NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Sunday, January 28, 2018 4:20 PM
To: RAI@nuscalepower.com
Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Dudek, Michael; Lavera, Ronald; Markley, Anthony
Subject: Request for Additional Information No. 355 RAI No. 9258 (12.2)
Attachments: Request for Additional Information No. 355 (eRAI No. 9258).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.

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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. 355 (eRAI No. 9258)

Issue Date: 01/28/2018
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

QUESTIONS

12.02-29

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 part 20 of this chapter. 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 Part 50 Appendix A, criterion 4 requires applicants to identify the environmental conditions, including radiation, associated with normal operation. The DSRS Acceptance Criteria section of NuScale DSRS section 12.2, “Radiation Sources,’ states that the applications should contain the methods, models and assumptions used as the bases for all sources described in DCD Section 12.2. The DSRS Acceptance Criteria 12.3-12.4, “Radiation Protection Design Features,” states that the areas inside the plant structures, as well as in the general plant yard, should be subdivided into radiation zones, with maximum design dose rate zones and the criteria used in selecting maximum dose rates identified.

Background

NuScale DCD Tier 2, Revision 0 Section 12.2.1.3, “Chemical and Volume Control System,” states that for the specific activity content of the resin transfer pipe, a lower density value for the resin than that stated in the spent resin storage tank (SRST) is assumed. DCD Section 12.2.1.13 further states that the theoretical maximum for randomly 'jammed' spherical matter is a packing density of 63.4%. At somewhere below this point, the resin beads would no longer flow through a pipe. The 'jammed' sphere packing with the lowest density is a diluted ('tunneled') packing density of 49.365%. Therefore, to prevent resin beads from clogging, a packing density of less than 49.365% is needed. A generic resin transfer line is modeled assuming it is 100% obstructed by spherical resin beads from the CVCS mixed bed demineralizer, which results in approximately 50% of the pipe's internal volume consisting of resin bead material and the other 50% consisting of water. The generic resin transfer line is modeled with the parameters listed in Table 12.2-6, “Chemical and Volume Control System Component Source Term Inputs and Assumptions.” The only additional information provided in DCD Table 12.2-6 are the dimensions of the resin transfer line. DCD Table 12.2-19, “Solid Radioactive Waste System Component Source Terms – Radionuclide Content,” lists the radionuclide content of the SRST. The parameters described above are used by the applicant to calculate the contents of the resin transfer pipe listed in Table 12.2-7, “Chemical and Volume Control System Component Source Terms - Radionuclide Content.” The staff also noticed that the column in DCD Table 12.2-7 listing the radionuclide content of the resin transfer line does not contain Ba-137m. Cs-137 decays, with a 30 year half-life, to Ba-137m, with a 2.5 minute half-life. Since Ba-137m is in secular equilibrium with the parent Cs-137 radionuclide, the specific activity of Ba-137m should be within 94 percent of the Cs-137 specific activity, within 20 minutes. The significant, 662 KeV photon, associated with the decay of Cs-137 is actually emitted from the decay of Ba-137m, so omitting Ba-137m results in a significant underestimation of the photon source strength and thus the resultant dose rate.

Key Issue 1:
Based on operating experience at commercial nuclear power plants (see DE2004826015 “Studsvik Processing Facility Update,” available from https://ntrl.ntis.gov/NTRL/), a relatively high ratio of water to resin is required to ensure unobstructed flow of resin slurries through the resin transfer pipes. However, based on that same operational experience, despite efforts by plant personnel, resin transfer lines do become clogged. When that happens the density of the resin in the transfer line becomes that of the water soaked resin in the SRST. As a result it is unclear why “A generic resin transfer line is modeled assuming it is 100% obstructed by spherical resin beads from the CVCS mixed bed demineralizer, which results in approximately 50% of the pipe's internal volume consisting of resin bead material and the other 50% consisting of water.” If the pipe contains more resin, this will result in higher exposures and would impact the designated radiation zones due to a higher maximum dose rate in the area, as stated in the Acceptance Criteria for DSRS 12.3-12.4.

Question 1

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions, the staff requests that the applicant:

- Please explain/justify the basis for assuming a non-conservative source term for the “obstructed” pipe and the resulting exposure rates and radiation zone designation,

- Revise DCD Section 12.2.1.3 to remove the discussion related to crediting a lower resin density for the design of shielding,
- Revise DCD Table 12.2-7 to increase the specific activity of the resin in the resin transfer line to the specific activity of the resin in the SRST,
- As necessary, revise the DCD radiation zone maps in DCD Section 12.3 to reflect the increase in specific activity of the resin in the resin transfer line,

OR

Provide the specific alternative approaches used and the associated justification.

12.02-30

The regulatory basis and summary are in RAI-9258 Q-30982

Key Issue 2
The methodology used to develop the photon source strength from the post-accident fluid does not account for some principle photon radiation emitting isotopes in the fluid stream. For instance, Ba-137m is in secular equilibrium with the parent Cs-137 radionuclide, the specific activity of Ba-137m should be within 94 percent of the Cs-137 specific activity, within 20 minutes. However, since DCD Table 12.2-7 shows that there is no Ba-137m activity in the resin transfer line, the photon source strength used by the applicant to perform the analysis of dose resulting from the sample fluid, apparently did not properly account for Ba-137m, thus resulting in an underestimation of the dose rate from the sample fluid.

Question 2

- Describe and explain the results of accounting for the correct isotopic content of the resin transfer line that includes Ba-137m, and any other radiologically significant isotopes that should be present but are not,
- Revise DCD Table 12.2-7 to include Ba-137m, and confirm that all other radiologically significant isotopes, in the resin transfer line, are appropriately accounted for,
- As necessary, revise the DCD radiation zone maps in DCD Section 12.3 to reflect the increase in specific activity of the resin in the resin transfer line,
- As necessary, revise the thicknesses of shielding described in the DCD to reflect the increase in the photon strength of the resin in the resin transfer line,

OR

Provide the specific alternative approaches used and the associated justification.