



December 12, 2017

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. 258 (eRAI No. 9153) on the NuScale Design Certification Application

**REFERENCE:** U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 258 (eRAI No. 9153)," dated October 13, 2017

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's response to the following RAI Question from NRC eRAI No. 9153:

- 18-5

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Steven Mirsky at 240-833-3001 or at [smirsky@nuscalepower.com](mailto:smirsky@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  
Samuel Lee, NRC, OWFN-8G9A  
Demetrius Murray, NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9153



**Enclosure 1:**

NuScale Response to NRC Request for Additional Information eRAI No. 9153

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

**eRAI No.:** 9153

**Date of RAI Issue:** 10/13/2017

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### **NRC Question No.:** 18-5

Criterion 1, in section 3.4.1 of NUREG-0711 states, in part, *“For applicants proposing to use new technology or systems that were not used in the predecessor plants, the OER should review and describe the operating experience of any other facilities that already use that technology.”*

Criterion 3, in Section 3.4.1 of NUREG-0711 states, *“Related HSI Technology – The applicant’s OER should cover operating experience with the proposed HSI technology in the applicant’s design.”*

The intent of both these criteria is to gather relevant operating experience from outside of the nuclear industry but that still relates to features of the design. This interpretation is consistent with Section 3.1 of NUREG-0711 which states: *“Considering an applicant’s submittal for a new NPP, its predecessor designs are those plants, systems, HSIs, and operational approaches that are the basis for the new plant’s design. It may be based on multiple predecessors and encompass both non-nuclear and nuclear industry sources.”*

Section 3.3 of the operating experience review (OER) results summary report (RSR) indicates at a high-level that some non-nuclear OER was considered in the OER process. Section 4.3 of the OER RSR provides a summary of some design changes that occurred as a result of this information. Appendices D and E that are referenced in these sections include examples of OER obtained from this process.

The sections of the RSR listed above identify important operating experience; however, it is not clear how the sample of operating experience provided in the RSR includes areas of particular regulatory importance for the HSI design (such as relating to multiple unit operation, newly automated functions, unique concepts of operation, and others). As a result, it is unclear if this is an indication that the OER process failed to identify important operating experience, or if this information was identified and subsequently found to be irrelevant.

NUREG/CR-7126 identifies several topics via the use of non-nuclear operating experience in surrogate industries that is likely relevant to small modular designs. It is not clear from the OER RSR if these issues are applicable to the NuScale design, and if so, how the issues have been addressed in the design.



For instance, research and recent experience with unmanned aircraft systems (UAS) has identified challenges with a single operator controlling several UASs. This concept of operations is similar to that of the NuScale design in which one operator will be responsible for safely controlling more than one unit. It is unclear from the summary of data provided in the RSR if this body of operating experience was considered, and if so, what the results were, and how these challenges are addressed in the current design.

Please provide a summary of how the topics described in NUREG/CR-7126 are addressed in the OER process. Also, provide a sample of results that relate to these topics, as well as a summary of how these results were addressed to ensure safe operation of the NuScale design.

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### **NuScale Response:**

As part of the Operating Experience Review (OER) program, NuScale reviewed NUREG/CR-7126, "Human-Performance Issues Related to the Design and Operation of Small Modular Reactors". This review is documented in RP-0316-17614 Human Factors Engineering Operating Experience Review Results Summary Report, Appendix B, List of Operating Experience Sources Reviewed. In the table under Operating Plant Events, NUREGs, the "Outcome" column lists "3 NUREGs reviewed". NUREG/CR-7126 was one of the three NUREGs indicated. The results of the review are documented in the NuScale OER database (OER-00580 through -00587) as part of the Operating Experience Review (OER) program. There are eight separate entries in the OER database related to NUREG/CR-7126 and eight corresponding entries in the Human Factors Engineering Issue Tracking System (HFEITS) database (H-00149 through -00156) that are available for audit and review.

The objective of NUREG/CR-7126 is to evaluate how the design and operations of small modular reactors (SMRs) differ from current plants and to identify potential human-performance issues. NUREG/CR-7126 reviewed the lessons learned from multi-unit operations in surrogate, non-nuclear facilities to gain a fuller understanding of potential HFE issues related to SMRs. A surrogate facility is one whose operation involves managing multiple units that make similar demands on human performance. NUREG/CR-7126 examined unmanned aircraft systems, petroleum refineries, and remote intensive-care centers.

Many insights from the NUREG/CR review were incorporated into the NuScale design. The following sample of results that impacted NuScale design to mitigate risk due to human performance are presented:

#### 1. Unmanned Aircraft Systems (UAS) review results:

- Increasing the number of unmanned aerial vehicles (UAVs) assigned to an operator (or crew) depends on the automation's design. Extensive automation is used in control and operation of a NuScale plant. NuScale uses a thorough multi-disciplinary process to develop, test, and document the control room automation.



- UAS researchers highlighted the importance of HSI design when managing multiple vehicles; this is also applicable to SMR operators managing multiple units. NuScale has developed several innovative HSI screens to provide an at-a-glance understanding of unit status, critical safety function status, unit key parameter trends, alarm status, active procedure status and active automation status. This was demonstrated during the staffing plan validation performed in August of 2016 (Reference RP-0516-49116, Control Room Staffing Plan Validation Results).
- UAS research emphasized the importance of measuring performance. NuScale adopted four of the five specific metrics mentioned in NUREG/CR-7126 when performing integrated system validation evaluations, specifically, primary task performance, teamwork, situational awareness, and workload. Trust in automation is not specifically measured but would be captured by general observations or during the post-scenario crew critiques.

## 2. Oil Refineries review results:

- Careful attention to designing the alarm system design is essential so the number of alarms is manageable. NuScale has developed an innovative and effective alarm and notification HSI to allow operators to manage and prioritize alarms from up to 12 units.
- Unit differences, as depicted in the HSIs, support operators in maintaining awareness of the status of individual units. NuScale maintains 12 individual standup stations, one for each unit, in addition to the operator stations. Each unit is prominently marked.

## 3. Tele-intensive Care Units review results:

- Organizational changes are needed during emergencies to manage events occurring at one unit. The NuScale concept of operations allows flexible adaptability of reactor operators assigned to manage a unit in an off-normal condition.
- HSI design for monitoring multiple reactor units will be a key aspect of safe operations, and may involve novel approaches to HSI design. HSI support is needed for monitoring multiple "units." HSI design was reinforced in each of the surrogate facilities reviewed by NUREG/CR-7126. NuScale has developed several innovative HSI screens to provide an at-a-glance understanding of unit status, critical safety function status, unit key parameter trends, alarm status, active procedure status and active automation status.

## Impact on DCA:

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