



May 02, 2019

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 494 (eRAI No. 9548) on the NuScale Design Certification Application

REFERENCES: 1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 494 (eRAI No. 9548)," dated July 13, 2018
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 494 (eRAI No.9548)," dated September 07, 2018

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

The Enclosure to this letter contains NuScale's supplemental response to the following RAI Question from NRC eRAI No. 9548:

- 09.01.01-20

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 Carrie Fosaaen at 541-452-7126 or at cfosaaen@nuscalepower.com.

Sincerely,

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

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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9548



Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9548

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

eRAI No.: 9548

Date of RAI Issue: 07/13/2018

NRC Question No.: 09.01.01-20

Title 10 of the Code of Federal Regulations (10 CFR) Part 50, Appendix A, General Design Criteria (GDC) 62 requires fuel assemblies in the fuel storage and handling system to be held sub-critical through the use of physical systems or processes. For the NuScale design the applicant utilizes a neutron absorbing material as the primary means to prevent re-criticality. The applicant has chosen to address GDC 62 primarily in Technical Report TR-0816-49833-P, Rev 0 "Fuel Storage Rack Analysis." The technical report describes the fuel storage racks and provides analyses to demonstrate that the fuel storage racks meet GDC 62.

The staff finds that TR-0816-49833-P does not contain information on how neutron absorbing material is qualified. Qualification testing should ensure that the neutron absorber is suitable during fabrication, shipping, construction, and operation. Additionally, the staff finds that the technical report does not impose process controls to ensure that the manufactured material meets the safety functions described in TR-0816-49833-P. Qualification reports, processes controls, and verification testing have been previously required by the staff for the Metamic and Maxus neutron absorbing materials.

The staff provides four issues below that should be addressed by the applicant. The four issues are: material fabrication, environmental compatibility, material structural adequacy, neutron absorption properties. The applicant should revise Technical Report TR-0816-49833-P to address the staff concerns.

The staff notes that regulatory guidance on the qualification of neutron absorber material may be found in Interim Staff Guidance document SFST-ISG-23 Revision 0, "Application of ASTM Standard Practice C1671-07 when performing technical reviews of spent fuel storage and transportation packaging licensing actions," and ASTM C- 1671-07, "Qualification and

Acceptance of Boron Based Metallic Neutron Absorbers for Nuclear Criticality Control for Dry Cask Storage System and Transportation Packaging." The staff acknowledges that SFST-ISG-23 and ASTM C1671-07 contain some aspects which are specific to dry spent fuel storage, however the majority of content in both documents are generic. Additional conditions or clarifications on the use of SFST-ISG-23 and ASTM C1671-07 are provided alongside the discussion of the four issues that should be addressed. The staff would consider the use of SFST-ISG-23, ASTM C1671-07, and the modifications below as an acceptable method of addressing the staff concerns in meeting GDC 62.

Issue A – Material Fabrication

The key processes and controls on the key processes should be described. Key processes should include neutron absorber material fabrication methods (e.g., extrusion, stir casting, compaction process, etc.), whether cladding is used, raw material specifications, etc. Process controls should include particle size distribution limitations, heat treatment ranges, ratio of B₄C to Al, minimum density, contamination controls, etc. The process controls shall prevent changes to the fabrication process which could impact the credited safety function or introduce new degradation mechanisms.

In addition, Technical Report TR-0816-49833-P, Section 3.4.1.3.2, "Neutron Absorber Material Specification," should be expanded to describe acceptance testing which will verify that key process controls were met during fabrication.

Revise FSAR Section 9.1.1 or Technical Report TR-0816-49833-P to describe how the material fabrication will be controlled to ensure that the manufactured product is consistent with the licensing basis. Alternatively, the applicant may commit to meeting ASTM C1671-07 (in particular Section 5.2.7, "Key Processes and Process Controls") subject to the conditions on ASTM C1671-07 in SFST-ISG-23, with the modifications shown in the attached marked up version of ISG-23.

Issue B – Environmental Compatibility

Neutron absorber material qualification testing should demonstrate that the material is suitable for use in the spent fuel pool environment for the lifetime of the component.

Qualification testing should verify that the safety functions of the neutron absorber are not impaired by radiation damage, borated water, or boiling temperatures. Testing should verify that



prolonged immersion in spent fuel pool water will not result in the formation of gas pockets (hydrogen or steam) which can interfere with spent fuel assembly withdrawal or may impact subcriticality.

Revise FSAR Section 9.1.1 or Technical Report TR-0816-49833-P to describe how the material will be qualified for environmental compatibility. Alternatively, the applicant may commit to meeting ASTM C1671-07 (in particular Section 5.2.3, "Environmental Qualification Tests") subject to the conditions on ASTM C1671-07 in SFST-ISG-23, with the modifications shown in the attached marked up version of ISG-23.

Issue C – Material Structural Adequacy

If the material is not credited with a structural design function, testing shall demonstrate that the neutron absorber has sufficient strength and ductility to prevent cracking, fracture, or other significant damage during fabrication, shipping, and operation.

Revise FSAR Section 9.1.1 or Technical Report TR-0816-49833-P to describe how the material will be qualified for structural adequacy. Alternatively, the applicant may commit to meeting ASTM C1671-07 (in particular Section 5.2.6, "Mechanical, Absorber Uniformity, and Other Qualification Testing") subject to the conditions on ASTM C1671-07 in SFST-ISG-23.

Issue D – Neutron Absorption Properties

Neutron absorber material qualification testing should demonstrate that the material has sufficient neutron absorption properties to achieve its design function. Uniformity of the neutron absorber, measurement uncertainties, and biases should be assessed during qualification. The assessments shall be used to demonstrate that the neutron attenuation measurements of the production material is sufficiently conservative.

The applicant should define neutron attenuation acceptance criteria and methods of assessing bias and uncertainty for the production material. The acceptance criteria and methods shall be used to verify that the production material meets the licensing basis.

Revise FSAR Section 9.1.1 or Technical Report TR-0816-49833-P to describe how the material will be qualified for neutron absorption properties. Alternatively, the applicant may commit to meeting ASTM C1671-07 (in particular Section 5.2.6, "Mechanical, Absorber Uniformity, and



Other Qualification Testing," and Section 5.3, "Neutron Absorber Material Acceptance Testing") subject to the conditions on ASTM C1671-07 in SFST-ISG-23, with the modifications shown in the attached marked up version of ISG-23.

NuScale Response:

Background:

On a clarification call held March 12, 2019, NuScale agreed to supplement the RAI response by adding a COL Item to resolve the outstanding issues related to the neutron absorbing material.

A COL Item has been added as shown in the attached FSAR markup.

Impact on DCA:

FSAR Sections 1.8 and 9.1.3 have been revised as described in the response above and as shown in the markup provided in this response.

RAI 01-61, RAI 02.04.13-1, RAI 03.04.01-4, RAI 03.04.02-1, RAI 03.04.02-2, RAI 03.04.02-3, RAI 03.05.01.03-1, RAI 03.05.01.04-1, RAI 03.05.02-2, RAI 03.05.03-4, RAI 03.06.02-6, RAI 03.06.02-15, RAI 03.06.03-11, RAI 03.07.01-2, RAI 03.07.01-3, RAI 03.07.02-4S3, RAI 03.07.02-6S1, RAI 03.07.02-6S2, RAI 03.07.02-8, RAI 03.07.02-12, RAI 03.07.02-15S5, RAI 03.07.02-16S1, RAI 03.07.02-23S1, RAI 03.07.02-26, RAI 03.08.04-1S1, RAI 03.08.04-3S2, RAI 03.08.04-23S1, RAI 03.08.04-23S2, RAI 03.08.04-23S3, RAI 03.08.05-14S1, RAI 03.09.02-15, RAI 03.09.02-48, RAI 03.09.02-67, RAI 03.09.02-69, RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-6, RAI 03.09.06-16, RAI 03.09.06-16S1, RAI 03.09.06-27, RAI 03.11-8, RAI 03.11-14, RAI 03.11-14S1, RAI 03.11-18, RAI 03.13-3, RAI 04.02-1S2, RAI 05.02.03-19, RAI 05.02.05-8, RAI 05.04.02.01-13, RAI 05.04.02.01-14, RAI 05.04.02.01-19, RAI 06.02.01.01.A-18, RAI 06.02.01.01.A-19, RAI 06.02.06-22, RAI 06.02.06-23, RAI 06.04-1, RAI 09.01.01-20, RAI 09.01.01-20S1, RAI 09.01.02-4, RAI 09.01.05-3, RAI 09.01.05-6, RAI 09.03.02-3, RAI 09.03.02-4, RAI 09.03.02-5, RAI 09.03.02-6, RAI 09.03.02-8, RAI 10.02-1, RAI 10.02-2, RAI 10.02-3, RAI 10.02.03-1, RAI 10.02.03-2, RAI 10.03.06-1, RAI 10.03.06-5, RAI 10.04.06-1, RAI 10.04.06-2, RAI 10.04.06-3, RAI 10.04.10-2, RAI 11.01-2, RAI 11.01-2S2, RAI 12.03-5S1, RAI 13.01.01-1, RAI 13.01.01-1S1, RAI 13.02.02-1, RAI 13.03-4, RAI 13.05.02.01-2, RAI 13.05.02.01-2S1, RAI 13.05.02.01-3, RAI 13.05.02.01-3S1, RAI 13.05.02.01-4, RAI 13.05.02.01-4S1, RAI 14.02-7, RAI 16-65, RAI 19-31, RAI 19-31S1, RAI 19-38, RAI 20.01-13

Table 1.8-2: Combined License Information Items

Item No.	Description of COL Information Item	Section
COL Item 1.1-1:	A COL applicant that references the NuScale Power Plant design certification will identify the site-specific plant location.	1.1
COL Item 1.1-2:	A COL applicant that references the NuScale Power Plant design certification will provide the schedules for completion of construction and commercial operation of each power module.	1.1
COL Item 1.4-1:	A COL applicant that references the NuScale Power Plant design certification will identify the prime agents or contractors for the construction and operation of the nuclear power plant.	1.4
COL Item 1.7-1:	A COL applicant that references the NuScale Power Plant design certification will provide site-specific diagrams and legends, as applicable.	1.7
COL Item 1.7-2:	A COL applicant that references the NuScale Power Plant design certification will list additional site-specific piping and instrumentation diagrams and legends as applicable.	1.7
COL Item 1.8-1:	A COL applicant that references the NuScale Power Plant design certification will provide a list of departures from the certified design.	1.8
COL Item 1.9-1:	A COL applicant that references the NuScale Power Plant design certification will review and address the conformance with regulatory criteria in effect six months before the docket date of the COL application for the site-specific portions and operational aspects of the facility design.	1.9
COL Item 1.10-1:	A COL applicant that references the NuScale Power Plant design certification will evaluate the potential hazards resulting from construction activities of the new NuScale facility to the safety-related and risk significant structures, systems, and components of existing operating unit(s) and newly constructed operating unit(s) at the co-located site per 10 CFR 52.79(a)(31). The evaluation will include identification of management and administrative controls necessary to eliminate or mitigate the consequences of potential hazards and demonstration that the limiting conditions for operation of an operating unit would not be exceeded. This COL item is not applicable for construction activities (build-out of the facility) at an individual NuScale Power Plant with operating NuScale Power Modules.	1.10
COL Item 2.0-1:	A COL applicant that references the NuScale Power Plant design certification will demonstrate that site-specific characteristics are bounded by the design parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the COL applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its combined license application.	2.0
COL Item 2.1-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site geographic and demographic characteristics.	2.1
COL Item 2.2-1:	A COL applicant that references the NuScale Power Plant design certification will describe nearby industrial, transportation, and military facilities. The COL applicant will demonstrate that the design is acceptable for each potential accident, or provide site-specific design alternatives.	2.2
COL Item 2.3-1:	A COL applicant that references the NuScale Power Plant design certification will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3
COL Item 2.4-1:	A COL applicant that references the NuScale Power Plant design certification will investigate and describe the site-specific hydrologic characteristics for Section 2.4.1 through Section 2.4.14, except Section 2.4.8 and Section 2.4.10.	2.4

Table 1.8-2: Combined License Information Items (Continued)

Item No.	Description of COL Information Item	Section
COL Item 9.1-9:	<u>A COL applicant that references the NuScale Power Plant design certification will provide a neutron absorber material qualification report which demonstrates that the neutron absorber material can meet the neutron attenuation and environmental compatibility design functions described in Technical Report TR-0816-49833. The COL applicant will establish procedures to evaluate the neutron attenuation uncertainty associated with the material lot variability and will establish procedures to inspect the as-manufactured material for contamination and manufacturing defects.</u>	9.1
COL Item 9.2-1:	A COL applicant that references the NuScale Power Plant design certification will select the appropriate chemicals for the reactor component cooling water system based on site-specific water quality and materials requirements.	9.2
COL Item 9.2-2:	A COL applicant that references the NuScale Power Plant design certification will describe the source and pre-treatment methods of potable water for the site, including the use of associated pumps and storage tanks.	9.2
COL Item 9.2-3:	A COL applicant that references the NuScale Power Plant design certification will describe the method for sanitary waste storage and disposal, including associated treatment facilities.	9.2
COL Item 9.2-4:	A COL applicant that references the NuScale Power Plant design certification will provide details on the prevention of long-term corrosion and organic fouling in the site cooling water system.	9.2
COL Item 9.2-5:	A COL applicant that references the NuScale Power Plant design certification will identify the site-specific water source and provide a water treatment system that is capable of producing water that meets the plant water chemistry requirements.	9.2
COL Item 9.3-1:	A COL applicant that references the NuScale Power Plant design certification will submit a leakage control program, including an initial test program, a schedule for re-testing these systems, and the actions to be taken for minimizing leakage from such systems.	9.3
COL Item 9.3-2:	A COL applicant that references the NuScale Power Plant design certification will develop the post-accident sampling contingency plans for using the process sampling system and the containment evacuation system off-line radiation monitor to obtain reactor coolant and containment atmosphere samples. The contingency plan will describe the process for collecting representative samples and disposing radioactive samples. A COL applicant will identify temporary equipment (e.g., temporary shielding, sample transport cask, etc.) required to support post-accident sampling.	9.3
COL Item 9.4-1:	A COL applicant that references the NuScale Power Plant design certification will specify a periodic testing and inspection program for the normal control room heating ventilation and air conditioning system.	9.4
COL Item 9.4-2:	A COL applicant that references the NuScale Power Plant design certification will specify periodic testing and inspection requirements for the Reactor Building heating ventilation and air conditioning system in accordance with Regulatory Guide 1.140.	9.4
COL Item 9.4-3:	A COL applicant that references the NuScale Power Plant design certification will specify periodic testing and inspection requirements for the Radioactive Waste Building heating ventilation and air conditioning system.	9.4
COL Item 9.4-4:	A COL applicant that references the NuScale Power Plant design certification will specify periodic testing and inspection requirements for the Turbine Building heating ventilation and air conditioning system.	9.4
COL Item 9.5-1:	A COL applicant that references the NuScale Power Plant design certification will provide a description of the offsite communication system, how that system interfaces with the onsite communications system, as well as how continuous communications capability is maintained to ensure effective command and control with onsite and offsite resources during both normal and emergency situations.	9.5
COL Item 9.5-2:	A COL applicant that references the NuScale Power Plant design certification will determine the location for the security power equipment within a vital area in accordance with 10 CFR 73.55(e)(9)(vi)(B).	9.5
COL Item 10.2-1:	Not used.	10.2
COL Item 10.2-2:	Not used.	10.2

9.1.2.5 Instrumentation

Section 9.1.3 describes the SFP water temperature instrumentation. Section 9.2.5 describes pool water level instrumentation. Section 12.3 describes radiation monitoring instrumentation.

COL Item 9.1-8: A COL applicant that references the NuScale Power Plant design certification will submit an evaluation of the spent fuel storage racks, [and fuel assemblies located in the racks](#), that addresses structural, thermal-hydraulic, criticality, and material analysis aspects of the design. This evaluation is dependent on a vendor-specific design and the as-built configuration of spent fuel storage racks. The design of the spent fuel storage racks is considered acceptable when it meets the criteria of Appendix D to Design Specific Review Standard 3.8.4.

RAI 09.01.01-20S1

COL Item 9.1-9: [A COL applicant that references the NuScale Power Plant design certification will provide a neutron absorber material qualification report which demonstrates that the neutron absorber material can meet the neutron attenuation and environmental compatibility design functions described in Technical Report TR-0816-49833. The COL applicant will establish procedures to evaluate the neutron attenuation uncertainty associated with the material lot variability and will establish procedures to inspect the as-manufactured material for contamination and manufacturing defects.](#)

9.1.2.6 References

- 9.1.2-1 American National Standards Institute/American Nuclear Society, "Design Requirements for Light Water Reactor Spent Fuel Storage Facilities at Nuclear Power Plants," ANSI/ANS-57.2-1983, La Grange Park, IL.
- 9.1.2-2 American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, Section III, Division I, Subsection NF, 2007 Edition, "Class 1, 2, 3, and MC Supports," New York, NY.
- 9.1.2-3 ASTM International, "Standard Guide for Establishing Surveillance Test Program for Boron-Based Neutron Absorbing Material Systems for Use in Nuclear Spent Fuel Storage Racks," ASTM C1187-2007, West Conshohocken, PA.
- 9.1.2-4 American Society of Civil Engineers and Structural Engineering Institute, "Seismic Design Criteria for Structures, Systems, and Components in Nuclear Facilities," ASCE/SEI 43-05, New York, NY.
- 9.1.2-5 American Institute of Steel Construction, "Manual of Steel Construction," 9th Edition, Chicago, IL.
- 9.1.2-6 American National Standards Institute/American Nuclear Society, "Design Requirements for New Fuel Storage Facilities at Light Water Reactor Plants," ANSI/ANS-57.3-1983, La Grange Park, IL.