



June 28, 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. 452 (eRAI No. 9518) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 452 (eRAI No. 9518)," dated May 01, 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. 9518:

- 15.06.05-7

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 452 (eRAI No. 9518). 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@nuscalspower.com.

Sincerely,

A handwritten signature in black ink, appearing to read "Zackary W. Rad". The signature is fluid and cursive, with a long horizontal stroke extending to the right.

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

Distribution: Gregory Cranston, NRC, OWFN-8G9A
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Samuel Lee, NRC, OWFN-8G9A
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9518, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9518, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0618-60667



RAIO-0618-60666

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9518, proprietary



Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9518, nonproprietary

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

eRAI No.: 9518

Date of RAI Issue: 05/01/2018

NRC Question No.: 15.06.05-7

Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Appendix A, General Design Criterion (GDC) 35, “Emergency Core Cooling,” requires that a system to provide abundant emergency core cooling shall be provided. 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. DSRS Section 15.6.5 provides guidance for complying with GDC 35. It requires that evaluation models meet the requirements of 10 CFR 50.46, which states that the evaluation model must include sufficient supporting justification to show that the analytical technique realistically describes the behavior of the reactor system during a loss-of-coolant accident.

FSAR Chapter 15.6.5 and Section 9 of the “Loss-of-Coolant Accident Evaluation Model,” TR-0516-49422-P, Rev. 0, a topical report supporting the DCD Chapter 15 analyses, indicates that a stable natural recirculation flow pattern with the reactor recirculation valves and steam venting through the reactor vent valves (RVVs) is relied upon to remove decay heat passively via boiling in the core. The staff noted that the applicant did not evaluate the flows in the RVVs for potential vortex forces in the flow during this recirculation phase. Further, in RAI 9486, Question 31454, the staff noted a similar issue relative to the Station Blackout calculation.

Please provide an evaluation of the occurrence of vortex forces in the valves nozzles, such as through analysis, and show that adverse effects are precluded in the NPM design.

NuScale Response:

NuScale power module components are screened for flow induced vibration mechanisms and analyzed and tested in accordance with Regulatory Guide 1.20. NuScale’s comprehensive vibration assessment program is summarized in Reference 1. Emergency core cooling system (ECCS) valves do not screen for any flow induced vibration (FIV) mechanism under any operating condition. A brief assessment of vortices in the ECCS valve is provided below. Additionally, flow testing is performed as a part of ECCS valve qualification per QME-1 (ITAAC 02.08.06).



The reactor recirculation valve (RRV) is an angle valve with a 90 degree turn in the flow path. It does not have any features in the flow path that would produce cyclic vortex shedding. All turbulent flow produces some non-cyclic vortices, but the dynamic effects of turbulent flow are well bounded by the dynamic events that are included in the design basis of the valve, such as thrust loads during discharge. For this simplified evaluation, the valve disc is considered as a cylinder in pure crossflow, which is a bounding arrangement for vortex shedding power.

Methods for evaluating vortex shedding lock-in of a cylinder in cross flow are found in Reference 3, N-1324. Method (a) is evaluated here by dividing the velocity by the frequency and characteristic dimension (diameter). If this dimensionless number is less than 1, then lock-in of the structure and the vortex shedding frequency is avoided. The RRVs of the ECCS have no natural frequencies less than $\{ \{ \}^{2(a),(c)}$. The characteristic dimension of the valve disc is $\{ \{ \}^{2(a),(c)}$. The free stream velocity in the RRV during recirculation does not exceed $\{ \{ \}^{2(a),(c)}$ (typical flow velocities are about $\{ \{ \}^{2(a),(c)}$). Therefore, $V/f_n D$ equals 0.3, which is less than 1. Vortex shedding frequencies do not lock-in to the component natural frequency, with significant margin even for this simplified, bounding assessment.

Application of equation 69 from Reference 3 yields an oscillating lift force amplitude of less than a pound. This dynamic force is very small compared to the design basis loads included in the design and qualification of the ECCS valves (i.e., deadweight, thrust loads from valve discharge at high pressure, seismic accelerations). Response to these bounding loads is calculated in ASME design reports that are provided to close COL item 3.9-2. Demonstration of valve function with design basis dynamic loads is provided during qualification of the valves.

In summary, using methods delineated in the ASME Boiler and Pressure Vessel Code, Section III, Division 1, the RRVs are not susceptible to vortex shedding lock-in and do not experience significant forces due to vortex shedding because they do not have susceptible geometries in the flow path.

References:

1. TR-0716-50439-P, NuScale Comprehensive Vibration Assessment Program Technical Report, Revision 1.
2. American Society of Mechanical Engineers, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," ASME QME-1-2007 Edition, November 2007.
3. American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, 2007 edition, Section III, Division I, Appendices, 2009 addenda, New York, NY.



Impact on DCA:

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



RAIO-0618-60666

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0618-60667

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 configuration by which NuScale develops its power module.

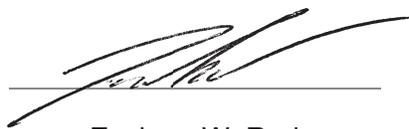
NuScale has performed significant research and evaluation to develop a basis for this configuration and has invested significant resources, including the expenditure of a considerable sum of money.

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. 452, eRAI 9518. 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 June 28, 2018.



Zackary W. Rad