December 27, 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. 333 (eRAI No. 9282) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 333 (eRAI No. 9282)," dated January 09, 2018
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 333 (eRAI No.9282)," dated March 08, 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. 9282:

- 03.11-17

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
Marieliz Vera, NRC, OWFN-8G9A
Getachew Tesfaye, NRC, OWFN-8H12

Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9282

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9282

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

eRAI No.: 9282
Date of RAI Issue: 01/09/2018

NRC Question No.: 03.11-17

Regulatory Basis

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 of 10 CFR Part 20. 10 CFR 50.49(e)(4) requires applicants to identify the type of radiation and the total dose expected during normal operation over the installed life of the equipment. Appendix A to Part 50—General Design Criteria (GDC) 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. GDC 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. 10 CFR Part 20 requires the use of engineering features to control and minimize the amount of radiation exposure to occupational workers, from both internal and external sources. NuScale DSRS 12.2 DSRS and DSRS 3.11 Acceptance Criteria states that the applicant should describe the radiation fields in sufficient detail for evaluating the inputs to shielding codes, and determination of radiation dose to electrical equipment important to safety as described in 10 CFR 50.49, and GDC 4.

Background

NuScale DCD, Tier 2 Revision 0, Table 3C-6: "Normal Operating Environmental Conditions," states that the 60 Years Integrated N Dose (Rads) for the area outside of the top of the Pressurizer is 6.00E7 rads (120 rads/hour). NuScale DCD, Tier 2, Revision 0, Chapter 12.2 "Table 12.2-1: Core and Coolant Source Information," only provides the fission neutron source strength and the fission neutron spectrum, without specifying the neutron energy spectrum in areas such as above the pressurizer. NuScale Technical Report TR-0116-20781-P Rev. 0 “Fluence Calculation Methodology and Results,” Table 5-1 “Best estimate of fluence expected to be experienced in various NuScale Power Module components and locations,” describes the neutron fluence to the reactor vessel and containment vessel, in the vicinity of the core, but does not provide any neutron flux and spectrum information for the area above the pressurizer. The Control Rod Drive Mechanisms (CRDM) are located in the area above the pressurizer and inside the containment vessel. DCD Tier 2, Revision 0, Table 4.5-1, “Control Rod Drive Mechanism Materials,” states that Stellite 6 may be used for Hard facing for latch arm tips, and the control rod remote disconnect expansion plugs use Haynes Alloy 25. Industry material specification data shows that for Stellite 6 Haynes Alloy 25, over 50% of the base metal consist of cobalt. Industry literature also shows that Alloy X-750 (UNS N07750) the cobalt impurity is limited to 1%. The CRDM springs use springs use Alloy X-750 (UNS N07750). Due to the relatively high neutron absorption cross section of cobalt, the relatively high resultant specific radioactivity and the quantity and energy of the emitted photons when cobalt 60 (Co-60) decays, the resultant gamma dose rates, the neutron spectrum and flux where cobalt is present, are important aspects of the DSRS 12.2 and DSRS 3.11 reviews.

The neutron spectrum and flux information evaluated during the staff review under NuScale DSRS 12.2, are used in the evaluation performed by the staff for NuScale DSRS 12.3-12.4 and DSRS 3.11, related to the acceptability of the shielding design, the establishment of radiation zones, the impact on systems, structures and components, and the activation of material. NuScale DSRS

12.2 Acceptance Criteria, states that the source descriptions should include all pertinent information required for input to shielding codes used in the design process, establishment of related facility design features, and determination of radiation dose to electrical equipment important to safety as described in 10 CFR 50.49, and GDC 4, as well as the controlling radiation exposure to workers, consistent with 10 CFR 20 and GDC 61. DSRS 12.2 also states that unless described within other sections of the FSAR, source descriptions should include the methods, models, and assumptions used as the bases for all values provided in FSAR Section 12.2. These acceptance criteria are consistent with the relevant requirements of 10 CFR Part 50 and 10 CFR Part 52.

Key Issue: The neutron flux and energy spectrum are not well-defined nor is the derivation of these values. The staff needs to know the neutron flux, energy spectrum and appropriate supporting information to evaluate the impact on materials and components located inside of the containment vessel and above the reactor core. This information is needed to evaluate the environmental qualification of components, to assess the generation of activated corrosion products, and to confirm direct occupational radiation exposure of workers during refueling evolutions. Based on information made available to the staff during the RPAC Chapter 12 Audit, the staff was not able to characterize the neutron radiation fields in the aforementioned areas.

Question

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions, the staff requests that the applicant:

- Identify and describe the methods, models and assumptions used to calculate the neutron spectrum and flux above the top of the pressurizer, inside the containment vessel.
- Provide data in NuScale DCD, Tier 2, Revision 0, Section 12.2 describing the neutron spectra and flux, at the area identified above, and the assumptions and input parameters used.

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

While NuScale's overall approach and main inputs into this calculation did not change from previously reported, there were some modeling changes that resulted in different dose rates from previous revisions. First, there was an inadvertent, overly conservative, double counting of the assembly peaking factor of 1.461 that was removed. This double counting was performed by taking a peak assembly fission rate and applying the peaking factor. The current method used the end of cycle fission rate of the core and applies the conservative peaking factor. Secondly, there was a variance reduction technique previously used of source biasing that artificially had more source particles generated on the outside assemblies of the core than the inside. Since these have a larger impact on the dose (due to self-shielding from the more inner assemblies) that resulted in artificially, non-physical, higher doses. Lastly, when the physical model was updated, minor conforming geometry changes in the model were done to accurately represent the current design as submitted in the latest revision of the FSAR.

Impact on DCA:

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