RAIO-0518-60157

May 23, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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11555 Rockville Pike
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 405 (eRAI No. 9277) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 405 (eRAI No. 9277)," 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. 9277:

- 12.03-48
- 12.03-49
- 12.03-50
- 12.03-51

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,

Zackary W. Rad
Director, Regulatory Affairs
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9277

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9277

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

eRAI No.: 9277
Date of RAI Issue: 04/02/2018

NRC Question No.: 12.03-48

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 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 52.47(a)(22) requires applicants to provided information necessary to demonstrate how operating experience insights have been incorporated into the plant design.

10 CFR 20.1204 requires that summation of and protection from radiation exposure consider both external and internal sources of radiation.

10 CFR 20.1101(b) states that "the licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA)." 10 CFR 20.1003 states that ALARA "means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest." 10 CFR 20.1406(b) states, in part, that "applicants for standard design certifications . . . shall describe in the application how facility design will minimize, to the extent practicable, contamination of the facility and the environment." 10 CFR 20.1701 states that "the licensee shall use, to the extent practical, process or other engineering controls (e.g., containment, decontamination, or ventilation) to control the concentration of radioactive material in air."

The Acceptance Criteria provided in NuScale DSRS section 12.3, "Radiation Protection Design Feature," provides guidance to the staff for evaluating the potential for airborne radioactivity areas within the facility.

The acceptance criteria of NuScale DSRS Section 12.3-12.4, "Radiation Protection Design Features," state 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

DCD Revision 0 Tier 2 Subsection 12.3.1.1.7, "Ventilation," states that the duct air velocity is kept at sufficiently high velocities to keep particulates suspended. DCD Subsection 12.3.3.2, "Design Features to Minimize Personnel Exposure from Heating Ventilation and Air Conditioning Equipment," states that ventilation ducts are designed to minimize the buildup of radioactive contamination within the ducts, and the duct air velocity is kept at sufficiently high velocities to keep particulates suspended. DCD Subsection 12.3.3, "Ventilation," states that the plant heating, ventilating, and air-conditioning (HVAC) systems are designed to provide a controlled environment for personnel and equipment during normal operation. In areas subject to airborne activity, the ventilation systems are designed to collect, process, and exhaust airborne radioactive material, including directing airflow to processed exhausts. DCD Subsection 12.3.3.2, "Design Features to Minimize Personnel Exposure from Heating Ventilation and Air Conditioning Equipment," states that the building ventilation systems are designed to maintain an air flow inside the building from areas of low airborne potential to areas of higher airborne potential.

DCD Tier 2 Subsection 9.4.2.2.1. "Component Description," states that ducting interior and exterior surfaces have relatively smooth finishes to reduce localized collection of radioactive contamination. The lengths of ducting runs are minimized, as are abrupt changes in direction.

Key Issue

Neither DCD Chapter 9 nor DCD Chapter 12 provided any additional specific information regarding physical parameters of the HVAC systems in the Reactor Building (RXB) or Radioactive Waste Building (RWB). DCD Section 9.4 states that ductwork, supports, and accessories meet the design and construction requirements of the industry standards listed below. The design and construction requirements of these industry standards, address the functional requirements needed to maintain airborne radioactive materials suspended in the ducts air, and to maintain local air flow rates that are needed to sweep air from areas of lower contamination to higher contamination:

- Sheet Metal and Air Conditioning Contractors' National Association "HVAC Systems - Testing, Adjusting and Balancing," SMACNA 1780, Third Edition, 2002, Chantilly, Virginia.
- Sheet Metal and Air Conditioning Contractors' National Association "Rectangular Industrial

Duct Construction Standards," SMACNA 1922, Second Edition, 2004, Chantilly, Virginia.
- Sheet Metal and Air Conditioning Contractors' National Association "Round Industrial Duct Construction Standards," SMACNA 1520, Second Edition,1999, Chantilly, Virginia.
- Sheet Metal and Air Conditioning Contractors' National Association, "HVAC Duct Construction Standards - Metal and Flexible," SMACNA 1966, Third Edition, 2005, Chantilly, Virginia.

Also, there is no discussion about the design features (e.g., flow balancing dampers) provided to support establishing the required flowrates, and the application does not contain any information, such as minimum and maximum ventilation flow rates or minimum or maximum allowable differential building pressure, required to maintain flow conditions within the criteria specified in the referenced standards.

Question

To facilitate staff understanding of the application information in support of its reasonable assurance review regarding the radiation protection design features of the HVAC systems in the RXB and RWB, the staff requests that the applicant:

- Justify/explain the controlling parameter, including the associated methods, models and assumptions, needed to maintain radiological conditions within the RWB and RXB,
- As necessary, revise DCD Section 12.3 to include the relevant assumptions and design parameters discussed above,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

HVAC system details are not finalized and therefore not described in the Design Certification Application to the level of detail requested by this RAI.

However, the primary design basis and therefore the controlling parameter for the reactor and radwaste building HVAC is documented in Tier 1 Section 3.3, Reactor Building Heating Ventilation and Air Conditioning System, which includes a design commitment to maintain a negative pressure in the Reactor Building and Radioactive Waste Building relative to the outside environment.

Compliance with this design commitment is further described by Table 3.3-1: Reactor Building Heating Ventilation and Air Conditioning System Inspections, Tests, Analyses, and Acceptance Criteria.

In addition to negative pressure, the system is a once-through design that flows from areas of lesser contamination to greater contamination with a minimum of 0.5 air changes per hour and greater for areas considered most likely to become contaminated in the Reactor Building (see FSAR Section 9.4.2.2 and Table 9.4.2-5) and a minimum of 2 air changes per hour in the Radioactive Waste Building (see FSAR Section 9.4.3.2.2.1).

As pointed out in the RAI, the FSAR commits to following the relevant industry standards that address design, construction, and functional requirements.

FSAR Section 9.4.2.2.1, Component Description, states that the supply and exhaust ducting has balancing dampers that are manually set when the system is initially tested and balanced.

The Initial Test Program consists of a series of preoperational and startup tests described in FSAR Table 14.2-20: Reactor Building HVAC System Test # 20 and Table 14.2-21: Radioactive Waste Building HVAC System Test # 21.

COL Item 9.4-2 requires the COL applicant that references the design certification to specify periodic testing and inspection requirements for the Reactor Building heating ventilation and air conditioning system in accordance with Regulatory Guide 1.140.

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.: 9277
Date of RAI Issue: 04/02/2018

NRC Question No.: 12.03-49

The Regulatory Basis and Background are in Question 12.03-48 above.

Key Issue

DCD Section 9.4.2.4 "Inspection and Testing," states that a system air balance test and adjustment to design conditions is conducted in the course of the plant preoperational test program using the SMACNA documents referenced in the application. Neither DCD Tier 2 Revision 0 Table 14.2-96, "Reactor Building Ventilation System (RBVS) Capability (Test #96)," nor DCD Table 14.2-20, "Reactor Building HVAC System Test # 20," includes any test parameters or criteria related to the radiation protection design functions (e.g., sufficient flow rate to prevent settling in ducts, sufficient air flow rate to ensure sweeping radioactive material from areas of low contamination to areas of higher contamination) for the RXB HVAC system, as described in the SMACNA documents referenced in the application.

Question

To facilitate staff understanding of the application information in support of its reasonable assurance review regarding the radiation protection design features (i.e., design flow rates) of the HVAC systems in the RXB, the staff requests that the applicant:

- Justify/explain the methods for testing the radiation protection design features of the RXB HVAC systems that supports the functional requirements stated in the DCD,
- As necessary, revise DCD Section 14.2 to include the relevant testing discussed above,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

The Reactor Building HVAC system (RBVS) design flow requirements and design differential

pressure requirements are established by design documents to satisfy the associated design requirements. Air flow requirements will ensure that exhaust air from areas that have a higher potential for contamination will be designed to create room air movement from areas of lower potential contamination to higher potential for contamination to aid in contamination containment.

The RBVS design air flow requirements and differential pressure requirements are verified by the conduct of an RBVS air flow balance to verify design flow rates and design differential pressures are established in the reactor building during normal and off-normal operation when the RBVS and the Radwaste Building HVAC system (RWBVS) are placed in automatic operation.

Tier 2 Section 9.4.2 Reactor Building and Spent Fuel Pool Area Ventilation System, contains subsection Section 9.4.2.4 Inspection and Testing which states the following:

> "*A system air balance test and adjustment to design conditions is conducted in the course of the plant preoperational test program (Section 14.2). Airflow rates are measured and balanced in accordance with the guidelines of SMACNA HVAC Systems Testing, Adjusting and Balancing (Reference 9.4.2-13).*"

In system level test #20-1, the RWBVS and the RBVS are placed in automatic control to establish the design flows and design differential pressures established in the RBVS air balance test during normal operation. Reactor Building (RXB) temperature, humidity and differential pressure data is then taken to confirm that these variables satisfy the following Test #20-1 test acceptance criteria.

i. The temperature and humidity of rooms and areas monitored by the MCR satisfy the design temperature and humidity requirements contained in Table 9.4.2-2.

ii. MCR display indicates the RBVS maintains a negative pressure in the RXB relative to the outside environment while operating in the normal operating alignment.

Note that the differential pressure acceptance criteria are a re-verification of a portion of the RBVS air balance.

Thus, the conduct of RBVS air balance and the conduct of RBVS system level test #20-1 verify that the RBVS maintains design flow rates, design temperatures, design humidity and design differential pressure while operating in automatic control during normal operation.

In system level test #20-3, the RWBVS and RBVS are placed in automatic control to establish the design flows and design differential pressures established in the RBVS air balance test during normal operation. A Hi-Hi radiation signal in the spent fuel pool exhaust upstream of the spent fuel pool charcoal filter units is simulated. The realignment of the RBVS is verified and negative pressure in the RXB and RWB relative to the outside environment while the RBVS is

operating in the off- normal alignment is verified.

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.: 9277
Date of RAI Issue: 04/02/2018

NRC Question No.: 12.03-50

The Regulatory Basis and Background are in Question 12.03-48 above.

Key Issue

DCD Tier 2 Revision 0 Table 14.2, does not contain adequate tests of the radiation protection design functions described above, of the HVAC system in the RWB.DCD Tier 2 Revision 0 Table 14.2, does not contain testing of the RWB ventilation system that includes testing parameters or criteria related to ensuring the functionality of the radiation protection design features of the RWB Ventilation system. There do not appear to be tests that verify functional requirements are met, such as, testing that the RWBS maintains the design environment for SSCs in the RWB (e.g., air flow from areas of low contamination to high contamination,) checking that sufficient flow rates exist in the ducting to prevent settling of radioactive material in the duct, testing that negative pressure with respect to adjacent areas inside of the facility is maintained, verifying that adequate ventilation of areas that may contain explosive/flammable gases, etc.).

Question

To facilitate staff understanding of the application information in support of its reasonable assurance review regarding the radiation protection design features (i.e., design flow rates) of the HVAC systems in the RWB, the staff requests that the applicant:

- Justify/explain the methods for testing the radiation protection design features of the HVAC systems that supports the functional requirements stated in the DCD,
- As necessary, revise DCD Section 14.2 to include the relevant testing of the RWB HVAC system discussed above,

  OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

The Radioactive Waste Building (RWB) HVAC system (RWBVS) design flow requirements and design differential pressure requirements are established by design documents to satisfy the associated design requirements. Air flow requirements that exhaust air from areas that have a higher potential for contamination are designed to create room air movement from areas of lower potential for contamination to higher potential for contamination to aid in contamination containment.

As stated in Tier 2 Section 9.4.3, Radioactive Waste Building Ventilation the design of the RWBS satisfies the following:

> "The Radioactive Waste Building HVAC system (RWBVS) supports personnel access and equipment functions by maintaining a suitable operating environment in the Radioactive Waste Building (RWB), including the RWB control and monitoring room. The RWBVS also supports the control of radioactive contamination by maintaining airflow from areas of lesser potential contamination to areas of greater potential contamination, maintaining the RWB at a negative pressure with respect to the outside atmosphere, and collecting potentially contaminated discharges vented from equipment in the RWB."

Section 9.4.3.4, Radioactive Waste Building Ventilation, Inspection and Testing, states the following:

> "*A system air balance test and adjustment to design conditions is conducted in the course of the plant preoperational test program (Section 14.2). Airflow rates are measured and balanced in accordance with the guidelines of SMACNA HVAC systems - Testing, Adjusting and Balancing (Reference 9.4.3-13)*."

Prior to conducting Radioactive Waste Building HVAC System Test # 21 the following prerequisite is verified.

> "*ii. Verify an RWBVS air balance has been performed and the RWBVS air balance records have been approved. [This prerequisite is not required for component-level tests.*]"

The RWBVS air balance test verifies design flows and design differential pressures in the Radwaste Building when the RWBVS is placed in automatic operation.

In system level test #21-1, the RWBVS and RBVS are placed in automatic control to establish the design flows and design differential pressures established in the RWBVS air balance test. RWB temperature, humidity and differential pressure data is then taken to confirm that these variables satisfy the following Test #21-1 test acceptance criteria.

i. The temperature and humidity of rooms and areas monitored by the MCR satisfy the design temperature and humidity requirements contained in FSAR Table 9.4.1-2.

ii. MCR display indicates the RWBVS maintains a negative pressure in the RWB relative to the outside environment while operating in the normal operating alignment.

Note that the differential pressure acceptance criteria are a re-verification of a portion of the RWBVS air balance.

Thus, the conduct of RWBVS air balance and the conduct of RWBVS system level test #21-1 verify that the RWBVS maintains design flow rates, design temperatures, design humidity and design differential pressure while operating in automatic control.

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.: 9277
Date of RAI Issue: 04/02/2018

NRC Question No.: 12.03-51

The Regulatory Basis and Background are in Question 12.03-48 above

Key Issue

Neither DCD Tier 2 Revision 0 Table 14.2-96, "Reactor Building Ventilation System (RBVS) Capability (Test #96)," nor DCD Table 14.2-20, "Reactor Building HVAC System Test # 20," includes any test parameters or criteria related to the radiation protection design functions described (e.g., variable speed controller operation for normal HVAC operation, and variable speed controllers following a high radiation signal, and operation of the SFP and dry dock ventilation dampers) as described in the following.

DCD Tier 2 Revision 0 Subsection 9.4.2.2.1, "Component Description," states that the cooling and heating of the ventilation air serving the RXB is provided by four air handling units (AHU) with variable speed supply air fans. DCD Subsection 9.4.2.2.2.2, "Off-normal Operation," states that on a high radiation alarm in spent fuel pool (SFP) area, the isolation damper of the RXB general exhaust from the dry dock area and SFP area is closed and supply fans reduce capacity to accommodate the reduction in exhaust. This change in supply air flow ensures that air in other areas of the RXB continues to flow from areas of low contamination to areas of potentially higher contamination, and exhaust from the RWB and annex building (ANB) continues to flow into the RBVS exhaust.

Question

To facilitate staff understanding of the application information in support of its reasonable assurance review regarding the radiation protection design features of the HVAC systems in the RXB (e.g., the ability of the variable speed controllers to maintain the required differential pressures for normal HVAC operation, and variable speed controllers following a high radiation signal, and operation of the SFP and dry dock ventilation dampers), the staff requests that the applicant:

- Justify/explain the methods for testing the radiation protection design features of the HVAC systems that supports the functional requirements stated in the DCD Subsection 9.4.2.2,

- As necessary, revise DCD Section 14.2 to include the relevant testing of the RXB HVAC system discussed above,

  OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

The Plant Control System (PCS) controls the Reactor Building HVAC System (RBVS) as shown in FSAR Figure 7.0-20: Plant Control System Internal Functions and External Interfaces. Therefore, the PCS controls the speed of the RBVS variable speed fans in both normal and off-normal operation.

The PCS is described in Section 7.0.4.6. The testing of the PCS system is described in Section 7.2.1.2.8 Software Integration and Testing. The site acceptance testing of the PCS demonstrates that the installed system performs in accordance with the system design basis. The NuScale Digital I&C Software Master Test Plan governs the generation of the Site Acceptance Test Report.

RBVS component level test vii. verifies that the fan speed of each RBVS variable-speed fan can be manually controlled from minimum to maximum speed.

RBVS system level tests #20-1 verifies that the RBVS maintains design flow rates from the RBVS fans and design differential pressure is maintained while the RBVS is operating in automatic control during normal operation.

In system level test #20-3, the RWBVS and RBVS are placed in automatic control to establish the design flows and design differential pressures established in the RBVS air balance test during normal operation. A Hi-Hi radiation signal in the spent fuel pool exhaust upstream of the spent fuel pool charcoal filter units is simulated. The realignment of the RBVS is verified and negative pressure in the RXB and RWB, relative to the outside environment while the RBVS is operating in the off-normal alignment, is verified.

Impact on DCA:

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