



April 09, 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. 9173 (eRAI No. 9173) 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. 9173 (eRAI No. 9173)," dated February 07, 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. 9173 :

- 01-60

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 9173 (eRAI No. 9173). 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,

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
Bruce Bavol, NRC, OWFN-8G9A



Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9173, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9173, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0418-59475



Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9173, proprietary



Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9173, nonproprietary

Response to Request for Additional Information Docket: PROJ0769

eRAI No.: 9173

Date of RAI Issue: 02/07/2018

NRC Question No.: 01-60

Title 10 of the Code of Federal Regulations (CFR), Part 50 Appendix A, General Design Criteria (GDC) 12- Suppression of reactor power oscillations requires that oscillations be either not possible or reliably detected and suppressed. The SRP 15.0.2 acceptance criteria with respect to evaluation models includes the requirement 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.

In sections 9.1 and 9.2 of topical report (TR), TR-0516-49417-P, transient PIM analyses of unmitigated events are used to demonstrate that there is sufficient time between a module protection system (MPS) trip on loss of subcooling and reactor shut down to prevent development of oscillatory behavior. The analyses depend on PIM's ability to reliably predict onset of instability and subsequent oscillatory behavior. With respect to initiating instabilities, section 8.2, "Stability Analysis of Operational Events," of the TR, states that unlike starting from a steady state (fixed point), there is no need to apply artificial perturbations in the case of transient analyses. However, artificial perturbations are typically required for other systems codes applied for similar analyses in order for those codes to predict either onset of instability or subcritical finite amplitude instabilities.

In order to make an affirmative finding associated with the above regulatory requirement important to safety, NRC staff requests NuScale demonstrate the PIM code's ability to reliably simulate growing oscillations that are initiated from the onset of unstable conditions without applying artificial perturbations to trigger the instability. For example, demonstrating similar results (time of onset and subsequent oscillation behavior) are obtained from two PIM calculations, with and without artificial perturbations, would sufficiently satisfy staff's request.

NuScale Response:

TR-0516-49417-P indicates that the stability of the module is examined under two situations. Situation 1, steady state operation; which must be perturbed in order to put the system at a neighboring point and watch the transient as the system returns to the original steady state. The



manner of returning is oscillatory and stability is determined by how fast the oscillations decay. In Situation 2, the state space is larger than the possible steady state points, and the system passes through these points during a transient. These other states (not steady) may be stable or unstable. For the stable ones, Situation 2-a, a perturbation is introduced to see how the system responds as it continues on its trajectory. Example of that is the startup scenario which was subject to RAI 9177. If the transient path encounters unstable points, Situation 2-b, the transient itself provides the perturbation, and there is no need to provide external perturbation.

It is acknowledged that if the transient responsible for the shifting of the operating point from a stable to an unstable one is slow, the initialization of oscillatory behavior can be delayed under certain conditions and depending on the simulation algorithms. For the NPM as simulated by the PIM code, it has been asserted that the transient leading to the loss of riser inlet subcooling and the onset of boiling in the riser would disturb the flow rate away from the quasi-equilibrium point which acts as a sufficient perturbation to initialize unstable oscillations. This assertion is demonstrated by performing PIM calculations where different rates of depressurization are imposed on the system to lead to its destabilization, and variants of externally imposed perturbations by intermittent pulses (similar to startup scenario addressed in RAI 9177), and also by imposing a random noise component. These variations of depressurization rate and different imposed perturbations are shown to have no significant impact on the timing of oscillations as shown by the specific cases presented here.

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In conclusion, it has been demonstrated that arriving at unstable configuration due to a transient is successfully perturbed by the transient itself where additional perturbations externally imposed do not significantly change the timing of the instability.



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Figure 1 PIM results of a depressurization case without external perturbation

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Figure 2 PIM results of a depressurization case with pulsed external perturbation every 10 min

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Figure 3 PIM results of a depressurization case with pulsed external perturbation every 1 min

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Figure 4 PIM results of a depressurization case with random external perturbation

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Figure 5 PIM results of a slower depressurization case without external perturbation

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Figure 6 PIM results of a slower depressurization case with random external perturbation



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-0418-59474

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0418-59475

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 these 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. 9173, eRAI No. 9173. 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