



April 23, 2018

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 Response to NRC Request for Additional Information No. 9388 (eRAI No. 9388) on the NuScale Topical Report, "Evaluation Methodology for Stability Analysis of the NuScale Power Module," TR-0516-49417, Revision 0

REFERENCES: 1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 9388 (eRAI No. 9388)," dated February 23, 2018
2. NuScale Topical Report, "Evaluation Methodology for Stability Analysis of the NuScale Power Module," TR-0516-49417, Revision 0, dated July 2016

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. 9388:

- 01-68

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 9388 (eRAI No. 9388). 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 Paul Infanger at 541-452-7351 or at pinfanger@nuscalepower.com.

Sincerely,

A handwritten signature in black ink, appearing to read "Zackary W. Rad".

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

Distribution: Samuel Lee, NRC, OWFN-8G9A
Prosanta Chowdhury NRC, OWFN-8G9A
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9388, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9388, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0418-59676



Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9388, proprietary



Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9388, nonproprietary

Response to Request for Additional Information Docket: PROJ0769

eRAI No.: 9388

Date of RAI Issue: 02/23/2018

NRC Question No.: 01-68

Title 10 of the Code of Federal Regulations (CFR), Part 50, Appendix A, General. Design Criterion (GDC) 10, “Reactor design,” requires that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. GDC 12 – Suppression of reactor power oscillations, states that the reactor core and associated coolant, control, and protection system shall be designed to assure that power oscillation which can result in conditions exceeding SAFDLs are not possible or can be reliably and readily detected and suppressed. The SRP 15.0.2 acceptance criteria with respect to evaluation models specifies that the chosen mathematical models and the numerical solution of those models must be able to predict the important physical phenomena reasonably well from both qualitative and quantitative points of view.

Section 5.5.4 “Ambient Heat Loss Model,” of the topical report (TR), TR-0516-49417-P, provides a brief summary of PIM’s ambient heat loss model. A cubic curve fit, where an ambient heat transfer coefficient, h_{amb} , is computed as a function of coolant temperature is given by Eq. 5-47 of the TR. The TR does not indicate how the data (h_{amb} , $T_{coolant}$) that was used to obtain the cubic fit was originally computed. The TR does note that the cubic expression includes effects of conduction through the RPV and CNV, thermal radiation between the outer RPV and inner CNV surfaces, and convection at inner RPV and outer CNV surfaces.

On December 13, 2017, NuScale and NRC staff participated in an audit call, and NuScale provided clarification to several questions concerning the ambient heat loss model. The remaining issues needing clarification are described herein. During the audit call, NuScale provided a qualitative description of the simplified heat loss model, indicating it was a steady state, 1-D, (multi-layer) conduction approximation to the energy conservation equation. Also, during the audit call, NuScale could not recall the geometry (cylindrical, slab, or other) of the simplified ambient heat loss model, but indicated additional details of the model could be found in two reports, EC-0000-2339 and EC-A010-00001507_03, which were added to NuScale’s Electronic Reading Room (ERR). These references provided parameter values, such as heat transfer coefficients and emissivities on the RPV and containment wall surfaces. However, the NRC staff still needs clarification of the simplified ambient heat loss geometry, explicit



mathematical expression of hamb developed for the ambient heat loss model, and radii/length values used for RPV/containment surfaces. The estimated ambient heat loss affects the primary side energy balance through heat addition term described in section 5.5.1.2, “Energy Balance,” of the TR. Since NuScale’s PIM code is currently an (NRC) unapproved code, and NuScale is seeking approval to use the PIM code to perform safety analyses as part of its stability methodology, further information regarding its ambient heat loss model is necessary.

In order to make an affirmative finding associated with the above regulatory requirement important to safety, NRC staff requests NuScale to provide the following information.

1. Provide the mathematical expression for hamb that was used in the simplified ambient heat loss model used to generate the data for the curve fit given by Eq. 5.47 of the TR and that appears to also be used for the ambient heat loss estimates described in section 4.4 of Appendix B of EC-0000-2339. For example, if a cylindrical geometry, hamb might have the form:

$$\text{hamb} = [1/h_r + r_{ri} \ln(r_{ro}/r_{ri})/k_r + r_{ri}/(r_{ro} * h_{rad}) + r_{ri} \ln(r_{co}/r_{ci})/k_c + r_{ri}/(r_{co} * h_c)]^{-1}$$

where: $h_{rad} = \text{emissivity}_{eff} * \sigma * (T_{ro}^2 + T_{ci}^2) * (T_{ro} + T_{ri})$

- i. r = radius
- ii. h= convective coefficients
- iii. sigma= Stephan Boltzmann constant subscripts
- iv. ri=inner RPV radius
- v. ro=outer RPV radius
- vi. ci=inner containment radius
- vii. co=outer containment radius

Update TR-0516-49417-P as appropriate based on the above request.

2. Provide the geometry (for example, cylindrical or slab) that was used to determine the ambient heat loss estimate given in section 4.4 of Appendix B of EC-0000-2339.
3. Confirm that the height(s) (elevation(s)) used to compute the RPV and containment surface areas is (are) the riser outlet elevation per section 4.4 of Appendix B of EC- 0000-2399. Also confirm that elevation value used for the ambient heat loss calculations was [] m ([]”) as per Table 3-1 of EC-A010-0001507_03, “System Transient Model Input Parameter Calculations.” If other lengths or elevations are used, provide their values, corresponding surface (RPV or containment), and rationale for the value.
4. Provide radii used to represent the RPV and containment surface areas and thermal resistances for the ambient heat loss estimate of [] kW given in section 4.4 of Appendix B of EC-0000-2339. If radii are not used to compute thermal resistance terms in hamb, provide the lateral dimensions used to compute surface areas for the ambient heat loss estimate; and rationale for how the dimensions apply to the actual RPV and containment geometry and associated heat losses.
5. If Tcoolant does not equal Tavg, [] K, provide the coolant temperature used to compute the ambient heat loss estimate of [] kW provided in section 4.4 of Appendix B of EC-0000-2339.

NuScale Response:

Item 1

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

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

Figure 1. Effective Heat Transfer Coefficient Diagram

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



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



Item 2

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

Item 3

The requested dimensions are included in Tables 1 and 2.

Item 4

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

Item 5

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

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

References

1. "Fundamentals of Heat and Mass Transfer, 5th Edition," Incropera and DeWitt, 2002.

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

Figure 2. Ambient Heat Loss Model.



Table 1. Inputs for Effective Heat Transfer Coefficient

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

Table 2. Elevations

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

Impact on Topical Report:

There are no impacts to the Topical Report TR-0516-49417, Evaluation Methodology for Stability Analysis of the NuScale Power Module, as a result of this response.



RAIO-0418-59676

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0418-59676

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 develops its stability analysis of the NuScale power module.

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 RAI No. 9388, eRAI 9388. 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 4/23/2018.



Zackary W. Rad