RAIO-0518-60209

May 29, 2018

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. 406 (eRAI No. 9303) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 406 (eRAI No. 9303)," dated April 02, 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 Questions from NRC eRAI No. 9303:

- 12.03-52
- 12.03-53
- 12.03-54

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 Steven Mirsky at 240-833-3001 or at smirsky@nuscalepower.com.

Sincerely,

Jennie Wike
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9303

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NuScale Response to NRC Request for Additional Information eRAI No. 9303

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

eRAI No.: 9303
Date of RAI Issue: 04/02/2018

NRC Question No.: 12.03-52

Regulatory Basis

10 CFR 52.47(b)(1), requires that the application contain the Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC), that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification (DC) has been constructed and will be operated in conformity with the DC, the provisions of the Atomic Energy Act (AEA), and NRC regulations.

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.

10 CFR 50.34(f)(2)(xvii) requires instrumentation to measure, record and readout in the control room containment radiation intensity (high level). 10 CFR 50.34(f)(2)(vii) requires radiation and shielding design reviews of spaces around systems that may, as a result of an accident, contain accident source term quantities of radioactive material, and design as necessary to permit adequate access to important areas and to protect safety equipment from the radiation environment. 10 CFR 50.34(f)(2) (xxvii) requires monitoring of in plant radiation and airborne radioactivity as appropriate for a broad range of routine and accident conditions.

Appendix A to 10 CFR 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 Criterion 60— “Control of releases of radioactive materials to the environment,” requires that the nuclear power unit design include means to control suitably the release of radioactive materials in gaseous and liquid effluents and to handle radioactive solid wastes produced during normal reactor operation, including anticipated operational occurrences.

GDC Criterion 4— “Environmental and dynamic effects design bases,” states that Structures, systems, and components (SSC) important to safety shall be designed to accommodate the effects of and to be compatible with the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents, including loss-of-coolant accidents.

Appendix A to 10 CFR Part 50 states that Anticipated operational occurrences (AOO) mean those conditions of normal operation which are expected to occur one or more times during the life of the nuclear power unit.

10 CFR 20.1201 requires controlling the occupational dose to individuals to within the limits of 10 CFR Part 20. 10 CFR 20.1301 requires controlling the dose to members of the public to 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 DSRS Section 12.3-12.4, “Radiation Protection Design Features,” contains a number of criteria related to the design of the shielding, including:

- 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), methods are in place to ensure that ORE remains ALARA, and the equipment exposures are maintained in accordance with the provisions of 10 CFR 50.49 should be specified
- The application should identify 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 area radiation monitoring systems will be acceptable if they meet the provisions of 10 CFR 20.1501, “General,” 10 CFR 50.34(f)(2)(xvii), the guidance in NUREG-0737 using the NuScale-specific source term, and the in-containment high-range radiation monitors meet the criteria of 10 CFR 50.34(f)(2)(xvii).
- Systems, Structures and Components (SSC) that are described in the application, should be designed to maintain radiation exposures to operating and maintenance personnel ALARA. Structures housing radioactive waste processing systems or components should be classified using the guidance for potential exposure to site personnel found in RG 1.143.

Background

DCD Tier 2 Revision 0 Section 12.3.2, “Shielding,” describes some of the design considerations for radiation shielding, such as stating that material used for a significant portion of plant shielding is concrete.

DCD Section 12.3.2.2, “Design Considerations,” states that the selection of shielding materials considers the ambient environment and potential degradation mechanisms. The material used for a significant portion of plant shielding is concrete. In addition to concrete, other types of materials such as steel, water, tungsten, and polymer composites are considered for both permanent and temporary shielding. DCD Section 12.3.2.4.3, “Reactor Building,” states that cubicle walls are concrete supported by carbon steel plates, called structural steel partition walls.

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,” lists the shielded doors located in the RXB. DCD Table 12.3-7, “Radioactive Waste Building Shield Wall Geometry,” provides the nominal thickness of concrete for some of the walls in the RWB. DCD Table 12.3-9, “Radioactive Waste Building Radiation Shield Doors,” list the shielded doors located in the RWB.

In a letter issued by the NRC to NuScale, “NuScale Letter on Draft Standard ITAAC,” and “Draft Standardized DCA ITAAC Tables - Enclosure to NuScale Letter on Draft Standard ITAAC,” dated April 8, 2016 (ADAMS Accession Nos. ML16096A132 and ML16097A123,) the staff described the ITAAC that are applicable to the staff review of the NuScale application. These standard ITAAC included:

- R07 “As-Built Inspection and Reconciliation Analysis,” to verify that the structures, systems and components of the non-Seismic Category I radioactive waste system are designed and constructed to the standards of RG 1.143 to withstand the design loads without loss of structural integrity. RG 1.143 Table 1 “Codes and Standards for the Design of SSC in Radwaste Facilities,” describes the design codes and standards expected to be met to demonstrate that the health and safety of members of the public and workers at the facility will be protected for the operational conditions described within RG 1.143 Table 2 “Natural Phenomena and Internal/External Man-Induced Hazard Design Criteria for Safety Classification” and Table 3 “Design Load Combinations.”
- R09 “As-Built Inspection and Analysis Containment High Range Radiation Monitor – Location,” checks that either the radiation monitors were installed in the location described, and no obstructions to the view of the radiation monitor(s) were added to the design, or if the design specified a percent of the containment atmosphere free volume view for each radiation monitor, that the radiation monitors have been installed in a location and manner that provides for appropriate monitoring of the containment radiation levels following an accident.

Key Issue

DCD Tier 1 Revision 0 Chapter 1 “Certified Design Descriptions and Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC),” subsection 3.12 “Radioactive Waste Building,” does not contain ITAAC corresponding to R07, with respect to verifying that the SSCs containing radioactive waste were designed and constructed, consistent with the guidance contained within RG 1.143 provided for demonstrating compliance with the provisions of 10 CFR Part 20 related to the protection of the health and safety of members of the public and protection of occupational radiation workers.

Question

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions regarding the ITAAC for ensuring that the radioactive waste SSCs have been designed and constructed in a manner that protects the health and safety of the public and the occupational workers, the staff requests that the applicant:

- Justify/explain the basis for not including an ITAAC for verifying that the radioactive waste

SSCs are design and constructed in accordance with the aforementioned guidance,

- As necessary, revised section DCD Tier 1 Section 3.12, to describe the ITAAC for verifying that the radioactive waste SSCs are design and constructed in accordance with the aforementioned guidance,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

As detailed below, the NuScale application contains ITAAC for top-level design features related to shielding to ensure the health and safety of workers in the Radwaste Building, as well as ITAAC for top-level radiation protection design features in the following systems that protect the health and safety of the public.

- Radwaste Building (RWB)
- Reactor Building Heating Ventilation and Air Conditioning System (RBVS)
- Liquid radwaste system (LRWS)
- Gaseous Radwaste System (GRWS)

ITAAC identified below in Tier 1 Table 3.12-2 that verifies Radwaste Building shielding is installed to *protect the health and safety of workers*.

ITAAC No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
03.12.01	The RWB includes radiation shielding barriers for normal operation and post-accident radiation shielding.	An inspection will be performed of the as-built RWB radiation shielding barriers.	The thickness of RWB radiation shielding barriers is greater than or equal to the required thickness specified in Table 3.12-1.
03.12.02	The RWB includes radiation attenuating doors for normal operation and for post-accident radiation shielding. These doors have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed.	An inspection will be performed of the as-built RWB radiation attenuating doors.	The RWB radiation attenuating doors are installed in their design location and have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed in accordance with the approved door schedule design.

ITAAC identified below in Tier 1 Table 3.12-2 that verifies the Radwaste Building will maintain its structural integrity under design basis loads to *protect the health and safety of the public*.

ITAAC No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
03.12.03	The RWB is an RW-IIa structure and maintains its structural integrity under the design basis loads.	An inspection and analysis will be performed of the as-built RW-IIa RWB.	A design report exists and concludes that the deviations between the drawings used for construction and the as-built RW-IIa RWB have been reconciled and that the as-built RW-IIa RWB maintains its structural integrity under the design basis loads.

ITAAC identified below in Tier 1 Table 3.3-1 that verifies the Radwaste Building can be operated at a negative pressure relative to the outside environment to *protect the health and safety of the public*.

ITAAC No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
03.03.02	The RBVS maintains a negative pressure in the RWB relative to the outside environment	A test will be performed of the RBVS while operating in the normal operating alignment.	The RBVS maintains a negative pressure in the RWB relative to the outside environment, while operating in the normal operating alignment.

ITAAC identified below in Tier 1 Table 3.9-2 that verifies that high-radiation effluent from the Liquid Radwaste System (LRWS) will be isolated from the environment to *protect the health and safety of the public*.

ITAAC No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
03.09.07	The LRWS automatically responds to a high-radiation signal from 00-LRW-RIT-0569 and 00-LRW-RIT-0571 to mitigate a release of radioactivity.	A test will be performed of the LRWS high-radiation signals.	Upon initiation of a real or simulated LRWS high-radiation signals listed in Table 3.9-1, the LRWS automatically aligns/actuates the identified components to the positions identified in the table.

ITAAC identified below in Tier 1 Table 3.9-2 that verifies that high-radiation effluent from the Gaseous Radwaste System (GRWS) will be isolated from the environment to *protect the health and safety of the public.*

ITAAC No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
03.09.04	The GRWS automatically responds to a high-radiation signal from 00-GRWRIT-0046 to mitigate a release of radioactivity.	A test will be performed of the GRWS high-radiation signals.	Upon initiation of a real or simulated GRWS high-radiation signals listed in Table 3.9-1, the GRWS automatically aligns/actuates the identified components to the positions identified in the table.
03.09.05	The GRWS automatically responds to a high-radiation signal from 00-GRWRIT-0060 to mitigate a release of radioactivity.	A test will be performed of the GRWS high-radiation signals	Upon initiation of a real or simulated GRWS high-radiation signals listed in Table 3.9-1, the GRWS automatically aligns/actuates the identified components to the positions identified in the table.
03.09.06	The GRWS automatically responds to a high-radiation signal from 00-GRWRIT-0071 to mitigate a release of radioactivity.	A test will be performed of the GRWS high-radiation signals.	Upon initiation of a real or simulated GRWS high-radiation signals listed in Table 3.9-1, the GRWS automatically aligns/actuates the identified components to the positions identified in the table.

In summary, separate ITAAC for verifying that the NuScale radioactive waste systems are designed and constructed in accordance with RG 1.143, Design Guidance For Radioactive Waste Management Systems, Structures, And Components Installed In Light-Water-Cooled Nuclear Power Plants, are unnecessary for the following reasons:

- The NuScale radioactive waste systems do not have any safety-related or risk-significant functions.
- The NuScale radioactive waste systems do not support the safety or risk-significant functions of another system.
- The radioactive waste systems do not contain top-level design features, as described in FSAR Section 14.3.2.1.1, for shielding that protects the health and safety of workers.
- The health and safety of the public is protected by ITAAC that ensure high radiation will be contained within the RWB. The related ITAAC verifies the following top-level design features:

- High radiation liquid in the LRWS is automatically isolated from the environment by containing the liquid in the LRWS.
- High radiation gas in the GRWS is automatically isolated from the environment by containing the gas in the GRWS.
- High radiation gas in the RWB is contained and precluded from leakage to the outside environment by keeping the RWB pressure negative relative to the outside environment.
- The as-built RW-IIa RWB maintains its structural integrity under the design basis loads.

Impact on DCA:

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

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

eRAI No.: 9303
Date of RAI Issue: 04/02/2018

NRC Question No.: 12.03-53

The Regulatory Basis and Background are in Question 12.03-52 above.

Key Issue

DCD Tier 1 Revision 0 Chapter 1 “Certified Design Descriptions and Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC),” subsection 3.9 “Radiation Monitoring - NuScale Power Modules 1 – 12,” does not contain ITAAC corresponding to R09, with respect to verifying that the containment high range radiation monitors installed consistent with the intent of 10 CFR 50.34(f)(2)(vii).

Question

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions regarding the adequacy of the ITAAC for the containment high range radiation monitor, the staff requests that the applicant:

- Justify/explain the basis for not including an ITAAC for the containment high range radiation monitor,
- As necessary, revised section DCD Tier 1 Section 3.9, to include the ITAAC for the containment high range radiation monitor,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

Tier 2, Table 1.9-5: Conformance with TMI Requirements (10 CFR 50.34(f)) and Generic Issues (NUREG-0933), indicates that the NuScale design conforms to 50.34(f)(2)(vii) which requires the NuScale design to perform radiation and shielding design reviews of spaces around systems that may, as a result of an accident, contain accident source term radioactive materials, and design as necessary to permit adequate access (II.B.2).

NuScale design conforms to 50.34(f)(2)(vii) without requiring a containment high radiation monitor as presented below.

Tier 2, Section 12.2.1.13, Post Accident Sources, discusses how primary coolant inventory can be released into the bioshield envelope during accident conditions. Tier 2, Section 12.4.1.8 Post-Accident Actions states that one of the primary means to detect and monitor fuel damage are radiation monitors located under the NPM bioshield which surrounds the top of the containment vessel.

Tier 2, Table 7.1-7: Summary of Type A, B, C, D, and E Variables identifies the Inside Bioshield Area Radiation Monitor which monitors activity inside the bioshield envelope. The Inside Bioshield Area Radiation Monitor is a Type B and C monitor.

Tier 2, Section 7.2.13.6, Three Mile Island Action Items, states that the Safety Display and Information System (SDIS) conforms to 10 CFR 50.34(f)(2)(iv) by providing the capability to display the Type B and Type C variables identified in Table 7.1-7 over anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions. Thus, the inside bioshield area radiation monitor is required to be displayed in the SDIS module-specific panels in the main control room.

Tier 1, Table 2.5-7: Module Protection System and Safety Display and Indication System Inspections,Tests, Analysis, and Acceptance Criteria contains ITAAC 02.05.25 (item number 25 in the table). The design commitment for ITAAC 02.05.25 stipulates that “The PAM Type B and Type C displays are indicated on the SDIS displays in the MCR”, and the ITAAC acceptance criteria is “The PAM Type B and Type C displays listed in Table 2.5-5 are retrieved and displayed on the SDIS displays in the MCR.” Tier 1, Table 2.5-5: Safety Display and Indication System Accident Monitoring Variables contains the inside bioshield area radiation monitor.

Thus, ITAAC 02.05.25 requires that the NuScale initial test program verify that the inside bioshield area radiation monitor is displayed on SDIS displays in the MCR.

Impact on DCA:

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

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eRAI No.: 9303
Date of RAI Issue: 04/02/2018

NRC Question No.: 12.03-54

The Regulatory Basis and Background are in Question 12.03-52 above.

<u>Key Issue</u>

The Acceptance Criteria of DSRS Section 12.3-12.4, “Radiation Protection Design Features,” states 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), methods are in place to ensure that ORE remains ALARA, and the equipment exposures are maintained in accordance with the provisions of 10 CFR 50.49 should be specified. It further states that the application should identify 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.

DCD 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. However, DCD Tier 2 Revision 0 Section 12.3.2, “Shielding,” does not identify any areas of the plant shielding (e.g., penetration shielding around hot pipes,) that have limitations associated with the shielding material or for which specific design criteria (e.g., maximum temperature, radiation resistance etc.,) are required for the integrity of the shielding to be maintained.

DCD Tier 1 Section 3.11, ”Reactor Building,” states that the RXB includes radiation shielding barriers for normal operation and post-accident radiation shielding. It further states that DCD Tier 1 Table 3.11-2, “Reactor Building Inspections, Tests, Analyses, and Acceptance Criteria,” contains the inspections, tests, and analyses for the RXB. DCD Tier 1 Section 3.12, ”Radioactive Waste Building,” states that the RWB includes radiation shielding barriers for normal operation and post-accident radiation shielding. It further states that that DCD Tier 1 Table 3.12-2: “Radioactive Waste Building ITAAC” contains the inspections, tests, and analyses for the RWB. However, neither DCD Tier 1 Section 3.11 nor DCD Tier 1 Section 3.12, describe ITAAC provided for verification of the design features (e.g., minimum air flow rate around hot pipes to prevent degradation of concrete, minimum spacing between hot pipes and structural components provided to prevent degradation of materials,) provided to ensure the continued integrity of the radiation shielding. Since routine tests or inspections of shielding material are not capable of assessing the degradation (e.g., dehydration of concrete due to high temperature) of the shielding material that may adversely impact its ability to perform under design basis conditions (i.e., accident or AOO source terms following design basis events, such as earth quakes,) provision and function of design features for protection of shielding are important for ensuring the continued integrity of the shielding.

<u>Question</u>

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions regarding the adequacy of the design features for ensuring the continued integrity of the radiation shielding, the staff requests that the applicant:

- Justify/explain the basis for not including an ITAAC for the inspecting design features provided for protecting the integrity of radiation shielding,
- As necessary, revised section DCD Tier 1 Section 3.11 and section DCD Tier 1 Section 3.912, to include the ITAAC for inspecting design features provided for protecting the integrity of radiation shielding,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

As identified in Tier 1, Table 3.11-2, ITAAC 03.11.04 verifies that the as-built Reactor Building shielding thickness is greater than or equal to its design thickness.

ITAAC No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
03.11.04	The RXB includes radiation shielding barriers for normal operation and post-accident radiation shielding.	An inspection will be performed of the as-built RXB radiation shielding barriers.	The thickness of RXB radiation shielding barriers is greater than or equal to the required thickness specified in Table 3.11-1.

Radiation shielding is a nonsafety-related, non risk-significant design feature. The Reactor Building radiation shielding has an ITAAC because the design feature meets ITAAC first principles, i.e. the radiation shielding ensures the health and safety of workers in the Reactor Building. Protective features for radiation shielding are nonsafety-related, non risk-significant design features that do not meet first principles for inclusion in Tier 1.

Impact on DCA:

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