RAIO-0717-55049

July 26, 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. 90 (eRAI No. 8758) on the NuScale Design Certification Application

**REFERENCE:** U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 90 (eRAI No. 8758)," dated July 10, 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 Enclosures to this letter contain NuScale's response to the following RAI Questions from NRC eRAI No. 8758:

- 18-1
- 18-2

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 90 (eRAI No. 8758). 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 Steven Mirsky at 240-833-3001 or at smirsky@nuscalepower.com.

Sincerely,

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

Distribution: Gregory Cranston, NRC, TWFN-6E55
Samuel Lee, NRC, TWFN-6C20

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8758, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 8758, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0717-55050

**Enclosure 1:**

NuScale Response to NRC Request for Additional Information eRAI No. 8758, proprietary

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**Enclosure 2:**

NuScale Response to NRC Request for Additional Information eRAI No. 8758, nonproprietary

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NuScale Power™

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

**eRAI No.:** 8758
**Date of RAI Issue:** 07/10/2017

**NRC Question No.:** 18-1

Title 10 of the Code of Federal Regulations (10CFR) Section 52.47(a)(8) requires an applicant for a design certification to provide a final safety analysis report (FSAR) that must include the information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), except paragraphs (f)(1)(xii), (f)(2)(ix), and (f)(3)(v). Section 10 CFR 50.34(f)(2)(iii) requires an applicant to "Provide, for Commission review, a control room design that reflects state-of-the-art human factor principles prior to committing to fabrication or revision of fabricated control room panels and layouts." Chapter 18, "Human Factors Engineering," of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," and NUREG-0711, "Human Factors Engineering Program Review Model," identify criteria the staff uses to evaluate whether an applicant meets the regulation. The applicant stated in the FSAR, Tier 2, Section 18.0, "Human Factors Engineering - Overview," that the HFE program incorporates accepted HFE standards and guidelines including the applicable guidance provided in NUREG-0711, Revision 3.

**Question 1:**

Criterion 11.4.3.8, "Validation Conclusions," in NUREG-0711, states, "the applicant should document the statistical and logical bases for determining that the performance of the integrated system is, and will be acceptable."

The NuScale Verification and Validation Implementation Plan, Section 4.6.1, "Scenario Sequencing," says a minimum of two operating crews will perform each scenario. However, the bases for determining that the performance of the integrated system will be acceptable using a minimum of two operating crews per scenario is not described in the application.

Additionally, the NRC Commission has previously taken action based on a greater number of scenario trials. The staff is concerned that a minimum of two trials for each ISV scenario does not provide (1) enough opportunities for users of the integrated system to identify errors with the design or (2) reasonable assurance that results from the ISV test will be indicative of the ability of the integrated system to support safe plant operation. Please describe the bases for determining that performance of the integrated system using a minimum of two operating crews

per scenario will be acceptable and will provide reasonable assurance that the health and safety of the public would be protected.

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**NuScale Response:**

In response to this RAI, Section 4.6.1, Scenario Sequencing, of RP-0914-8543, the Human Factors Verification and Validation Implementation Plan, has been revised to describe the bases for determining the performance of the integrated system using a minimum of two operating crews per scenario.

Changes to RP-0914-8543 and a minor conforming change to FSAR Section 18.10 were made and are attached.

**Impact on DCA:**

FSAR Section 18.10.4 and the Human Factors Verification and Validation Implementation Plan have been revised as described in the response above and as shown in the markup provided with this response.

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

**eRAI No.:** 8758
**Date of RAI Issue:** 07/10/2017

**NRC Question No.:** 18-2

**Question 2**

Criterion 11.4.3.1 of NUREG 0711 states, "The applicant should describe how the team performing the validation has independence from the personnel responsible for the actual design." Additionally it states, "The members of the validation team should have no responsibility for the design; i.e., they should never have been part of the design team. While they may work for the same organization, their responsibilities must not include contributions to the design, other than validating it."

Section 4.1 of the Human Factors Verification and Validation Implementation Plant (V&V IP states,

"Validation team members can be selected from the HFE Design Team. There is very low risk of impact to the validity of the ISV [integrated systems validation] results. Objective performance measures and success criteria are developed as part of the methodology...The Validation Team members are trained and qualified to conduct the ISV in an objective and unbiased manner." In addition FSAR Tier 2, Chapter 18, Section 18.10.2.3.1, states, "The test team administers the ISV and collects data via questionnaires, post-scenario debriefing, personal observations...Bias is reduced by the training program applicable to each validation team member; in addition, the test results are obtained by consensus of the test team rather than individual observations."

The staff understands that objective performance and success criteria will be used to determine the results of the ISV; however, questionnaires and personal observations, which are subjective in nature, are also used to collect data and to determine the results and any design changes that may need to be made. The main intent of Criterion 11.4.3.1 of NUREG 0711 is to ensure that bias is reduced to the greatest extent during ISV data collection (e.g. observer notes/evaluations) and when the results of ISV are analyzed and evaluated to determine whether design changes are necessary.

Clarify whether the validation will include members who were not part of the design team Explain how training and results by consensus minimize bias and ensure objectivity of the validation team members who are part of the HFE Design Team. Also, if any other means will

be established to maximize objectivity, please revise the application to describe them.

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**NuScale Response:**

In response to this RAI, Section 4.1, Validation Team, of RP-0914-8543, the Verification and Validation Implementation Plan, has been revised:

- to clarify that the validation team includes members who were not part of the design team, and
- to explain how training and results by consensus minimize bias and ensure objectivity of the validation team members who are part of the HFE design team
- describe that at least one independent observer is assigned to the validation team

Changes to RP-0914-8543 and a minor conforming change to FSAR Section 18.10 were made and are attached.

**Impact on DCA:**

FSAR Section 18.10.4 and the Human Factors Verification and Validation Implementation Plan have been revised as described in the response above and as shown in the markup provided with this response.

- design changes made for individual HEDs and their status.
- compliance of design change with V&V evaluation criteria.
- the basis for not correcting an HED.

### 18.10.3 Results

Once the V&V activities are completed, the results will be compiled in an RSR. The contents of the RSR will be consistent with the methodology described in Reference 18.10-1 and the applicable NUREG-0711 guidance.

### 18.10.4 References

RAI 18-1, 18-2

18.10-1 NuScale Power, LLC, "~~Human Factors Engineering~~ Human Factors Verification and Validation Implementation Plan," RP-0914-8543-P, Revision 3~~2~~.

18.10-2 ANSI/ANS-3.5-2009, Nuclear Power Plant Simulators for Use in Operator Training and Examination, American National Standards Institute.

# Human Factors Verification and Validation Implementation Plan

~~12/02/2016~~

07/13/2017

Revision ~~2~~3

Docket: ~~PROJ076952~~-048

**NuScale Power, LLC**

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## 4.0 Integrated System Validation

The ISV is the process by which an integrated system design (i.e., hardware, software, and personnel elements) is evaluated using performance-based tests to determine whether it acceptably supports safe operation of the plant. The ISV is undertaken only after HEDs that were identified in the upstream process, including design verification, have been resolved and the resulting changes implemented.

Scenarios are developed using the guidance described in the implementing procedures. Performance measures used for assessing the results of an ISV are summarized in Section 4.5 and further described in implementing procedures.

## 4.1 Validation Team

ValidationSome validation team members can be selected from the HFE Design Team. There with at least one observer for each test that is very low risk selected outside of impact to the validity of the ISV results.design team. Objective performance measures and success criteria are developed as part of the methodology. and listed within the scenario guides used for the conduct of ISV tests. Objective performance measures are designed to trigger evaluation of the condition regardless of observation comments, and are purposely set at a low threshold. The methodology including the detailed, scenarios and, ISV test plan, and ISV test performance are available for NuScale management assessment or NRC audit well in advance of the conduct of or during the ISV.conduct of the ISV in order to allow for an outside perspective to detect and influence potential bias concerns. The Validation Teamvalidation team members are trained and qualified to conduct the ISV in an objective and unbiased manner. The conduct of the ISV is scheduled such that all or any portion is available for audit. A detailed ISV test report is developed which supports the findingsresults documented in the V&V RSR; both documents will be submitted to the NRC. The HFE Design Team developing and conducting the ISV is analogous to a commercial nuclear plant's Training Department developing and conducting an NRC license exam or annual requalification exam.

{{ The Validation Team consists of

- test lead
- plant operations experts
- human factors engineering experts
- one lead test bed engineer (simulator operator)
- test bed support staff (simulator operator and communicator)

The observers (test lead, plant operations experts, and HFE experts) collect data via questionnaires, post-scenario debriefing, personal observations, review of video, and from HSI computer system logging. }}$^{2(a),(c)}$ The observers are trained and qualified using the NuScale training program. At least one of the selected observers in each ISV test performance must have independence from HFE Design Team (i.e. has not been involved in the design, development, or testing of the NuScale HFE program, HSI, or

concept of operations). Observations made by these observers are relied upon to provide independent, unbiased, and objective observations of the test performance.

{{The administrators (test lead, test bed engineer, and test bed support staff) manage the ISV, control each scenario in accordance with the test procedure, maintain and set up the test bed, and collect the test bed archived data following each scenario. The Validation Team personnel may act as simulated plant personnel as necessary within each scenario. The administrators are trained and qualified using the NuScale training program. Bias is further reduced by the training program applicable to each Validationvalidation team member, and the fact that results are obtained by consensus of the team rather than individual observations. }}2(a),(c)

{{

}}2(a),(c)

## 4.2 Test Objectives

The objectives of the ISV are to validate

- the acceptability of the shift staffing, the assignment of tasks to operating crew members, and crew coordination within the control room, between the control room and local control stations and support centers, and with individuals performing tasks locally. This should encompass validating minimum shift staffing levels, nominal levels, higher levels, and shift turnover.
- that the design has adequate capability for alerting, informing, controlling, and feedback such that personnel tasks are successfully completed during normal plant evolutions, transients, design-basis accidents, and also under selected risk significant events beyond-design basis, as defined by the SOC.
- that specific personnel tasks can be accomplished within the time and performance criteria, with effective situational awareness, and acceptable workload levels that balance vigilance and personnel burden.
- that the HSIs minimize personnel error and ensure error detection and recovery capability when errors occur.
- the assumptions about performance on important human actions (IHAs).

## 4.3 Validation Test Beds

The principal validation test bed for the ISV is the control room simulator. The fidelity of the validation test bed's models and HSI are verified to represent the current, as-designed NuScale plant prior to use for the validation.

The test bed model is made up of four modeling software packages, all working from current NuScale designs. Together, they provide a high level of fluid and reactivity modeling. Precisely modeling the predicted behavior of the reactor core, thermodynamic performance, balance of plant, -and electrical system design is desired as NuScale does not have a comparison reference plant. All 12 units are simultaneously and

| Characteristic | Meaning |
|---|---|
| Objectivity | A measure should be based on easily observed phenomena. |

The basis for inclusion of a performance criterion in the ISV (or a particular scenario within ISV) used to judge acceptability of that criterion is determined during the development of the scenario. Bases for performance criteria are described in Table 4-2.

Table 4-2. Basis for performance criteria

| Criteria | Basis Meaning |
|---|---|
| Requirement | The observed performance of the integrated system is compared with a quantified performance requirement; i.e., the requirements for the performance of systems, subsystems, and personnel are defined through engineering analyses. |
| Benchmark | The observed performance of the integrated system is compared with a criterion established using a benchmark system, e.g., a current system is predefined as acceptable. |
| Norm | The observed performance of the integrated system is compared with a criterion using many predecessor systems (rather than a single benchmark system). |
| Expert Judgment | The observed performance of the integrated system is compared with a criterion established by subject-matter experts. |

Performance measures are designated as pass, fail or diagnostic. Diagnostic is measureable and the criteria include both range and unit of measure.

## 4.6 Test Design

Test design refers to the process of developing scenarios, test plans, and conducting ISV based on the integrated HSI as described in the preceding sections. The goal of test design is to permit the observation of integrated system performance while minimizing bias.

Once the ISV test plan and scenarios are developed they will be reviewed by the appropriate SMEs and approved by operations management. Upon approval, the ISV scenarios and test plan will be available for review or audit by the NRC sufficiently before the conduct of ISV so that comments or concerns can be adequately addressed prior to commencing ISV.

This section describes characteristics of the test design important to supporting ISV validity.

### 4.6.1 Scenario Sequencing

Integrated System Validation: Methodology and Review Criteria, NUREG/CR-6393 (Reference 8.1.2), is employed as the standard for selection of crew ~~or~~and scenario order ~~as follows:~~.

- ~~A minimum of two operating crews perform each scenario.~~
- ~~Crews perform a grouping of scenarios in a different order than other crews.~~

- When running individual scenarios across multiple crews, the order of the crews is varied when the scenario is changed.

ISV scenarios also contain variable variations of normal operation time prior to introducingand abnormal events and are sequenced to ensure that operating crews are not pre-tuned to immediateexpecting events and actions at the beginning of each scenario or at the same time during each scenario. The scenario performance sequence is developed using the following guidance:

- Equalize the opportunity for testing among all participants.
- Vary the types of scenarios within the sequence; such that all are not easy at first and then progress to hard.
- A minimum of two operating crews perform each scenario.

At least three participant crews will be assembled but only two of those three will be scheduled to perform any one scenario. {{

}}2(a),(c)

### 4.6.2 Test Procedures

Prior to ISV, detailed test procedures are prepared to manage tests, assure consistency, control test bias, support repeatable results, and focus the test on the specific scenario objectives. The test observers/administrators use the test procedures to set up each

**Enclosure 3:**

Affidavit of Zackary W. Rad, AF-0717-55050

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**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 human factors verification and validation.

    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 Request for Additional Information RAI Set Number 90 - eRAI No. 8758 - RAI Questions no. 18-1 and 18-2. 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 7/25/2017.

Zackary W. Rad