



July 25, 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. 427 (eRAI No. 9408) on the NuScale Design Certification Application

**REFERENCE:** U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 427 (eRAI No. 9408)," dated April 17, 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. 9408:

- 03.09.02-75

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 427 (eRAI No. 9408). 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 Marty Bryan at 541-452-7172 or at mbryan@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: Gregory Cranston, NRC, OWFN-8G9A  
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9408, proprietary



RAIO-0718-61073

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9408,  
nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0718-61074



**Enclosure 1:**

NuScale Response to NRC Request for Additional Information eRAI No. 9408, proprietary



**Enclosure 2:**

NuScale Response to NRC Request for Additional Information eRAI No. 9408, nonproprietary

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

**eRAI No.:** 9408

**Date of RAI Issue:** 04/17/2018

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**NRC Question No.:** 03.09.02-75

10 CFR 50, Appendix A, GDC 4 requires structures, systems, and components important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents. During the audit from May 16, 2017, through November 2, 2017, the staff finds that NuScale has not measured or simulated reasonable flow-induced forcing functions for the CRAGT structures. Although several internal NuScale documents state that the CRAGT flow-induced forces are not known and that the flow fields do not resemble those of simple flows cited in the literature, no measurements of these flows or forces have been conducted. Assuming the simplified flow forces led to an estimated  $\{\{ \quad \} \}^{2(a),(c)}$  wall thickness degradation. The staff is unable to determine if this significant wall degradation impacts safety, or if more severe wall degradation may occur due to more complex flows through and around the CRAGTs.

NuScale is requested to provide the following information. Alternatively, NuScale may propose other options to resolve the staff's concerns identified above.

1. summarize the operating history of similar CRAGT designs in other currently operating plants,
2. define the maximum acceptable wall thickness degradation for the CRAGTs before replacement is needed,
3. explain the safety implications associated with complete wall thickness degradation of the CRAGTs, and
4. explain how more prototypic flow fields and forces will be estimated and applied to updated structural response analyses, or how tests might be used to show that CRAGT vibration and/or strain is negligible.

Update the comprehensive vibration assessment program report TR-0716-50439 or other appropriate documentation in the design certification package to include a summary of the requested information.

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## **NuScale Response:**

### Item 1

1) The EPRI Materials Reliability Program (MRP) considers the potential for wear for components found in operating reactors. MRP-227 provides guidelines for inspection and evaluation of the reactor vessel internals based on a detailed assessment of the aging degradation mechanisms for reactor vessel internals found in MRP-175. Figures 4-1 and 4-5 of MRP-227 show that structures similar to NuScale's control rod assembly guide tube (CRAGT), the B&W control rod guide tubes (CRGTs), have been evaluated using this program for aging degradation mechanisms. Wear is one of the eight aging degradation mechanisms considered (See Section 2.1 of MRP-227). Table 3-1 of MRP-227 lists the assessment results regarding the B&W CRGTs. The subparts were found to be not susceptible to wear and no additional measures were recommended. The NuScale design has a similar mechanical design to the B&W CRGTs, but has no bulk external cross flow (the fluid exits through the upper CRAGT support for NuScale, while for B&W the fluid exits the side of the region), and has flow velocities around 1/5<sup>th</sup> of those found in the B&W design (due to natural circulation vs. forced flow). These differences are advantages for the NuScale CRAGT relative to the B&W CRGT with respect to turbulent buffeting.

Appendix C of MRP-175 establishes the screening criteria for wear. The first criterion for inclusion is locations where relative motion may occur. The CRGTs are given as an example, but only the Westinghouse CRGT cards are placed in the primary group for wear. These components have relative motion (between the card and the rodlets), and thus are susceptible to wear. B&W CRGT components, which are similar to the NuScale CRAGT, are categorized as requiring no additional measures (i.e., they are not susceptible to wear).

In summary, MRP review of similar structures in operating plants concluded that they are not a location for wear due to 1) lack of motion of the part relative to the supports and 2) no history of wear being observed in service at the interface between the industry CRGT and their supports.

### Items 2-4

The wear estimates presented for the CRAGTs have been revised to more accurately represent the maximum relative motion between the CRAGT and the support. Wear estimates generally vary linearly with the cumulative sliding distance over the life of the component. The sliding distance due to turbulent buffeting has been revised to take out unnecessary conservatism. The previous estimate was based on the CRAGT traveling one complete circular path around the support hole at the root mean square (RMS) crossing frequency. Turbulent buffeting of the CRAGT cannot generate this large motion. The new estimate is based on traveling four times the zero-to-peak amplitude of the RMS vibration at the crossing frequency. The new estimate for the cumulative sliding distance is more than three orders of magnitude lower than the previous estimate.



The revised calculation shows that the maximum wear over the life of the plant of the CRAGT due to turbulent buffeting vibrations is low: equivalent to wear through  $\{\{ \quad \} \}^{2(a),(c)}$  of the wall thickness at a single concentrated wear location. This analysis conservatively applies the maximum RMS response (found at the mid-span of the CRAGT) to the support location.

2) The CRAGTs do not have specified limits for the extent of allowable wear. The Comprehensive Vibration Assessment Program (CVAP) inspection during startup testing and the inservice inspection program ensure that the plant is not operated with unsafe levels of wear on reactor vessel internal components on a case-by-case basis.

3) The CRAGTs are not expected to experience significant wear that would warrant the evaluation of the consequences of complete degradation. This is supported by operating experience of similar components. Regular inspection ensures that, even if the wear estimates are lower than real wear rates, the CRAGTs will not progress to an unsafe condition over the life of the plant.

4) Because the estimated extent of turbulent vibration induced degradation is low for fatigue, impact, and wear, no additional analysis or tests to validate the flow force estimates are necessary. The annular flow PSD selected exceeds similar PSD evaluations for cross flow. The CRAGT flow is a mix of cross flow and annular flow, so the larger of the two PSDs is used.

In summary, CRAGT wear has been estimated with a more accurate, yet still conservative, methodology demonstrating that the CRAGT is not at risk for significant flow induced degradation of any kind. While the CRAGT flow patterns do not neatly fit into an available literature source for a PSD, the most bounding PSD estimate available is used to estimate turbulent buffeting vibrations. The CRAGT is included in the inservice inspection program to ensure that unforeseen degradation does not progress to the point of component failure over the plant life. The CRAGT screens out of further testing according to the methodology defined in the CVAP technical report TR-0716-50439. Additionally, the CVAP technical report does not contain wear assessments. NuScale does not plan to have additional tests or analyses to develop further specific flow forcing functions for the CRAGT due to the large margins estimated in turbulent buffeting calculations with standard flow forcing functions.

#### **Impact on DCA:**

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



RAIO-0718-61073

**Enclosure 3:**

Affidavit of Zackary W. Rad, AF-0718-61074



**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 power module seismic analysis.

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 No. 427, eRAI 9408. 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 July 25, 2018.



Zackary W. Rad