NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Friday, December 22, 2017 12:30 AM
To: RAI@nuscalepower.com
Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Burkhart, Lawrence; Lavera, Ronald; Markley, Anthony
Subject: Request for Additional Information No. 310 RAI No. 9264 (12.02)
Attachments: Request for Additional Information No. 310 (eRAI No. 9264).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 this question in this RAI is likely to require greater than 60 days.

The NRC Staff recognizes that NuScale has preliminarily identified that the response to the question 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. 310 (eRAI No. 9264)

Issue Date: 12/22/2017
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

12.02-4

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. 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 50.49(e)(4) and 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

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 if Ba-137m is omitted in an analysis, the results would be a significant underestimation of the photon source strength and thus the resultant dose rate.

NuScale DCD Tier 2, Revision 0 Table 12.2-7: "Chemical and Volume Control System Component Source Terms - Radionuclide Content," Ba-137m is not included in the column listing the radionuclide content of the resin transfer line. Also, based on information made available to the staff during the RPAC Chapter 12 Audit, the staff observed that several calculations did not properly account for the equilibrium condition between Cs-137 and Ba-137m. Examples of the types of calculations reviewed during the audit that had this error include the proposed revision to DCD Table 12.2-20: "Solid Radioactive Waste System Component Source Terms – Source Strengths," included as part of the applicant's response to RAI-8860 Question 12.02-2, dated July 10 2017, and the source term associated with the applicant's response to RAI-8775 Question 12.03-1, dated June 26, 2017, regarding post-accident vital area mission dose calculations.

The radionuclide content of systems and components is used to determine the photon source strength, which is, in turn, used to determine dose rates. The calculated dose rates are then used to establish shielding requirements, radiation zones, doses to equipment and doses to personnel during normal operations, Anticipated Operational Occurrences (AOO) and following accidents. The staff's analysis confirmed that some of the photon source strength information contained in documents made available to the staff during the audit, were underestimated.

As stated in Regulatory Guide 1.183, "Alternative Radiological Source Terms for Evaluating Design Basis Accidents at Nuclear Power Reactors," Appendix I, "Assumptions for Evaluating Radiation Doses for Equipment Qualification," in paragraph 7 of section "Dose Model for Containment Atmosphere," all gamma dose rates should be multiplied by a correction factor of 1.3 to account for the omission of the contribution from the decay chains of the radionuclides. Dose to EQ equipment resulting from gamma emitters during normal operation and from liquids containing post-accident sources of radioactive material should appropriately account for parent-daughter relationships.

Key Issue:

The methodology used to develop the photon source strength from source terms does not account for some principle photon radiation emitting isotopes resulting in underestimates of some dose rates in the DCD.

Question 1

- Please explain omission of BA-137m in determining the isotopic content of components and systems cited above,

- As necessary, revise the calculations used to determine the isotopic content of components and systems to correct Ba-137m, and any other radiologically significant isotopes that are not accurately accounted for,
- As necessary revise tables contained in DCD Section 12.2- to correct Ba-137m, and as necessary other radiologically significant isotopes,
- As necessary, revise the DCD radiation zone maps in DCD Section 12.3 to reflect the changes to the table in DCD section 12.2,
- As necessary, revise the thicknesses of shielding described in the DCD to reflect the increase in the photon strength resulting from the changes to the table in DCD section 12.2,
- As necessary, revise the dose estimates affected by the changes in photon strength caused the changes to the table in DCD section 12.2,
- As necessary, revise the EQ dose estimates and categories described in DCD Table 3C-1: “Environmental Qualification Zones - Reactor Building,” DCD Table 3C-8: “Accident EQ Radiation Dose,” and DCD Table 3C-6: “Normal Operating Environmental Conditions,” affected by the changes in photon strength caused the changes to the table in DCD section 12.2,

OR

Provide the specific alternative approaches used and the associated justification.