RAIO-0218-58884

February 27, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 326 (eRAI No. 9266) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 326 (eRAI No. 9266)," dated January 08, 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. 9266:

- 12.02-12
- 12.02-13

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. 9266

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9266

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

eRAI No.: 9266
Date of RAI Issue: 01/08/2018

NRC Question No.: 12.02-12

Regulatory Basis

10 CFR 52.47(a)(5) requires applicants to identify the kinds and quantities of radioactive materials expected to be produced during operation and the means for controlling and limiting radiation exposures within the limits set forth in 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 20 as is practical. The requirements of 10 CFR 20.1204, “Determination of Internal Exposure”; 10 CFR 20.1701, “Use of Process or Other Engineering Controls”; and 10 CFR 20.1702, “Use of Other Controls,” specify the use of design features such as the use of ventilation for controlling the intake of radioactive materials. NuScale DSRS section 12.2, “Radiation Source,” regarding the identification of isotopes and the methods, models and assumptions used to determine dose rates. 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.

Background

NuScale Design Control Document (DCD) Tier 2 Revision 0, Subsection 12.2.2.1, “Reactor Building Atmosphere,” states that airborne radioactivity may be present in the RXB atmosphere due to reactor pool evaporation or primary coolant leakage. The airborne concentration is modeled as a buildup to an equilibrium concentration given the production and removal rate. The airborne concentration in the air space above the reactor pool is determined by using the peak reactor pool water source term. The input parameters are listed in Table 12.2-32 “Input Parameters for Determining Facility Airborne Concentrations.” DCD Table 12.2-32 lists the pool evaporation rate at 1705 lbm/hour.

Based on information made available to the staff during the RPAC Chapter 12 Audit, the staff determined that the stated evaporation rate was based on assumed air flow rates over the pool surface, and an assumed temperature of the ultimate heat sink (UHS) water. The staff determined that the NuScale Technical Specifications 3.5.3, “Ultimate Heat Sink,” bulk average

temperature limit of 140 ºF was significantly greater than the temperature assumed for determining the evaporation rate. As the pool temperature increases, the pool evaporation rate increases. The assumed pool temperature is not listed in DCD Table 12.2-32.

As stated, the assumed evaporation rate is based on an assumed air flow rate over the pool surface, however, this value is not listed in DCD Table 12.2-32. Also, based on information made available to the staff during the RPAC Chapter 12 Audit, the staff was not able to ascertain the bases of the assumed air flow rate above the UHS pool. It is not clear to the staff what conditions (e.g., ventilation supply and exhaust flow rates etc.) are assumed in order to meet the stated flow conditions.

Based on information made available to the staff during the RPAC Chapter 12 Audit, the staff also noted that the atmospheric conditions (e.g., temperature and humidity) inside of the RXB were inputs to the methodology used by the applicant to determine the evaporation rates. The staff reviewed DCD Section 9.4, “Air Conditioning, Heating, Cooling, and Ventilation Systems,” and DCD Section 9.4.2, “Reactor Building and Spent Fuel Pool Area Ventilation System,” and was unable to find any reference to the conditions used to establish the assumed evaporation rate.

Key Issue 1:

The DCD does not contain the information necessary for the staff to perform their evaluation of airborne activity as stated above.

Question 1:

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:

- Revise, as necessary, DCD Table 12.2-32 to include all of the parameters needed to calculate the RXB airborne tritium, and other radionuclide concentrations,
- As necessary revise DCD Sections 9.4.2 and DCD Section 12.2.1.8 to describe the bases for the assumed pool air flow rate,
- As necessary revise DCD Sections 9.4.2 to describe the design features provided for maintaining the required air flow rate over the pool,
- As necessary, revise DCD 12.2.1.8 to describe how this value is to be assessed,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

10 CFR 20.1101(b) and 10 CFR 20.1003 allow the use of both procedures and engineering controls to maintain exposures to radiation as far below the dose limits in 10 CFR Part 20 as is

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practical. As in the case of operating licensed nuclear power plants and previously NRC-approved design certification applications, the facility's design features work in concert with the radiation protection programs and procedures to comply with this regulation. Operational procedures are frequently relied upon to comply with regulations.

The calculated airborne activity in the airspace above the reactor pool water is based on an evaporation rate from the reactor pool while the pool water temperature is at the design basis temperature for the Reactor Building HVAC (RBV) system, which is 100°F. Above this temperature, the RBV system may be unable to adequately cool the Reactor Building atmosphere, thereby potentially resulting in compensatory measures, such as increasing pool heat removal via the pool cooling systems, to return the pool water temperature below 100°F. As always, the radiation protection programs would also employ the necessary measures to ensure radiation exposures are as low as reasonably achievable, and in compliance with regulations.

The RBVS was designed to operate and accommodate pool water temperatures (for extended periods of time) at, or less than, 100°F. The pool water evaporation rate at 100°F is calculated using the 2007 ASHRAE Handbook Applications Manual, Chapter 4, equation 1.

$$w_p = \frac{A}{Y} (p_w - p_a)(95 + 0.425V)$$

where:

w_p = evaporation rate

A = area of pool surface

Y = latent heat of evaporation

p_w = saturation vapor pressure of water

p_a = saturation pressure at room air dew point

V = air velocity over water surface

The inputs to this equation include the surface area of the pool surface, and the air velocity over the water surface. Air conditions over the pool are assumed to be the midpoint between the

RBV supply air condition and final room air condition, when plotted on the psychrometric chart.

The NuScale engineering calculations are available for NRC audit.

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.: 9266
Date of RAI Issue: 01/08/2018

NRC Question No.: 12.02-13

The Regulatory Basis and Background are in RAI-9266 Question 30992

Key Issue 2:

Because the methodology used by the applicant to calculate the evaporation rate from the UHS pool water appears to use non- bounding values, it may underestimate the total evaporation of tritium and other radionuclides from the UHS pool water. Since airborne concentrations in the RXB are directly dependent on the UHS pool evaporation rate, the airborne activity concentrations in the RXB may be underestimated. The concentrations described in Chapter 12.2 for the RXB are for the purpose of radiation protection, and should be based on appropriately conservative assumptions (e.g., UHS bulk average temperature at 140 ºF). Other related parameters should be based on assumed bounding values, and the basis for those assumptions should be clearly stated.

Question 2:

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:

- Establish bounding values to be used for determining radiation protection airborne concentrations in the RXB resulting from UHS pool evaporation.
- Using the bounding values, calculate the evaporation rate, and the subsequent RXB airborne activity concentration calculations,
- As necessary, revise DCD Section 12.2.1.8 to include a description of the revised methodology, that reflect the assumptions related to the evaporation rate from the pool,
- As necessary, revise DCD Section 12.2.2, “Airborne Radioactive Material Sources,” to include a description of the revised methodology, that reflect the assumptions related to the evaporation rate from the pool,
- As necessary, revise DCD Section 12.2.2 to clearly state the bounding assumptions for maintaining RXB airborne concentration limits within the limits of 10 CFR Part 20,
- As necessary, revise DCD Table 12.2-10, DCD Table 12.2-32 and DCD Table 12.2-33 to reflect the changes in UHS pool and RXB airborne tritium and other radionuclide concentrations establishing the bounding conditions for pool evaporation,

- As necessary, revise DCD Section 9.4.2 to clearly identify that the ventilation flow rate, the RXB air temperature and the RXB are key inputs to the RXB airborne activity concentrations,

OR

Provide the specific alternative approaches used and the associated justification.

NuScale Response:

10 CFR 20.1101(b) and 10 CFR 20.1003 allow the use of both procedures and engineering controls to maintain exposures to radiation as far below the dose limits in 10 CFR Part 20 as is practical. As in the case of operating licensed nuclear power plants and previously NRC-approved design certification applications, the facility's design features work in concert with the radiation protection programs and procedures to comply with this regulation. Operational procedures are frequently relied upon to comply with regulations.

The analyses performed by NuScale that provide radiation protection related information in the FSAR is appropriately conservative and provides a reasonable and sound basis for the design of various radiation protection design features. The conservatism of the NuScale Reactor Building airborne concentration analysis is demonstrated by assuming twelve reactor modules are simultaneously operating at the design basis fuel failure for two years and by assuming the pool water is at the peak concentration following a refueling outage, while still ensuring that airborne concentrations are less that 10% of a derived airborne concentration (DAC). There is no regulatory requirement that these analyses, provided for radiation protection purposes, be bounding. Plant airborne radiological conditions will be addressed by plant personnel using the radiation protection procedures and programs to ensure continued compliance with regulations.

The calculated airborne activity in the airspace above the reactor pool water is also based on an evaporation rate from the reactor pool while the pool water temperature is at the design basis temperature (100°F) for the Reactor Building HVAC (RBV) system, which is a non-safety, non-risk significant system. The pool water temperature assumed as an input to the design basis NuScale Power Module accident safety analyses is conservatively set at 140°F, demonstrating a margin of safety of the NPM design. Therefore, the upper limit of the pool water temperature in the technical specifications is 140°F. This is intended to ensure the health and safety of the public. Therefore, the current NuScale airborne concentration analysis is appropriate to demonstrate plant personnel protection, using both design features and procedures.

Impact on DCA:

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