NuScaleDCRaisPEm Resource

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Sent:	Tuesday, January 09, 2018 3:21 PM
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Cc:	NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Dudek, Michael; Lavera, Ronald; Markley, Anthony
Subject:	Request for Additional Information No. 331 RAI No. 9270 (12.2)
Attachments:	Request for Additional Information No. 329 (eRAI No. 9270).pdf

Attached please find NRC staff's request for additional information concerning review of the NuScale Design Certification Application.

Please submit your technically correct and complete response within 60 days of the date of this RAI to the NRC Document Control Desk.
The NRC Staff recognizes that NuScale has preliminarily identified that the response to one or more questions in this RAI is likely to require greater than 60 days. NuScale is expected to provide a schedule for the RAI response by email within 14 days.

If you have any questions, please contact me.

Thank you.

Gregory Cranston, Senior Project Manager
Licensing Branch 1 (NuScale)
Division of New Reactor Licensing
Office of New Reactors
U.S. Nuclear Regulatory Commission
301-415-0546

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Request for Additional Information No. 329 (eRAI No. 9270)

Issue Date: 01/08/2018
Application Title: NuScale Standard Design Certification - 52-048
Operating Company: NuScale Power, LLC
Docket No. 52-048
Review Section: 12.02 - Radiation Sources
Application Section: 12.2, 11.1

QUESTIONS

12.02-19

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 Part 20 as is practical. 10 CFR 20.1204, “Determination of Internal Exposure” and 10 CFR 20.1702, “Use of Other Controls,” requires occupational radiation exposure (ORE) be the sum of external and internal radiation exposure. 10 CFR 20.1701, “Use of Process or Other Engineering Controls” requires the use of engineering controls (e.g., ventilation,) to control the amount of radioactive material in air.

NuScale Design Specific Review Standard (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.

NuScale DSRS section 12.2 “Acceptance Criteria,” states in part, that for nuclear power plants designed for the recycling of tritiated water, tritium concentrations in contained sources and airborne concentrations should be based on a primary coolant concentration of 1.3x10+5 Bq/gm (3.5 µCi/gm), or an alternate value for which the methods, models, and assumptions have been provided in the application.

Background

NuScale Design Control Document (DCD) Tier 2 Revision 0, subsection 12.2.1 “Contained Sources,” states that the contained radiation sources are developed for normal operation and shutdown conditions and are based on the design basis primary coolant activity concentrations from DCD Tier 2, Section 11.1. DCD Tier 2 Revision 0, Table 12.2-32: “Input Parameters for Determining Facility Airborne Concentrations,” states that the primary coolant source terms are derived from DCD Tier 2 Revision 0, Table 11.1-4.

NuScale Technical Report (TR) TR-1116-52065 Revision 0, “Effluent Release (GALE Replacement) Methodology and Results,” Figure 4-2, “Tritium reactor coolant system balance,” shows a peak Reactor Coolant System (RCS) tritium content of about 75 Ci. DCD Tier 2 Revision 0, Table 11.1-2: “Parameters Used to Calculate Coolant Source Terms,” list the Reactor coolant system mass as 117,400 lbm (5.325174e+007 grams.) Based on the listed RCS mass, and the shown RCS tritium content, the peak RCS tritium concentration would be about 1.4 µCi/gm. TR-1116-52065 subsection 4.1.1 “Water Activation Products ,” uses RCS makeup water (for boron dilution) over the operating cycle (as shown in Figure 4-2, “Tritium reactor coolant system balance,”) to calculate a time weighted RCS tritium concentration of 0.97 µCi/ml. This is shown in TR-1116-52065 Figure 4-3, “Tritium concentration and time weighted average,” which provides “Tritium Concentration in RCS - No Recycle (uCi/g)” versus “Time (years).” Consistent with this analysis DCD Tier 2 Revision 0, Table 11.1-4, “Primary Coolant Design Basis Source Term,” lists the RCS tritium (H3) concentration as 9.7000E-01 µCi/g. Based on information made available to the staff during the RPAC Chapter 12 audit, the staff determined that the RCS tritium concentration listed in Table 11.1-4 was derived by assuming no recycling of RCS, that is, all make up water supplied to the RCS during the operating cycle was assumed to contain zero radioactivity, including tritium.

Multiple statements in DCD Section 11.2, “Liquid Waste Management System,” state that processed RCS liquids may be recycled for use in the RCS. The description of the Chemical and volume control system (CVCS) provided in DCD Section 9.3.4.2.1, “General Description,” states recycled, degassed reactor coolant from the LRWS can also be added back to the CVCS by a supply line upstream of the makeup pumps. DCD Tier 2, Revision 0, Figure 9.3.4-1: “Chemical and Volume Control System Diagram,” shows a return from the LRWS (liquid radioactive waste system).

TR-1116-52065 does not provide a discussion about the impact of recycled RCS on the RCS tritium concentration. The most immediate impact is that the concentration of the RCS tritium will be higher because the makeup water will be supplied at the tritium concentration previously in the RCS. The longer term impact is from the change in the macroscopic cross section of deuterium used to determine the amount of tritium produced by activation of water. The macroscopic cross section of deuterium is based on the microscopic cross section of deuterium (which does not change) and the relative atomic abundance of deuterium. With recycling, the relative atomic abundance of deuterium will increase over time due to activation of mono-nucleon hydrogen contained in the water. Based on the review of documents made available to the staff during the RPAC Chapter 12 Audit, the staff determined that the applicant assumed a constant cross section for the production of tritium from the neutron activation of water in the reactor core.

Key Issue 1:
Because the methodology used by the applicant to calculate the tritium production rate in the RCS does not account for the change in atomic abundance of deuterium in the RCS over time, it underestimates the total production of tritium due to neutron activation of water. Since airborne activity concentrations in equipment cubicles is more dependent on RCS activity concentrations, and less on ultimate heat sink (UHS) pool tritium concentration, the airborne tritium activity concentrations in equipment cells may be underestimated by over a factor of 3.

Question 1:

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions with respect to the potential production of tritium in the RCS, the staff requests that the applicant:

- In light of the information above, describe, with regard to the production of tritium, how NuScale accounts for the buildup of deuterium over the operating life of the facility,
- Describe the methods, models, and assumptions used to evaluate and account for the increased production of tritium due to the buildup of deuterium,
- As necessary, revise DCD Table 11.1-2 to reflect the methods, models and assumptions related to the buildup of deuterium and resultant increased tritium production rate over time,

OR

Provide the specific alternative approaches used and the associated justification.

12.02-20

The Regulatory Basis and Background are in RAI-9270 Quesiton 31001

Key Issue 2:
The methodology used by the applicant to calculate the tritium concentration in the RCS does not account for the buildup of tritium due to recycling of previously used RCS, therefore RCS tritium concentration appears to be underestimated. NuScale has proposed an alternative and potentially non-conservative design basis RCS tritium concentration value, which is used for determining airborne activity concentrations within the plant, without demonstrating that the health and safety of occupational workers is maintained and that the potential doses are ALARA for compliance with 10 CFR Part 20. Since airborne activity concentrations in equipment cubicles is more dependent on RCS activity concentrations, and less on ultimate heat sink (UHS) pool tritium concentration, the airborne tritium activity concentrations in equipment cells may be underestimated by over a factor of 3

Question 2:

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions with respect to the potential production of tritium in the RCS, the staff requests that the applicant:

- Explain the use of an apparent non-conservative tritium value as discussed above, and
- Revise DCD Chapter 12.2 to use an RCS tritium concentration value of 1.3x10+5 Bq/gm (3.5 µCi/gm), or revise DCD Chapter 12.2 to use a calculated RCS tritium concentration supported by the associated, including methods, models and assumptions, for determining the RCS coolant concentration of tritium, consistent with the system description provided in DCD Tier 2 Revision 0, including sections in Chapters 9 and sections in Chapter 11,

AND

- Revise DCD Section 12.2.2 “Airborne Radioactive Material Sources,” to reflect the changes to RCS tritium concentration and the associated bases,

AND

- Revise DCD Table 12.2-32: “Input Parameters for Determining Facility Airborne Concentrations,” to reflect the revised methods, models and assumptions,

AND

- Revised DCD Table 12.2-33: “Reactor Building Airborne Concentrations,” to reflect the changes to tritium concentrations,

OR

Provide the specific alternative approaches used and the associated justification.