RAIO-0519-65588

May 15, 2019

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 519 (eRAI No. 9656) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 519 (eRAI No. 9656)," dated March 18, 2019

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. 9656:

- 12.03-63

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,

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9656

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9656

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

eRAI No.: 9656
Date of RAI Issue: 03/18/2019

NRC Question No.: 12.03-63

The Regulatory Requirements:

- 10 CFR 52.47(a)(24) requires the applicant to provide a representative conceptual design for those portions of the plant for which the application does not seek certification, to aid the NRC in its review of the FSAR and to permit assessment of the adequacy of the interface requirements.

- 10 CFR 52.47(a)(25) requires the applicant to provide interface requirements to be met by those portions of the plant for which the application does not seek certification. These requirements must be sufficiently detailed to allow completion of the FSAR.

- 10 CFR 52.47(a)(26) requires the applicant to provide justification that compliance with the interface requirements 10 CFR 52.47(a)(25) is verifiable through inspections, tests, or analyses. The method to be used for verification of interface requirements must be included as part of the proposed ITAAC.

- NUREG-0800 Standard Review Plan (SRP) Section 14.3 "Inspections, Tests, Analyses, and Acceptance Criteria," indicates that the "Interface Requirements" section of Tier 1 specifies interface requirements that should be met by the site-specific portions of a facility that are not within the scope of the certified design. The interface requirements in the DCD define the design attributes and performance characteristics that ensure that the site-specific portion of the design is in conformance with the certified design. Interface requirements are defined for: (a) systems that are entirely outside the scope of the design, and (b) the out-of-scope portions of those systems that are only partially within the scope of the standard design. In some cases, the scope of the standard

design requires that the DCD contain information that was supplied by a utility in the past. However, simply because design information may be traditionally "licensee-supplied" does not mean that it is "out-of-scope" of the standard design. Top-level interface requirements are specified in Tier 1, more detailed interface requirements may be specified in Tier 2, but they should be consistent with the Tier 1 information.

- NuScale DSRS Section 12.3 "Radiation Protection Design Feature, "states in the specific acceptance criteria that areas inside the plant structures should be subdivided into radiation zones, with maximum design dose rate zones and the criteria used in selecting maximum dose rates identified.

Background:

In RAI-9295 Question 12.03-55 dated 30 April 2018, NuScale DCD Tier 2, the staff identified that DCD Revision 0, Figure 12.3-1g "Reactor Building Radiation Zone Map - 100' Elevation," shows that the area between column lines RX4 and RX6 (east and west of the reactor pool), RXA and RXB (north of the reactor pool) and between column lines RXD and RXE (south of the reactor pool) as depicted on DCD Figure 1.2-216, "Reactor Building 100'-0" Elevation" as Steam Galleries, Rooms 010- 411 and 010-418 respectively, are labelled as a Radiation Zone 0. DCD Tier 2, Revision 0, Table 12.3-1 "Normal Operation Radiation Zone Designations, " shows that areas designated as radiation Zone 0 have dose rates ≤ 0.05 mrem/hr. However, NuScale DCA 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 containment vessel and under the bioshield is 1.85E6 rads (3.7 rads/hour). Figure 12.3-1g depicts the areas under the bioshield as a radiation Zone VI (dose rates ≥ 1 rad/hr and ≤ 500 rad/hr from Table 12.3-1.)

The staff noted that there are several large penetrations (e.g., main steam line, feedwater, ventilation ducts) that penetrate the Bioshield shielding wall that could lead to higher dose rates in the RXB Steam Gallery area as a result of radiation streaming effects. The staff asked the applicant to explain/justify the methods, models, and assumptions used to calculate the radiation sources that were used to determine the radiation zones depicted in DCD Chapter 12.3, and to provide appropriate and sufficient information, including shielding, absorption, and attenuation effects, to justify significant decreases in dose in the adjacent radiation zones (e.g., the RXB Steam Galleries).

The applicant's response to RAI-9295 Question 12.03-55 dated 8 May 2018 (ADAMS Accession No. ML18128A390), stated:

- FSAR Figures 3.6-16 and 3.6-17 are labeled as "Postulated" and "COL applicant scope" because the actual pipe routing and penetration shielding has not yet been finalized, and has been identified as COLA scope.

- FSAR Section 12.3.1.2.3 Penetrations and FSAR Section 12.3.2.2 Design Considerations, state that shield wall penetrations may be configured and shielded, as necessary, to prevent excessive radiation streaming into accessible spaces.

- The details of the NuScale penetrations and penetration shielding design are not finalized, but will be finalized during a future design phase. The NuScale design is not unique in this respect and the detailed design of shield wall penetration compensatory measures will utilize standard industry practices to ensure the design complies with the FSAR.

The applicant's supplemental response to RAI-9295 Question 12.03-55 dated 23 August 2018 (ADAMS Accession No. ML18235A648), proposed adding COL Item 12.3-8, stating:

"A COL applicant that references the NuScale Power Plant design certification will describe the radiation shielding design measures used to compensate for the main steam and main feedwater piping penetrations through the Reactor Building pool wall between the NuScale Power Module bays and the Reactor Building steam galleries near the 100 ft elevation."

They also included this new proposed COL Item in Table 1.8-2: "Combined License Information Items."

Key Issue:

In a supplemental response to RAI 9295, Question 12.03-55 dated 23 August 2018 (ADAMS Accession No. ML18235A648), NuScale states that the portion of the shielding referenced is the responsibility of the COL applicant. In the DCA, NuScale provides COL Item 12.3-8. In reviewing the RAI response and the proposed COL item, the staff did not identify an applicable regulatory requirement in 10 CFR 52.79 that would provide the regulatory basis for the review of the subject shielding in a subsequent COL application. Instead, NuScale's acknowledgement that the details of the design of the wall, including penetration locations and sizing, will be finalized at a later time after the design certification, appears to align with the concept of a conceptual design item (CDI) in accordance with 10 CFR 52.47(a)(24). 10 CFR 52.47(a)(25) requires that an interface requirement be established for CDIs. NuScale has provided Table 1.8-1: "Summary of NuScale Certified Design Interfaces with Remainder of Plant listing the interface

requirements for its design."

In addition, the staff notes that the proposed COL Item 12.3-8, only addresses the Main Steam and Main Feedwater lines, and does not address the large HVAC duct penetrations.

The applicant stated that the portion of the shielding referenced within RAI 9295 is the responsibility of the COL Applicant, and will be finalized during a future design phase. However, the applicant did not provide the Interface Requirements, as described in SRP Section 14.3 and as required by 10 CFR 52.47(a)(25), and would need to address 10 CFR 52.47(a)(26) for any interface requirements developed.

Question:

To facilitate staff understanding of the application information in support of its reasonable assurance review regarding the identification of radiation shielding design interfaces consistent with 10 CFR 52.47(a)(24), 10 CFR 52.47(a)(25) and 10 CFR 52.47(a)(26) and 10 CFR 52.79:

A. Option 1

- Revise proposed COL Item 12.3-8 to include the HVAC duct penetrations and/or other penetrations as appropriate, in addition to the Main Steam and Main Feedwater lines already identified.

- Provide the regulatory basis in 10 CFR 52.79 that supports the proposed COL Item that will facilitate the staff's review during the COL application review.

B. Option 2

- Revise proposed COL Item 12.3-8 to include the HVAC duct penetrations and/or other penetrations as appropriate, in addition to the Main Steam and Main Feedwater lines already identified.

- Identify this shielding as an interface requirement in accordance with 10 CFR 52.47(a)(24) and revise DCD Tier 2 Section 12.3 to indicate which portions of the application are considered outside of the scope of the design,

- Consistent with the requirements of 10 CFR 52.47(a)(25) and 10 CFR 52.47(a)(26) to provide interface requirements to be met by those portions of the plant for which the

application does not seek certification and the associated method to be used for verification of the interface requirement, revise DCD Tier 2 Table 1.8-1: "Summary of NuScale Certified Design Interfaces with Remainder of Plant listing the interface requirements for its design," to include the proposed interface requirement.

C. Option 3

- Provide the penetration shielding design information, and the associated methods, models, and assumptions, to support the radiation zone designations for the reactor building steam gallery area.

NuScale Response:

For Option 1, the NuScale staff agrees that there is no regulatory basis for such a COL item related to the detailed design of shield wall penetration compensatory shielding.

For Option 2, the NuScale staff believes the level of detail regarding penetration shielding is not appropriate for the DCA, therefore can not be considered to be conceptual design information (CDI). Therefore, an interface requirement would not be appropriate.

For Option 3, the detailed design for pipe routing and penetration shielding has not been completed. However, the NuScale DCA describes the various means by which shield wall penetrations can be compensated in Section 12.1.2.3.2 "Minimizing Radiation Levels in Plant Access Areas and Vicinity of Equipment," Section 12.3.1.2.3 "Penetrations," and Section 12.3.2.2 "Design Considerations." The radiation zone map shielding analysis models for accessible areas assume that the penetration shielding is as effective as the surrounding wall that contains the penetration. A COL applicant will complete the detailed design, construct and operate the facility as described in the DCA, as required by 10 CFR 52.97(a)(1)(iii).

To clarify the requirement for shield wall penetration compensatory shielding, Section 12.3.1.2.3 "Penetrations" has been revised to link the radiation zone maps to penetration shielding design, and COL Item 12.3-8 has been revised to include other major shield wall penetrations, and the associated DCA sections that provide the compensatory shielding design descriptions.

Impact on DCA:

FSAR Section 12.3.1.2.3, Section 12.3.2.4.1 and Table 1.8-2 have been revised as described in the response above and as shown in the markup provided in this response.

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

Item No.	Description of COL Information Item	Section
COL Item 11.5-1:	A COL applicant that references the NuScale Power Plant design certification will describe site-specific process and effluent monitoring and sampling system components and address the guidance provided in American National Standards Institute (ANSI) N13.1-2011, ANSI N42.18-2004, and Regulatory Guides 1.21, 1.33, and 4.15.	11.5
COL Item 11.5-2:	A COL applicant that references the NuScale Power design certification will develop an offsite dose calculation manual (ODCM) that contains a description of the methodology and parameters used for calculation of offsite doses for gaseous and liquid effluents, using the guidance of Nuclear Energy Institute (NEI) 07-09A (Reference 11.5-8).	11.5
COL Item 11.5-3:	A COL applicant that references the NuScale Power design certification will develop a ~~r~~Radiological ~~e~~Environmental ~~m~~Monitoring ~~p~~Program (REMP), consistent with the guidance in NUREG-1301 and NUREG-0133, that considers local land use census data for the identification of potential radiation pathways radioactive materials present in liquid and gaseous effluents, and direct external radiation from systems, structures, and components.	11.5
COL Item 12.1-1:	A COL applicant that references the NuScale Power Plant design certification will describe the operational program to maintain exposures to ionizing radiation as far below the dose limits as practical, as low as reasonably achievable (ALARA).	12.1
COL Item 12.2-1:	A COL applicant that references the NuScale Power Plant design certification will describe additional site-specific contained radiation sources that exceed 100 millicuries (including sources for instrumentation and radiography) not identified in Section 12.2.1.	12.2
COL Item 12.3-1:	A COL applicant that references the NuScale Power Plant design certification will develop the administrative controls regarding access to high radiation areas per the guidance of Regulatory Guide 8.38.	12.3
COL Item 12.3-2:	A COL applicant that references the NuScale Power Plant design certification will develop the administrative controls regarding access to very high radiation areas per the guidance of Regulatory Guide 8.38.	12.3
COL Item 12.3-3:	A COL applicant that references the NuScale Power Plant design certification will specify personnel exposure monitoring hardware, specify contamination identification and removal hardware, and establish administrative controls and procedures to control access into and exiting the radiologically controlled area.	12.3
COL Item 12.3-4:	A COL applicant that references the NuScale Power Plant design certification will develop the processes and programs necessary for the implementation of 10 CFR 20.1501 related to conducting radiological surveys, maintaining proper records, calibration of equipment, and personnel dosimetry.	12.3
COL Item 12.3-5:	A COL applicant that references the NuScale Power Plant design certification will describe design criteria for locating additional area radiation monitors.	12.3
COL Item 12.3-6:	A COL applicant that references the NuScale Power Plant design certification will develop the processes and programs necessary for the use of portable airborne monitoring instrumentation, including accurately determining the airborne iodine concentration in areas within the facility where plant personnel may be present during an accident.	12.3
COL Item 12.3-7:	A COL applicant that references the NuScale Power Plant design certification will develop the processes and programs associated with Objectives 5 and 6, to work in conjunction with design features, necessary to demonstrate compliance with 10 CFR 20.1406, and the guidance of Regulatory Guide 4.21.	12.3
COL Item 12.3-8:	A COL applicant that references the NuScale Power Plant design certification will describe the radiation shielding design measures used to compensate for ~~the main steam and main feedwater piping~~major shield wall penetrations in accordance with FSAR Section 12.1.2.3.2 "Minimizing Radiation Levels in Plant Access Areas and Vicinity of Equipment," Section 12.3.1.2.3 "Penetrations," and Section 12.3.2.2 "Design Considerations."~~through the Reactor Building pool wall between the NuScale Power Module bays and the Reactor Building steam galleries near the 100 ft elevation (Shown on Figure 3.6-16 and Figure 3.6-17).~~	12.3
COL Item 12.4-1:	A COL applicant that references the NuScale Power Plant design certification will estimate doses to construction personnel from a co-located existing operating nuclear power plant that is not a NuScale Power Plant.	12.4

water). Radioactive waste system components are largely designed using stainless steel also, following the recommendations of RG 1.143.

The reactor pressure vessel (RPV), control rod drive mechanisms (CRDMs), and containment vessel materials are predominately low alloy steels, clad with stainless steel, and austenitic stainless steels. The use of cobalt containing materials in contact with the primary coolant, such as Stellite, is limited to a small number of wear components such as CRDM latches, hard faces, springs and CRA hub connection couplings (Haynes Alloy-25). The cobalt content of austenitic stainless steel and Ni-Cr-Fe weld filler metals is limited to a maximum of 0.05 percent. The cobalt content of austenitic stainless steel base materials is limited to 0.15 percent. Steam generator (SG) heat transfer tubing is limited to a cobalt content of a maximum average of 0.014 percent, with zero heats exceeding 0.020 percent. Table 12.3-4 summarizes the typical cobalt content for materials and components.

12.3.1.2 Plant and Layout Design Features for ALARA

This section provides descriptions and examples of facility design features to reduce personnel exposures in accordance with the guidance of RG 8.8 and the ALARA principle.

12.3.1.2.1 Pipe Routing

Whenever possible, pipes with radioactive fluids are routed through pipe chases or shielded areas, and away from pipes for "clean" services.

If pipes with radioactive fluids are routed near clean service pipes, provisions for isolation and draining of the radioactive pipes are provided.

Piping is designed to minimize "dead legs" and low points.

12.3.1.2.2 Valve Galleries

Valve galleries are provided in several locations to protect plant operators from radiation exposures from process equipment. Floors are sloped towards local drain hubs to collect leakage. Concrete surfaces within the valve galleries are coated to facilitate decontamination.

12.3.1.2.3 Penetrations

Penetrations through shield walls are minimized as much as possible.

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If penetrations through shield walls are necessary, the penetrations are designed to minimize streaming (e.g., with an offset) from a radiation source to accessible areas. If penetration offsets are not practical, then penetrations are either shielded or elevated above floor level. Shield wall penetrations will be sufficiently compensated to comply with the associated radiation zone map dose rates for normally accessible areas.

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COL Item 12.3-8: A COL applicant that references the NuScale Power Plant design certification will describe the radiation shielding design measures used to compensate for ~~the main steam and main feedwater piping~~major shield wall penetrations in accordance with FSAR Section 12.1.2.3.2 "Minimizing Radiation Levels in Plant Access Areas and Vicinity of Equipment," Section 12.3.1.2.3 "Penetrations," and Section 12.3.2.2 "Design Considerations."~~through the Reactor Building pool wall between the NuScale Power Module bays and the Reactor Building steam galleries near the 100 ft elevation (Shown on Figure 3.6-16 and Figure 3.6-17).~~

12.3.2.4.2 Main Control Room

The dose rate in the main control room during normal operations is negligible. The Control Building (CRB) room locations and elevations are shown in figures provided in Section 1.2. The CRB walls are designed to attenuate radiation from the RXB. As indicated by Table 15.0-12, the ~~G~~PDC 19 dose acceptance criteria for the control room are met for postulated accidents.

12.3.2.4.3 Reactor Building

In general, the calculated dose rates in open areas and corridors of the RXB are less than five mrem/hr during normal operation as shown in the radiation zone maps (Figure 12.3-1a through Figure 12.3-1i).

The RXB includes systems that contain radioactive components. The major radiation sources in the RXB are associated with the NPM (see Section 12.3.2.4.1), chemical volume and control system, PCUS, and spent fuel storage. The shielding designs for these systems are described below.

Chemical and Volume Control System

The CVCS contains radioactive ion exchangers, filters, and heat exchangers. The CVCS components and piping are located below grade in the RXB as shown in the radiation zone maps. The regenerative and non-regenerative heat exchangers are located at elevation 50'-0". The module heatup system heat exchangers are located at elevation 62'-0". The CVCS reactor coolant particulate filters and the CVCS ion exchangers are located at elevation 24'-0". Access to these areas is restricted and is not required for normal operation of this equipment.

RAI 12.03-23, RAI 12.03-25

The filters, ion exchangers, and heat exchangers are located in shielded cubicles with knockout panels, which provide equivalent shielding as the wall in which they are located. The CVCS filters and resin traps are accessible via removable floor shield plugs at elevation 35'-8" for maintenance purposes. The cubicle walls are concrete supported by carbon steel plates, called structural steel partition walls. The labyrinths in the cubicles provide shielding that significantly lowers the dose rates from areas adjacent to the radioactive component.