RAIO-0618-60462

June 14, 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. 332 (eRAI No. 9245) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 332 (eRAI No. 9245)," dated January 09, 2018
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 332 (eRAI No.9245)," 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 Enclosures to this letter contain NuScale's supplemental response to the following RAI Questions from NRC eRAI No. 9245:

- 12.03-7
- 12.03-8

Enclosure 1 is the proprietary version of the NuScale Supplemental Response to NRC RAI No. 332 (eRAI No. 9245). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The proprietary enclosures have been deemed to contain Export Controlled Information. This information must be protected from disclosure per the requirements of 10 CFR § 810. 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 Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

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

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Omid Tabatabai, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A

Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9245, proprietary

Enclosure 2: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9245, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0618-60463

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9245, proprietary

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

Enclosure 2:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9245, nonproprietary

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.: 9245
Date of RAI Issue: 01/09/2018

NRC Question No.: 12.03-7

Regulatory Basis

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 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.

NuScale DSRS 12.2 and DSRS 3.11 Acceptance Criteria state 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.

10 CFR 50.46 (b)(5) and GDC 35 requires providing long term emergency core cooling. The guidance of Regulatory Guide 1.82, “Water Sources for Long-Term Recirculation Cooling Following a Loss-of-Coolant Accident,” provides guidance for minimizing the potential for debris introduction into containment that could impact the ability to cool the core. As noted in RG 1.82, the debris may be generated as a result of the post-accident environment.

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 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 or 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.

The acceptance criteria of NuScale DSRS 12.2 and DSRS 3.11 state 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.

Based on information made available to the staff as a result of the RPAC Chapter 12 Audit, and RPAC participation in the Control Rod Drive Mechanism (CRDM) Audit, the staff became aware that there were a number of B2 components (i.e. non-safety related and non-risk significant components) that were located outside of the reactor coolant system pressure boundary, but within the Containment Vessel that were not included in the EQ program described in DCD Section 3.11. For example, information reviewed by the staff during these audits, specified the use of flexible metal hoses between the Reactor Closed Cooling Water (RCCW) system and the CRDM magnet cooling coils. The hoses are classified as B2 items. When asked as part of the audits, NuScale stated that the hoses were rated for 200 ºF. When asked about the condition of the hose following actuation of the reactor recirculation valves (RRV) and/or the reactor vent valves (RVV), they stated that the RCCW system was not required to be operational following actuation of the RRVs and RVVs (i.e., post-accident). However, the post-accident conditions inside of the containment vessel (CNV) far exceed 200ºF. A similar discussion was held regarding some RCCW Thermal Relief valves, again located inside of the containment vessel and outside of the RV.

Key Issue:

It is unclear to the staff that if the non-safety related equipment located inside of containment were to degrade, as a result of the normal or post-accident environmental conditions (e.g., radiation,), that the safety-related SSCs would still be able to carry out their safety related function, such as coolant recirculation through the reactor core.

Question Q-31009

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

- Explain/justify how non-safety related components located inside of the CNV but outside of the reactor vessel, are evaluated as it relates to meeting the requirements of 10 CFR 50.49(e)(4), GDC 4 and 10 CFR 50.46 (b)(5) and GDC 35.
- As necessary, revise DCD 3.11 to include any non-safety related equipment located inside of the CNV but outside of the reactor vessel that should be included in the DCD Section 3.11,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

During a closed telecom concerning the response to eRAI 9245, Question 12.3-7, transmitted by NuScale letter RAIO-0318-59021, dated March 8, 2018, NuScale indicated that a design requirement prohibiting environmentally induced debris inside the containment that could interfere with the proper functioning of the ECCS will be added to FSAR Section 3.11. This response supplements the RAIO-0318-59021 response by updating FSAR Section 3.11 accordingly.

The following statement is added to the FSAR,Section 3.11.6.:

"There can be no environmentally induced debris inside the CNV that could interfere with the proper functioning of the ECCS. This requirement is addressed as a generic requirement to ensure that all SSCs inside the CNV that have the potential to generate debris during the course of an accident have been qualified to demonstrate that no debris is generated or released that could impair the performance of the ECCS."

Impact on DCA:

FSAR Section 3.11 has been revised as described in the response above and as shown in the markup provided with this response.

accident, and post-accident conditions as required by GDC 4 and 10 CFR 50 Appendix B. Mechanical equipment qualification verifies the design is capable of functioning during normal, abnormal and accident conditions and includes the effects of the fluid medium (e.g., borated water) on the environmental conditions.

RAI 03.11-13

For mechanical equipment located in a mild environment, acceptable environmental design is demonstrated by the design and purchase specifications for the equipment. The specifications contain a description of the functional requirements for a specific environmental zone during normal environmental conditions and anticipated operational occurrences. The programs identified in Section 3.11.2.1 for verifying that electrical equipment located in a mild environment are capable of performing their intended function will also be applied to mechanical equipment located in a mild environment. For mechanical equipment that must function during or following exposure to a harsh environment, compliance with the environmental design provisions of GDC 4 are generally achieved by demonstrating that the non-metallic parts/components of the equipment suitable for the postulated design basis environmental conditions. Safety-related mechanical equipment that performs an active function during or following exposure to harsh environmental conditions will be qualified in accordance with ASME QME-1, Appendix QR-B (Reference 3.11-13). Documentation and the status of the testing and analysis are performed in accordance with the processes presented in Appendix 3.C.

Mechanical equipment located in harsh environmental zones is designed to perform under all appropriate environmental conditions. The primary focus with mechanical equipment is on materials that are sensitive to environmental effects (e.g., seals, gaskets, lubricants, fluids for hydraulic systems, and diaphragms). A list of the mechanical components that contain non-metallic or consumable parts located in harsh environment areas that require EQ is provided in Table 3.11-1.

RAI 12.03-7S1

There can be no environmentally induced debris inside the CNV that could interfere with the proper functioning of the ECCS. This requirement is addressed as a generic requirement to ensure that all SSCs inside the CNV that have the potential to generate debris during the course of an accident have been qualified to demonstrate that no debris is generated or released that could impair the performance of the ECCS.

RAI 03.11-14

3.11.7 Equipment Qualification Operational Program

RAI 03.11-18

An EQ operational program is provided that ensures continued capability of qualified mechanical and electrical equipment to perform its design function throughout its qualified life. The EQ operational program contains the following aspects specific to the EQ of mechanical and electrical equipment: (1) evaluation of EQ results to establish activities to support continued EQ for the entire time an item is installed in the plant, (2) determination of surveillance and preventive maintenance activities based on EQ results, (3) consideration of EQ maintenance recommendations from equipment vendors, (4) evaluation of operating experience in developing surveillance and preventive maintenance activities for

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

eRAI No.: 9245
Date of RAI Issue: 01/09/2018

NRC Question No.: 12.03-8

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 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 NuScale DSRS section 12.3, “Radiation Protection Design Feature,” states that radiation protection features should be incorporated into the design including design measures to reduce the production, distribution, and retention of activated corrosion products (e.g., material selection), including those resulting from direct neutron activation.

10 CFR 20.1406 requires applicants to describe in the application how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste. The acceptance criteria of NuScale DSRS Section 12.3-12.4, “Radiation Protection Design Features,” states that the applicant is to describe how facility design and procedures for operation will minimize, to the extent practicable, contamination of the facility and the environment, facilitate eventual decommissioning, and minimize, to the extent practicable, the generation of radioactive waste.

Background

The design documents reviewed by the NRC staff during the CRDM Audit, indicated that due to the length of the control rod drive shaft and the expected deceleration forces expected during control rod dropping, that there was a potential for increased flexure at the control rod drive shaft to control rod assembly junction. The applicant stated that the design of the CRDMs was not complete, so future design work and testing of this junction was expected. Since the applicant is currently unable to provide additional information regarding how increased flexure of this junction could affect cobalt introduction rates, the staff was not able to identify how the expected extra wear at this junction was factored into estimating the introduction of cobalt-containing wear products into the reactor coolant system.

NuScale DCD Tier 2, Revision 0 Section 12.3.1.1.13, “Material Selection,” states that proper material selection is an important factor to balance component performance while reducing the amount of corrosion and activation products generated. The use of materials containing cobalt is minimized to reduce the quantity of activation products. DCD Table 12.3-4, “Typical Cobalt Content of Materials,” states that the Maximum Weight Percent (w/o) of Cobalt in the CRDM internals springs in contact with primary coolant (Inconel X-750) is 1.00 w/o, and the cobalt content of other small components in contact with primary coolant, is not limited.

DCD Section 4.2.2.8, “Control Rod Assembly Description,” states that the top ends of the control rods are fastened to a spider using a threaded and pinned joint. The upper end plug is designed with a flex joint which provides the ability to accommodate misalignment between the control rods and the fuel assembly. DCD Tier 2 Revision 0 Section 4.5.1.3 “Other,” states that nickel- chromium based alloy X-750 is used for the CRDM springs and cobalt-based alloys Haynes 25 and Stellite 6 are used for wear- resistant parts as identified in Table 4.5-1, “Control Rod Drive Mechanism Materials.” 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 and Haynes Alloy 25, over 50% of the base metal consist of cobalt. Industry literature shows that for Alloy X-750 (UNS N07750) the cobalt impurity is limited to 1%. 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, wear of components containing high cobalt content is important for evaluating compliance with 10 CFR 20.1101(b).

Key Issue

Since the applicant is currently unable to provide additional information regarding how increased flexure of this junction could affect cobalt introduction rates, and because cobalt is a major source of radiation exposure in operating nuclear power plants, increased wear of cobalt containing material will increase operational radiation exposure, contrary to the requirements of 10 CFR 20.1101(b) and fails to minimize contamination in accordance with 10 CFR 20.1406.

Question

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions with respect to potential Co-60 contamination from the CRDM, the staff requests that the applicant:

1. Explain/justify the amount of allowable flexure for the control rod drive shaft, including the limiting number of cycles, the basis for the stated flexure value, and the expected material wear rates,
2. Explain/justify the testing that will be performed to assess the actual amount of control rod

drive shaft flexure,

3. As necessary, revise and update section 12.3 of the NuScale DCD to specify the design features of the control rod drive shaft provided to minimize the introduction of cobalt due to flexure,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

The following response to eRAI 9245, Question 12.03-8 completely supersedes the response transmitted by NuScale letter RAIO-0318-59021, dated March 8, 2018.

The flexure referenced in this question comes from a review of the buckling analysis in the vendor summary report for the control rod drive mechanism (CRDM). The purpose for this analysis was to demonstrate a large buckling margin. The deflections are a result of applying a very large load sufficient to create a buckling condition, and in many of the cases without credit for lateral supports. The smallest buckling load was approximately 5 times greater than the largest expected load on the control rod drive shaft, and this was without the lower drive shaft horizontal supports, and a pinned boundary condition on the bottom. The depicted flexures cannot actually occur as the maximum allowable flexure will be limited by the horizontal supports, and the connection to the control rod assembly (CRA) hub also provides axial support. Figure 1 displays the drive shaft support elevations and fuel assembly. The design specification defines the maximum number of SCRAMs and latching cycles for this component.

{{

}}2(a),(c),ECI

Figure 1 CRD shaft support elevations

The NuScale design provides CRD shaft supports, in general at a close spacing {{

}}2(a),(c),ECI. In addition, the lower drive shaft horizontal supports are spaced more closely, as shown in Figure 1.

The Cobalt item, at the base of the control rod drive shaft, is the coupling expansion plug, item 10, depicted in Figure 2. The design of this latching interface is similar in form and in material to the control rod latching mechanisms in service in the existing fleet. In these existing applications Haynes Alloy 25 has proved to be the appropriate material for these applications. Since this item is inside the control rod drive shaft, there will be very little motion due to any shaft bending (flexure) motion during a SCRAM. The vertical motion is also expected to be similar to that of similar mechanisms in the existing fleet. Industry experience has shown that Haynes Alloy 25 is the appropriate material for this application.

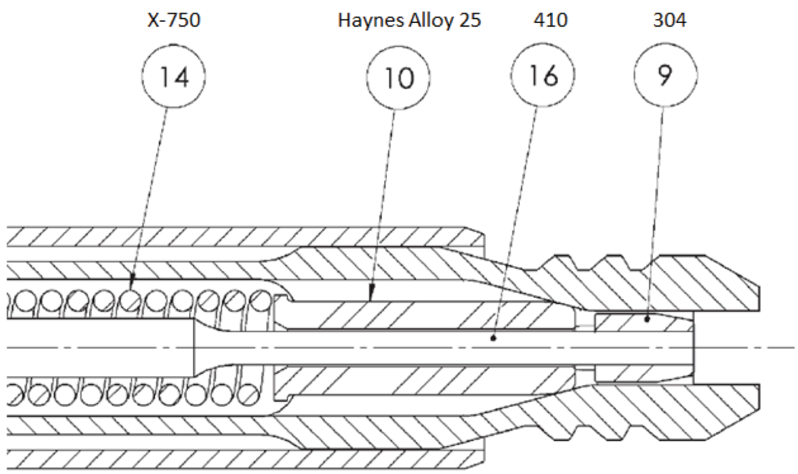

Figure 2 Control Rod Drive Shaft Base

Impact on DCA:

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

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0618-60463

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

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 control rod drive shaft support spacing by which NuScale develops its control rod drive mechanism design.

   NuScale has performed significant research and evaluation to develop a basis for this control rod drive shaft support spacing 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 response to NRC Request for Additional Information No. 332, eRAI 9245. 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 June 14, 2018.

Zackary W. Rad