NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Friday, December 22, 2017 12:46 AM
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Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Burkhart, Lawrence; Lavera, Ronald; Markley, Anthony
Subject: Request for Additional Information No. 309 RAI No. 9263 (12.02)
Attachments: Request for Additional Information No. 309 (eRAI No. 9263).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 the question in this RAI is likely to require greater than 60 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. 309 (eRAI No. 9263)

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, 12.3, 11.1

QUESTIONS

12.02-6

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 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

DCD Section 12.2.3, “References,” references Electric Power Research Institute (EPRI), "Pressurized Water Reactor Primary Water Chemistry Guidelines," Volumes 1 and 2, EPRI 3002000505 (TR-3002000505), Palo Alto, CA, Revision 7, April 2014. TR-3002000505 Volume 2 states that deposition of particulates released during the shutdown evolution can lead to increased shutdown dose rates, elevated smearable activity levels in low flow regions, and increases in personnel contamination risks. It further notes that that without operating reactor coolant pumps, the flow forces will be reduced. Some outcomes of reduced flow forces include increased deposition of suspended material, less solubilization of system deposits, and an increased rate of deposition in low flow rate areas.

NuScale DCD Tier 2, Revision 0 Section 12.2.1.3, “Chemical and Volume Control System,” states that at the end of the fuel cycle, a crud burst is assumed, with the mixed-bed demineralizers being loaded with the entire radionuclide inventory increased due to the crud burst. This increase in radionuclide concentration in the primary coolant is determined by a review of industry data of increased radionuclide concentrations during crud bursts. The resulting crud burst peaking factors are listed in Table 12.2-6. DCD Table 12.2-6, “Chemical and Volume Control System Component Source Term Inputs and Assumptions.” This table lists the peaking factors to be applied to the normal reactor coolant system (RCS) activity expected to be contained in Chemical and Volume Control System (CVCS) liquid following a crud burst during an outage.

DCD 12.2.1.8 “Reactor Pool Water,” states that the primary source of radionuclides in the reactor pool comes from the primary coolant system when a nuclear power module (NPM) is disassembled in the reactor pool during outages. During refueling outages, after the primary coolant crud burst is cleaned by the CVCS, the small remaining quantities of radionuclides are released into the pool water during NPM disassembly. DCD Table 12.2-6: “Chemical and Volume Control System Component Source Term Inputs and Assumptions,” list the assumptions used for assessing the ability of plant systems to clean up crud bursts. DCD Table 12.2-9: “Reactor Pool Cooling, Spent Fuel Pool Cooling, Pool Cleanup, and Pool Surge Control Systems Component Source Term Inputs and Assumptions,” discusses the assumptions used for cleaning up the pool, and DCD Table 12.2-10: “Reactor Pool Cooling, Spent Fuel Pool Cooling, Pool Cleanup and Pool Surge Control System Component Source Terms - Radionuclide Content,” provides the resultant pool radionuclide concentrations. Since the lower RCS flowrate may result in less cleanup through the CVCS components, there may be a larger release of radionuclides to the pool water during refueling evolutions.

DCD Tier 2 Revision 0 Section 9.3.4 “Chemical and Volume Control System,” (CVCS) notes that portions of the CVCS are used for crud burst clean up. DCD Figure 9.3.4-1: “Chemical and Volume Control System Diagram,” shows the location of the Chemical and volume control system (CVCS) reactor coolant system (RCS) injection line and the RCS discharge lines.

During normal operation, the RCS system flow is driven by the temperature gradients within the RCS. As noted in DCD Table 5.1-2: “Primary System Temperatures and Flow Rates,” the RCS primary flow rate at 100% reactor power is 587.0 Kg/s. As noted in DCD Table 5.1-2, following plant shutdown the RCS flowrate decreases to 68.5 Kg/s or less at 0% power. Based on DCD Table 11.1-2: “Parameters Used to Calculate Coolant Source Terms,” the CVCS purification system flow rate corresponds to approximately 1.4 Kg/s, while the RCS mass corresponds to about 5.3E4 Kg.

The radioactive material contained in the RCS as a result of crud burst challenges the ability of plant systems to control airborne radioactive material, minimize surface contamination, reduce effluent releases, and to control occupational radiation exposure.

Key Issue:
Using the information provided in the application, and information made available to the staff as part of the RPAC Chapter 12 Audit, the staff was unable to determine how the application factored these aspects of the design into the estimated amounts of radioactive material projected to be initially present in the RCS following shutdown, the estimation of the effectiveness of the processes used to clean up the RCS, the amount of radioactive material that may be present inside of NPM components at the time of disassembly, the subsequent amount of radioactive material added to the ultimate heat sink pool water and ultimately, the impact on radiological conditions (i.e., dose rates, airborne activity etc.) in the area of refueling activities.

Question

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions, with respect to the descriptions of the sources of radiation present in the facility, the staff requests that the applicant:

- Justify/explain how the applications assesses the impact of low RCS flow rates on the crud burst clean up capabilities of the NPM.
- As necessary revise DCD Section 12.2 to include adjustment factors for lack of forced flow RCS mixing,
- As necessary revise the radiation zone maps to account for any increased dose rates due to increased radionuclide contribution to the pool water,
- As necessary revise Table 12.2-33: "Reactor Building Airborne Concentrations," to account for any increased dose rates due to increased radionuclide contribution to the pool water,
- As necessary revise Table 12.2-9, 12.2-10 and 12.2-11 to account for any increased radionuclide contribution to the pool water,
- Provide information on design features meant to reduce radionuclide buildup in the pool,

OR

Provide the specific alternative approaches used and the associated justification.