enclosure 5: Affidavit of Thomas A. Bergman, [AF-0317-53417]

Enclosure 1:

NuScale Response to NRC Request for Additional Information Letter No. 5, Letter No. 7, and Letter No. 9, for TR-0915-17565, “Accident Source Term Methodology” Revision 1, proprietary version

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Enclosure 2:

NuScale Response to NRC Request for Additional Information Letter No. 5, Letter No. 7, and Letter No. 9, for TR-0915-17565, “Accident Source Term Methodology” Revision 1, nonproprietary version

NRC RAI Number: 05 NRC RAI Date: November 1, 2016

NRC Review of: Accident Source Term Methodology, TR-0915-17565-P, Revision 1

NRC RAI Question Number: 02.03.04-1 Question #1

NRC RAI Question

Please justify why it is acceptable for the NuScale methodology to use the 95th percentile X/Q value as the maximum sector X/Q value instead of a 99.5th percentile X/Q value as suggested by RG 1.145.

NuScale RAI Question Response

It is acceptable to utilize the 95th percentile X/Q value as the maximum sector X/Q because RG 1.194 directs that the 95th percentile X/Q value should be determined for control room related atmospheric dispersion analyses. Control room related atmospheric dispersion analyses have historically dealt with distances from source to receptor on the order of 400 feet. Since NuScale's assumed source-receptor distance for offsite dose analysis is also on the order of 400 feet, it is reasonable to apply the 95th percentile guidance of RG 1.194 rather than the 99.5th percentile guidance of RG 1.145.

The use of ARCON96 versus PAVAN creates non-analogous situations when trying to combine guidance from both RG 1.145 and RG 1.194 or compare NuScale's methodology to these regulatory guides. For example, NuScale uses ARCON96's default direction window of 90 degrees, which is more conservative than the RG 1.145 and PAVAN approach of using a 22.5 degree direction window. Section 4.1.6 of the report details other aspects of NuScale's methodology for utilizing ARCON96 for offsite atmospheric dispersion calculations that are conservative compared to what is allowable in RG 1.145 and RG 1.194.

A X/Q value that is not exceeded by more than 5.0 percent of the X/Q values generated with the meteorological observations in the data set is acceptable and reasonable for use in calculating individual offsite doses, especially in light of the conservative methodology being implemented to calculate each of these X/Q values. NUREG/CR-2260 details the basis for the 99.5th percentile X/Q suggested by RG 1.145 as being to create an equality, without consideration of plume meander, between the 95th percentile directionally independent evaluation of X/Q (the previous evaluation procedure before RG 1.145) and the directionally dependent evaluation procedure of RG 1.145.

NUREG/CR-2260 states, in relation to using the directionally independent evaluation of X/Q (the previous evaluation procedure before RG 1.145), that "the frequency of occurrence of this X/Q value at any specific location on the exclusion area boundary is expected to be substantially less than 5 percent of the time annually, because the particular location is less than the entire circumference of the appropriate boundary. For example, if one considers a segment of a circular exclusion area boundary which extends only one fifth of the way around the circumference of the boundary, then the expected frequency of the X/Q value in that segment would be one fifth of 5 percent or 1 percent…" It is NuScale's position that a 95th percentile directionally dependent evaluation on an individual sector basis is more appropriate and that

NUREG/CR-2260's decision to suggest a X/Q value that is exceeded 5 percent of the time around the entire circumference of the evaluation (which corresponds to a 99-99.5th percentile evaluation on a sector basis) was unnecessarily conservative. See reply to RAI 02.03.04-1 Question #2 for additional discussion.

Impact of NRC RAI Question Response on TR-0915-17565:

This RAI response does not require a revision to the report.

NRC RAI Question Number: 02.03.04-1 Question #2

NRC RAI Question

Please justify why it is acceptable for the NuScale methodology to {{ }}$^{2(a),(c)}$ as suggested by RG 1.145.

NuScale RAI Question Response

The NuScale methodology calculates {{

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

Impact of NRC RAI Question Response on TR-0915-17565:

This RAI response does not require a revision to the report.

NRC RAI Question Number: 02.03.04-1 Question #3

NRC RAI Question

Please justify why the NuScale criteria for utilizing ARCON96 for offsite atmospheric dispersion calculations allows {{

}}2(a),(c)

NuScale RAI Question Response

{{

}}2(a),(c)

Impact of NRC RAI Question Response on TR-0915-17565:

This RAI response does not require a revision to the report.

NRC RAI Number: 07 NRC RAI Date: November 1, 2016

NRC Review of: Accident Source Term Methodology, TR-0915-17565-P, Revision 1

NRC RAI Question Number: 15.00.03-1

NRC RAI Question

Section 4.5 of the Topical Report presents a post-accident pH methodology similar to ones used in previous design certifications. In Section 5.8 the applicant presents the results of an example post-accident pH calculation. However, to determine the acceptability of the applicant's methodology, the staff will perform a sensitivity analysis of the example post-accident pH calculation which will require access to the input values used in the example calculation. Provide the example post-accident pH analysis calculation, including the input values used, such that the staff can confirm the acceptability of the proposed methodology.

NuScale RAI Question Response

NuScale has made the example post-accident pH calculation available to the staff for audit in the electronic reading room.

Impact of NRC RAI Question Response on TR-0915-17565:

This RAI response does not require a revision to the report.

NRC RAI Number: 09 NRC RAI Date: November 1, 2016

NRC Review of: Accident Source Term Methodology, TR-0915-17565-P, Revision 1

NRC RAI Question Number: 01.05-22

NRC RAI Question

On page 24, in equations 3-5 through 3-7 the removal mechanisms do not include reactor coolant system (RCS) leakage in the calculation of the isotopic appearance rate. What is the basis for this omission?

NuScale RAI Question Response

The report will be revised to explicitly include RCS leakage as a removal mechanism in the calculation of isotopic appearance rate.

Impact of NRC RAI Question Response on TR-0915-17565:

Section 3.3.2 of the report will be revised to explicitly include RCS leakage as a removal mechanism in the calculation of isotopic appearance rate.

NRC RAI Question Number: 01.05-23

NRC RAI Question

On page 29, third paragraph, the topical report states that shine to the environment is negligible. Please provide the calculations to justify this claim.

NuScale RAI Question Response

NuScale has made the calculations available to the NRC for audit in the electronic reading room.

Table 1 below shows the key result of the calculations, which shows that shine from the containment vessel (CNV) through the reactor building (RXB) walls or ceiling to the environment or the control room building (CRB) is negligible.

Table 1- Sensitivity of dose results to inclusion of shine from the CNV

{{

}}2(a),(c)

Impact of NRC RAI Question Response on TR-0915-17565:

This RAI response does not require a revision to the report.

NRC RAI Question Number: 01.05-24

NRC RAI Question

On page 30, first paragraph, the topical report proposes to use {{ }}2(a),(c) in the reactor building pool boil-off calculation. Provide the basis for this assumption.

NuScale RAI Question Response

{{

}}2(a),(c)

Impact of NRC RAI Question Response on TR-0915-17565:

Section 3.3.4.7 of the report will be revised {{ }}2(a),(c)

NRC RAI Question Number: 01.05-25

NRC RAI Question

In Section 4.3.3 of the topical report provides a discussion of phoretic phenomena for aerosol removal. However, Section 4.2.4 (pg. 57, 4th paragraph) states that {{ }}2(a),(c)
Similarly, Section 4.3.4 provides a discussion of the effects of hygroscopicity on aerosol removal, while Section 4.2.4 (pg. 57, 4th paragraph) states that {{ }}2(a),(c) Please clarify the before mentioned statements and resolve any discrepancies of these statements in the topical report.

NuScale RAI Question Response

{{

}}2(a),(c)

Impact of NRC RAI Question Response on TR-0915-17565:

This RAI response does not require a revision to the report.

Enclosure 3:

Redline/strikeout pages of NuScale Topical Report TR-0915-17565, “Accident Source Term Methodology,” Revision 1, proprietary version

Enclosure 4:

Redline/strikeout pages of NuScale Topical Report TR-0915-17565, “Accident Source Term Methodology,” Revision 1, nonproprietary version

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Term	Definition
NRC	Nuclear Regulatory Commission (United States)
NWS	National Weather Service
pH_T	concentration of H+ ion on a logarithmic scale (temperature dependent)
PF	partition factor
PRA	probabilistic risk assessment
PWR	pressurized water reactor
RCS	reactor coolant system
REA	rod ejection accident
rem	Roentgen equivalent man (unit of dose, see TEDE)
RG	Regulatory Guide
RPV	reactor pressure vessel
RRV	reactor recirculation valve
RVV	reactor vent valve
scfh	standard cubic feet per hour (unit of flow)
scfm	standard cubic feet per minute (unit of flow)
SG	steam generator
SGTF	steam generator tube failure
SMR	small modular reactor
Sv	sievert (unit of radiation dose)
TEDE	total effective dose equivalent
χ/Q	atmospheric dispersion factor in units of seconds per cubic meter

{{ At equilibrium the production and removal of iodine is equal, by definition. Therefore, the equilibrium iodine release rate, (i.e., iodine production rate) may be calculated by determining the iodine removal rate. The removal rate is a function of the ~~CVCS flow~~reactor coolant system (RCS) removal, CVCS decontamination, and the natural radioactive decay process. For conservatism, no decontamination of the CVCS is credited, as doing so would result in a lower production rate. Therefore, for each isotope i, the isotopic production or removal rate λ_i is the sum of the two removal mechanisms of ~~the CVCS~~ RCS removal ~~λ_{CVCS}~~ $\lambda_{i,RCS}$ and radioactive decay $\lambda_{i,decay}$, expressed algebraically in the form of

$$\lambda_{i,Production} = \lambda_{i,Removal} = \lambda_{i,RCS} + \lambda_{i,decay}$$

~~$$\lambda_{i,\text{Production}} = \lambda_{i,\text{Removal}} = \lambda_{i,CVCS} + \lambda_{i,decay}$$~~ Eq 3-5

where, $\lambda_{i,RCS}$ is derived from contributions of CVCS letdown flow and allowable RCS operational leakage.

The equilibrium production rate (R_i) is then the activity of each isotope (A_i) multiplied by the appearance rate of the isotope, as in

$$R_i = A_i \times (\lambda_{i,RCS} + \lambda_{i,decay})$$

~~$$R_i = A_i \times (\lambda_{CVCS} + \lambda_{i,decay})$$~~ Eq 3-6

For all isotopes, the removal rate of iodine by ~~the CVCS~~RCS removal is based on the ~~letdown~~ flow rate and the total mass of coolant (M) in the primary system. Applying the appropriate unit conversions results in an expression of the form

$$\lambda_{i,RCS}(sec^{-1}) = \frac{Flow\ gal}{min} \cdot \frac{1}{M\ lbm} \cdot \frac{\rho\ lbm}{ft^3} \cdot \frac{ft^3}{7.481\ gal} \cdot \frac{min}{60\ sec}$$

~~$$\lambda_{CVCS}(\text{sec}^{-1}) = \frac{Flow\ gal}{\text{min}} \cdot \frac{1}{M\ lbm} \cdot \frac{\rho lbm}{ft^3} \cdot \frac{ft^3}{7.481 gal} \cdot \frac{\text{min}}{60\,\text{sec}}$$~~ Eq 3-7

The decay rate of each isotope is determined from the half-lives $T_{1/2}$ of each isotope, using

$$\lambda_{i,decay} = \frac{\ln|2|}{T_{1/2}}$$ Eq 3-8

3.3.4.7 Reactor Building Pool Boiling Radiological Consequences

An extended loss-of-offsite power event is expected to result in the decay heat from the reactors and the spent fuel to heat up the spent fuel pool and eventually cause the reactor pool to boil. The dose contribution of the pool boiling, such as would be postulated to occur in the NuScale reactor pool in the event of an extended loss of power to the pool heat removal system, is accounted for in the following manner.

{{ The methodology assumes that the reactor pool water would contain radionuclides primarily from routine refueling operations of a number of modules over a period of time. A lifetime equilibrium tritium concentration is assumed based on estimated boron concentrations in the reactor coolant and radwaste recycling associated with the pool cleanup system. Isotopes considered are those isotopes deemed important contributors to dose, and that are predicted to occur in the reactor pool, specifically the isotopes of H-3, I-131, Cs-137 and Sr-90.

The radioactive source term for this event are the nuclides released in the reactor pool water from refueling operations. These values are multiplied by the cumulative pool water volume released during boil off. {{

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

{{

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

3.3.4.8 Parent and Daughter Isotopes

Consistent with RG 1.183 (Reference 7.2.2), the RADTRAD decay and daughtering modeling option is used to include progeny from the decay of parent radionuclides that are significant with regard to radiological consequences and the released radioactivity. The calculated total effective dose equivalent (TEDE) dose is thus the sum of the committed effective dose equivalent from inhalation and the deep dose equivalent from external exposure from all tracked isotopes.

3.3.4.9 Two-Hour Sliding Window

RADTRAD determines the maximum two-hour TEDE by calculating the postulated dose for a series of small time increments and performing a "sliding" sum over the increments of successive two-hour periods. The time increments appropriately reflect the progression of the accident to capture the peak dose interval between the start of the event and the end of radioactivity release.

Enclosure 5:

Affidavit of Thomas A. Bergman, AF-0317-53417

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvallis, Oregon 97330 Office 541.360-0500 Fax 541.207.3928
www.nuscalepower.com

NuScale Power, LLC

AFFIDAVIT of Thomas A. Bergman

I, Thomas A. Bergman, state as follows:

(1) I am the Vice President of 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 Responses reveal distinguishing aspects about the process and method by which NuScale develops its Accident Source Term Methodology.

NuScale has performed significant research and evaluation to develop a basis for this process and 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 Enclosure 1 and Enclosure 3 entitled "NuScale Response to NRC Request for Additional Information Letter No. 5, Letter No. 7, and Letter No. 9, for TR-0915-17565, 'Accident Source Term Methodology' Revision 1, proprietary version" and "Redline/strikeout pages of NuScale Topical Report TR-0915-17565, 'Accident Source Term Methodology,' Revision 1, proprietary version" respectively. Enclosure 1 contains the designation "Proprietary" at the bottom of each page containing proprietary information. Enclosure 3 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 documents.

(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.

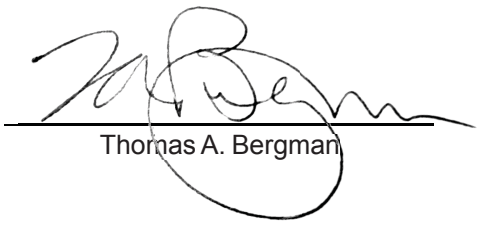
(b) The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, 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 March 22, 2017



Thomas A. Bergman