RAIO-0918-61696

September 07, 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. 494 (eRAI No. 9548) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 494 (eRAI No. 9548)," dated July 13, 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 Enclosure to this letter contains NuScale's 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

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
Getachew Tesfaye, NRC, OWFN-8H12

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

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

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

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 B_4C 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:

The NuScale approach to compliance with the regulatory guidance and requirements associated with neutron absorbing material follows NRC guidance provided by NUREG-0800 Section 9.1.1, Criticality Safety of Fresh and Spent Fuel Storage and Handling.

Part II, Acceptance Criteria, states:

> The criteria for GDC 62 are specified in American National Standards Institute (ANSI)/American Nuclear Society (ANS) 57.1, ANSI/ANS 57.2, and ANSI/ANS 57.3, as they relate to the prevention of criticality accidents in fuel storage and handling.

The stated technical rationale for this criteria is:

> ANSI/ANS 57.1, ANSI/ANS 57.2, and Regulatory Guide 1.13 provide guidance acceptable to the staff for meeting the requirements associated with spent fuel storage and handling.

Regulatory Guide 1.13, Spent Fuel Storage Facility Design Basis, states: “This regulatory guide endorses ANSI Standard N210-1976/ANS-57.2-1983 (Ref. 1), with the following additions, clarifications, and exceptions.”

Appendix B of 10 CFR Part 50 requires the existence of a quality assurance program that appropriately characterizes each component (Criterion VII, “Control of Purchased Material, Equipment and Services,” and Criterion VIII, “Identification and Control of Materials, Parts, and Components”), that provides for appropriate testing to demonstrate satisfactory inservice performance of components (Criterion XI), and that ensures that sufficient records will be maintained to furnish evidence of such activities in an identifiable and retrievable form (Criterion XVII, “Quality Assurance Records”).

Compliance with the above stated regulatory guidance and requirements is achieved by the NuScale DCA. Specifically FSAR Sections 3.2, 9.1, 17.5, ITAAC Table 3.5-1, Technical Specification 5.5.12, Technical Report TR-0816-49833 and FSAR Section 17.5 demonstrate compliance with the above stated regulatory guidance and requirements.

The applicability of these citations is discussed below.

FSAR Table 3.2-1: Classification of Structures, Systems, and Components, list the following under Spent Fuel Storage Racks:

> ANSI/ANS 57.1-1992
>
> ANSI/ANS 57.2-1983 with additions, clarifications, and exceptions of RG 1.13
>
> ANSI/ANS 57.3

FSAR Section 9.1.1.1, Criticality Safety of Fresh and Spent Fuel Storage and Handling states:

> General Design Criterion (GDC) 62, American National Standards Institute/American Nuclear Society (ANSI/ANS) 57.1 (Reference 9.1.1-5), ANSI/ANS 57.2 (Reference 9.1.1-6), and ANSI/ANS 57.3 (Reference 9.1.1-7) were considered in the design of the storage and handling facility for new and spent fuel assemblies.

T**R-0816-49833**, Fuel Storage Rack Analysis, Sections 1.3, 2.2 and 3.4:

> Section 1.2 General Description of the Fuel Storage Racks states:

Design of the fuel storage racks is in accordance with applicable sections the DSRS and applicable requirements in the ASME Code Section III, Division I, Subsection NF. Additionally, guidance specified in ANS 57.2 (Reference 33) and ANS 57.3 (Reference 34) that pertains to the design of the fuel storage racks is used.

Section 2.2 Codes, Standards, and Regulatory Requirements lists:

Regulatory Guide 1.13, “Spent Fuel Storage Facility Design Basis,” Revision 2.

ASME NQA-1a-2009, “Quality Assurance Program for Nuclear Facilities," 2008 Revision with 2009 Addenda.

Section 3.4.1 Material Evaluation for NuScale Fuel Racks, specifies the design, material specification, and monitoring program requirements for the neutron absorption material.

Tier 1, Table 3.5-1: Fuel Storage System Inspections, Tests, Analyses, and Acceptance Criteria states:

The as-built fuel storage racks, including any neutron absorbers, and their configuration within the SFP conform to the design values for materials and dimensions and their tolerances, as shown to be acceptable in the approved fuel storage criticality analysis.

Technical Specification 5.5.12, Spent Fuel Storage Rack Neutron Absorber Monitoring Program, states:

This Program provides controls for monitoring the condition of the neutron absorber used in the spent fuel pool storage racks to verify the Boron-10 areal density is consistent with the assumptions in the spent fuel pool criticality analysis. The program shall be in accordance with NEI 16-03-A, "Guidance for Monitoring of Fixed Neutron Absorbers in Spent Fuel Pools," Revision 0, May 2017.

FSAR Table 3.2-1 specifies “AQ-S” for the Spent Fuel Storage Racks QA program applicability. This designation requires that the pertinent requirements of 10 CFR 50 Appendix B are applicable to nonsafety-related SSC classified as Seismic Category I or Seismic Category II in accordance with the quality assurance program.

FSAR Section 17.5, Quality Assurance Program Description, states:

The Quality Assurance Program Description (QAPD) for the standard design of the NuScale Power Plant is provided in the topical report, “NuScale Topical Report: Quality Assurance Program Description for the NuScale Power Plant”

> COL Item 17.5-1: A COL applicant that references the NuScale Power Plant design certification will describe the quality assurance program applicable to site-specific design activities and to the construction and operations phases.

Therefore NuScale believes concerns regarding how neutron absorbing material is qualified and tested to ensure that the neutron absorber is suitable during fabrication, shipping, construction, and operation and concerns regarding process controls to ensure that the manufactured material meets the safety functions are met by committing to ANSI/ANS 57.2 consistent with Regulatory Guide 1.13 as supported by ITAAC, Technical Specifications and the required design, construction and operations QA programs.

NuScale agrees that other DCDs have specifically cited qualified neutron absorbing materials. For example Metamic is cited in the AP1000, APWR, and APR1400. However, the ESBWR DCD does not specifically cite a material but rather cites compliance to ANSI/ANS 57.2 as shown in ESBWR DCD Section 9.1.2 Spent Fuel Storage below:

> GDC 62 Criticality in the spent fuel storage pool is prevented by the presence of fixed neutron absorbing material to assure keff does not exceed 0.95 under all normal and abnormal conditions which include earthquake and load drop. The spent fuel storage system is designed to the applicable provisions of ANSI/ANS 57.2, which specify criteria for compliance with GDC 62. Individual fuel racks are spaced less than one fuel assembly apart so that a fuel assembly cannot be inserted between racks. The spent fuel storage system conforms to the applicable provisions of RG 1.13 and ANSI/ANS 57.2 and complies with GDC 62 requirements.

Impact on DCA:

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