RAIO-1218-63813

December 12, 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 Supplemental Response to NRC Request for Additional Information No. 343 (eRAI No. 9298) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 343 (eRAI No. 9298)," dated January 26, 2018
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 343 (eRAI No.9298)," dated August 22, 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. 9298:

- 12.03-17

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 Supplemental Response to NRC Request for Additional Information eRAI No. 9298

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NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9298

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.: 9298
Date of RAI Issue: 01/26/2018

NRC Question No.: 12.03-17

Regulatory Basis

Appendix A to Part 50—General Design Criteria (GDC) for Nuclear Power Plants, Criterion 4 requires applicants to ensure that structures, systems, and components important to safety are designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation and postulated accidents.

10 CFR 52.47(a)(5) requires applicants to identify the kinds and quantities of radioactive materials expected to be produced in the operation and the means for controlling and limiting radiation exposures within the limits set forth in 10 CFR Part 20.

Appendix A to Part 50—General Design Criteria for Nuclear Power Plants, Criterion 61—“Fuel storage and handling and radioactivity control,” requires systems which may contain radioactivity to be designed with suitable shielding for radiation protection and with appropriate containment, confinement, and filtering systems.

10 CFR 20.1101(b) and 10 CFR 20.1003 require the use of engineering controls to maintain exposures to radiation as far below the dose limits in 10 CFR Part 20, as is practical. The Acceptance Criteria of DSRS Section 12.3-12.4, “Radiation Protection Design Features,” notes that where the applicant’s shielding design incorporates material subject to degradation, such as through the effects of radiation (e.g., depletion of boron neutron absorbers,) temperature extremes (e.g., degradation of polymer based materials because of high temperature,) density changes (e.g., sagging or settling of shielding material with age,) the reviewer should ensure that methods are in place to ensure that ORE remains ALARA. The staff should review how the application identifies the allowable constraints (e.g., minimum cooling air flow, maximum shielding material temperature, and maximum allowable neutron flux), and how those parameters are measured and assessed over the design life of the facility. The acceptance

criteria of NuScale DSRS section 12.3-12.4 states that the applicant's methods for performing shielding design calculations are acceptable if assumptions regarding source terms, cross sections, shield and source geometries, and transport methods are realistic; and if specified radiation zones are consistent with the assumed source term and shielding specified in the design.

Background

DCD Tier 2 Revision 0 Section 12.3.2.2, "Design Considerations," states that in addition to concrete, other types of materials such as steel, water, tungsten, and polymer composites are considered for both permanent and temporary shielding. The only location where the use of polyethylene is identified is in DCD Table 12.3-6: "Reactor Building Shield Wall Geometry."

DCD Table 12.3-6: "Reactor Building Shield Wall Geometry," provides the nominal thickness of concrete for some of the walls in the RXB. DCD Table 12.3-8: "Reactor Building Radiation Shield Doors," list the shielded doors located in the RXB. DCD Table 12.3-9: "Radioactive Waste Building Radiation Shield Doors," list the shielded doors located in the RWB. DCD Section 12.3 does not contain any information about the assumption for concrete density, other than the references to ANSI/ANS 6.4-2006 and PNNL- 25870.

Using information made available to the staff during the RPAC Chapter 12 Audit, the staff reviewed some of the shielding calculation information for the RXB and the RWB. The staff noticed that the polyethylene shielding specified for the bioshield cover is high density polyethylene and includes 5% natural boron.

Based on information made available to the staff during the RPAC Chapter 12 a, the staff was able to review some of the assumptions used for the RXB shielding analysis. However, the RXB MCNP6 analysis package for the RXB was not available for staff review, so the staff was unable to assess what values were used in the actual RXB shielding calculations.

The acceptance criteria of NuScale DSRS section 12.3-12.4 states that the applicant's methods for performing shielding design calculations are acceptable if assumptions regarding source terms, cross sections, shield and source geometries, and transport methods are realistic; and if specified radiation zones are consistent with the assumed source term and shielding specified in the design.

Key Issue 1

DCD Tier 2 Section 12.3.2, “Shielding,” DCD Section 12.3.2.3, “Calculation Methods,” and DCD Section 12.3.2.4.3, “Reactor Building,” do not specify the values of key assumptions, such as minimum polyethylene density, or that the polyethylene is supposed to contain boron; nor the minimum weight percent of boron in the polyethylene documented.

Question 1

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions with respect to the neutron shielding materials incorporated into the design, the staff requests that the applicant:

- Justify/explain the assumptions used to perform the neutron shielding analysis for the bioshield polyethylene shielding, including the associated methods, models and assumptions used to establish the identified values,
- As necessary, revise DCD Section 12.3.2, and Table 12.3-6 to describe the these assumptions

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

This supplemental response is provided to address potential consequences of changes to the bioshield design, as documented in the NuScale response to RAI 9447 and in FSAR Section 3.7. This design change added high density polyethylene (HDPE) to the front face portion of the bioshield, which now includes an array of HDPE radiation panels that are 4 inches thick, borated to 5%, plus two 0.25 inch steel plates that sandwich the radiation panels. NuScale's shielding analysis, models, methods, and assumptions have not changed since the original response to this RAI 9298, Q12.03-17. The basis for this is as follows:

The shielding analysis supporting the radiation zone designation in FSAR Figure 12.3-1h used an open item that credits additional neutron shielding in the front face of the bioshield to reduce the neutron dose rate streaming through the front face of the bioshield and across the pool. The open item did not specify the type of material or thickness for this neutron shield, only that it needed to be equivalent to, or greater than, 3.75 inches of 5% borated HDPE. The evaluation of

the added HDPE panels in the front face of the bioshield, closes the current NuScale engineering open item in the shielding analysis.

The use of 5% borated HDPE (approximately 1 g/cc) is a common material used for neutron shielding in nuclear facilities and is readily available from suppliers. The density of 1 g/cc is not the minimum HDPE density for the bioshield design criteria, but was used to show adequacy of the radiation zone depicted in the FSAR Figure 12.3-1h. The radiation shielding calculations confirmed that the dose rate above the bioshield is approximately an order of magnitude less than the designated radiation zone's upper limit (radiation zone IV $\leq$ 100 mrem/hour), which will more than account for boron depletion over the life of the plant, or variances in HDPE density.

The shielding model uses MCNP to perform particle transport of fission neutrons, neutron induced gammas, fission gammas, and primary coolant gammas of an operating reactor. The MCNP model accounts for particles traveling up through the top of the bioshield, as well as through the front face of the bioshield across the pool to the areas on top of the bioshield. The area on top of the bioshield is access controlled and is not a normally occupied area. When access becomes necessary, plant personnel using the radiation protection and ALARA programs will monitor, assess, and employ additional measures, as necessary, to ensure occupational exposures are as low as reasonably achievable.

Additional discussion regarding HDPE degradation mechanism is provided in the supplemental response to RAI 9294 (Question 12.03-26).

Updated versions of FSAR Tier 1 Table 3.11-1 and Tier 2 Table 12.3-6 have been provided with the NuScale response to RAI 9447 on November 16, 2018.

There is no change to FSAR Section 12.3-2 or additional changes to Table 12.3-6 as a result of this supplemental response.

Impact on DCA:

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