



September 13, 2018

U.S. Nuclear Regulatory Commission  
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11555 Rockville Pike  
Rockville, MD 20852-2738

**SUBJECT:** NuScale Power, LLC Response to NRC Request for Additional Information No. 447 (eRAI No. 9508) on the NuScale Design Certification Application

**REFERENCE:** U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 447 (eRAI No. 9508)," 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. 9508:

- 15-7

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 447 (eRAI No. 9508). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The proprietary enclosures have been deemed to contain Export Controlled Information. This information must be protected from disclosure per the requirements of 10 CFR § 810. 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](mailto:pinfanger@nuscalepower.com).

Sincerely,

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. 9508, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9508, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0918-61782



**Enclosure 1:**

NuScale Response to NRC Request for Additional Information eRAI No. 9508, proprietary



**Enclosure 2:**

NuScale Response to NRC Request for Additional Information eRAI No. 9508, nonproprietary

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

**eRAI No.:** 9508

**Date of RAI Issue:** 05/01/2018

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**NRC Question No.:** 15-7

10 CFR 50 Appendix A, GDC 34, Residual heat removal, and NuScale's PDC 34, in FSAR Section 3.1.4.5, state,

"A system to remove residual heat shall be provided. The system safety function shall be to transfer fission product decay heat and other residual heat from the reactor core at a rate such that specified acceptable fuel design limits and the design conditions of the reactor coolant pressure boundary are not exceeded."

As discussed in FSAR Section 15.0.5, there are two systems to remove decay heat: the DHRS and the ECCS. The Long Term Cooling technical report, TR-0916-51299, which addresses long term decay heat removal after ECCS actuation, and supports the FSAR Chapter 15 analyses, states, "...during long-term cooling, maintaining a collapsed liquid level in the riser above the core and demonstrating cladding temperatures remain acceptably low indicate that MCHFR is not challenged."

The RCS water mass is a function of the reactor power and there may be an initial power in which the water level drops below the riser after a reactor trip. If the RCS level drops below the riser, but not low enough to actuate the ECCS, it is unclear to the staff if fuel cladding temperatures would remain low enough to preserve the SAFDLs consistent with PDC 34. The staff is requesting the applicant address this potential scenario involving the interruption of continuous RCS natural circulation and, if necessary, demonstrate that cladding temperature remains acceptable low indicating that MCHFR is not challenged in a similar manner to that evaluated in the LTC report. If credit is taken for degraded DHRS heat removal capability (i.e., intermittent RCS natural circulation) the applicant should provide experimental data which validates the degraded DHRS heat removal capability.

### **NuScale Response:**

The RCS temperature and inventory control scheme for the NPM is designed to require letdown during heatup and power ascension from hot zero power to 15% power and normal vessel average temperature conditions. For power levels above 15%, a nearly constant RCS inventory is maintained with constant vessel average temperature in order to limit required letdown or makeup operations. For all power operations, including between hot zero power and 15% power, the pressurizer level is maintained above 40% to ensure pressurizer heaters are covered. This is approximately {{ }}<sup>2(a),(c),ECL</sup>. Following reactor trip and establishment of stable DHRS cooling, reactor coolant system natural circulation flow is maintained until the riser is uncovered.

The uncovering of the riser, following a reactor trip, is caused by RCS coolant volume shrinkage due to DHRS cooling. The initial RCS inventory, along with the rate of DHRS cooling, are the primary factors in the timing of this phenomena. The scope of the non-LOCA transients demonstrates that reactor trip occurs early in the event transient progression and RCS coolant volume shrinkage to the point of uncovering the riser does not occur within the first 30 minutes for any event, including inventory reduction or overcooling events. Analysis of a nominal DHRS cooldown with two condensers shows that riser uncovering could begin approximately 3 hours after reactor trip, starting from a conservatively low initial PZR level of 50% (the normal operating range for pressurizer level at greater than 15% power is 52-68%). The station blackout analysis, which assumes a conservatively low cooldown rate, calculates riser uncovering around 18 hours as described in eRAI 9486, Question 20.01-17, in letter RAIO-0618-60652, dated June 28, 2018. The design basis minimum DHRS cooldown scenario does not reach complete riser uncovering for the design cooling period of 36 hours. In all cases, riser uncovering is calculated to occur when reactor coolant temperatures are less than 400° F. As described in FSAR Section 5.4.3.1, the DHRS is designed to ensure that the RCS average temperature is below 420 °F within 36 hours of the event.

DHRS performance calculations show that as the RCS temperature decreases, the DHRS heat removal decreases. If the RCS loop flow becomes interrupted, this would further decrease the DHRS heat removal. Considering the DHRS system design and natural circulation characteristics of the RCS, two physical extremes of the event progression can be considered:

1. If the DHRS is still capable of matching decay heat and all the sensible energy released from the heat structures, the RCS will continue to cooldown.



2. If the DHRS energy removal rate becomes lower than the decay heat and the sensible energy release, then the RCS will heatup, and RCS coolant level will rise due to thermal expansion. If the RCS heats up continuously, the riser will be recovered and the RCS loop flow will be reestablished. This will restore the DHRS thermal performance, and start to cooldown the RCS. An intermittent natural circulation flow could be established.

As described in RAI-9486 response, as the RCS flow becomes interrupted by the RCS level shrinkage, NRELAP5 predicts an intermittent flow behavior due to limitation in the one-dimensional RCS loop modeling. However, these limitations are deemed unimportant to the overall safety evaluation because even with intermittent flow, the overall RCS and core temperatures show a declining trend proportional to the declining decay heat input.

Independent of which event progression is followed, further quantitative evaluation of SAFDLs is not required due to the low temperature conditions and decay heat levels at the time riser uncovering occurs.

**Impact on DCA:**

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



RAIO-0918-61781

**Enclosure 3:**

Affidavit of Zackary W. Rad, AF-0918-61782



**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 long term cooling 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. 447, eRAI 9508. 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 September 13, 2018.



Zackary W. Rad