NuScaleDCRaisPEm Resource

From:	Cranston, Gregory
Sent:	Monday, January 14, 2019 9:45 AM
To:	Request for Additional Information
Cc:	Lee, Samuel; Dudek, Michael; Lavera, Ronald; Tesfaye, Getachew; Chowdhury, Prosanta; NuScaleDCRaisPEm Resource
Subject:	Request for Additional Information No. 515 eRAI No. 9607 (12.02)
Attachments:	Request for Additional Information No. 515 (eRAI No. 9607).pdf

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

Please submit your technically correct and complete response by March 14, 2019, to the RAI to the NRC Document Control Desk.

If you have any questions, please contact me.

Thank you.

Hearing Identifier: NuScale_SMR_DC_RAI_Public
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Request for Additional Information No. 515 (eRAI No. 9607)

Issue Date: 01/14/2019
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: 12.02

QUESTIONS

12.02-34

As a follow-up RAI to RAI 9257, Question 12.02-14, the staff is requesting additional information on the crud burst model used for the development of the DCA submittal.

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.

Criterion 61—"Fuel storage and handling and radioactivity control," requires systems which may contain radioactivity to be designed with suitable shielding for radiation protection and with appropriate containment, confinement, and filtering systems.

10 CFR 20.1101(b) states that "the licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA)." 10 CFR 20.1003 states that ALARA "means making every reasonable effort to maintain exposures to radiation as far below the dose limits in this part as is practical consistent with the purpose for which the licensed activity is undertaken, taking into account the state of technology, the economics of improvements in relation to state of technology, the economics of improvements in relation to benefits to the public health and safety, and other societal and socioeconomic considerations, and in relation to utilization of nuclear energy and licensed materials in the public interest."

DSRS Section 12.3-12.4 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:

The applicant's response to RAI-9257, Question 12.02-14, dated 8 August 2018 (ADAMS Accession No. ML18220B407), stated that the crud burst model used for the development of DCD Revision 0, Tier 2, was based on using relevant industry operating information as described in EPRI Technical Report 1011106, "Proceedings of the June 2004 EPRI PWR Primary Shutdown Workshop." This EPRI report utilized data from several large PWRs, including some with high duty core indexes, from which NuScale selected the highest reported values on which to base its model.

The staff reviewed the referenced EPRI report, and agrees that the crud burst factors, as derived from the information contained in the report, satisfies the staff concerns with respect to consideration of significant crud bursts related to a HDCI. The radioactive material contents for CVCS demineralizers and filters contained in DCA Revision 1, Tier 2, were based on the expected accumulation of radioactive material (e.g., CVCS Mixed Bed Demineralizer 489 Ci of Co-58) resulting from a crud burst of a power adjusted magnitude consistent with the operating experience described in TR-1011106. Therefore, the staff found the crud burst peaking factor assumptions provided in DCA Revision 1, Table 12.2-6, "Chemical and Volume Control System Component Source Term Inputs and Assumptions," to be acceptable.

However, NuScale further stated in the same response to RAI-9257 that they had decided to remove the radionuclide activity from an assumed crud burst transient condition from the Chemical and Volume Control System (CVCS) design basis evaluation because NuScale indicated that the crud burst assumption was unnecessarily conservative. Therefore, NuScale removed the crud burst peaking factor information from Table 12.2-6 and recalculated source terms without the assumed crud burst (this will subsequently lead to lower calculated dose rates). NuScale stated that instead of using the assumed crud burst peaking factor they will utilize the guidance of American National Standards Institute/American Nuclear Society (ANSI/ANS), Standard 18.1-1999, "Source Term Specification," for crud isotopes, as recommended in NuScale DSRS Section 11.1. NuScale also stated that the CVCS mixed bed demineralizers are assumed to collect radionuclide activity from the primary coolant during the operating cycle and for a short post shutdown period, but with no additional radionuclide inventory from an assumed additional crud burst.

The staff reviewed NUREG-CR-1992 "In-Plant Source Term Measurements at Four PWR's," to assess the applicability of ANSI-18.1 for evaluating the contributions from crud bursts on coolant radioactivity concentrations and the subsequent accumulation of radioactive material in systems such as the CVCS and Radioactive Waste systems. NUREG-CR-1992 Section 2.3 "Measurement Results," states that in all cases, only measurements obtained during non-spiking periods when the reactor power was 75% or higher were included in the averages. NUREG-CR-1992 Section 2.4 "Comparisons with Predictions," states that ANSI/ANS-18.1 provides typical radionuclide concentrations for use in estimating the average radioactivity in reactor coolant water. Therefore, the staff believes that while ANSI/ANS-18.1 is a valid reference for estimating the coolant concentrations for routine releases from nuclear power plants, it is not appropriate for determining the coolant concentrations associated with shutdown crud bursts.

As a result of this change by NuScale the corrosion product inventory assumed in some of the CVCS system components (e.g., the Mixed Bed (MB) demineralizer) decreased significantly. For example, the Co-58 content of the CVCS Mixed Bed Demineralizer decreased from 489 Ci to 9.1 Ci. The reduction in corrosion products assumed to be present in the CVCS components significantly (non-conservatively) impacts the assumed dose rates from those components. Based on analysis performed by the staff, the dose rate from the CVCS MB using NuScale's proposed source term is over a factor of 3 less than the dose rate from the CVCS MB source term with 0.066% Failed Fuel with a crud burst included. An additional analysis by the staff indicates that the dose rate from the CVCS MB from a crud burst only (no other activity in the CVCS MB) is over 2 times higher than the dose rate from the CVCS MB demineralizer using the isotopic concentrations provided in the response to RAI 9257.

Questions:

To facilitate staff understanding of the application information sufficient to make appropriate regulatory conclusions:

Given that the prior NuScale analysis and RAI responses anticipated a post shut down crud burst (see DCD Tier 2 Sections 12.2.1.3, 12.2.1.8, 12.3.1.3.1, 12.3.2.3 and the response to RAI 9263), provide a technical justification for why ANSI/ANS-18.1 accounts for anticipated radionuclide inventory associated with the expected post shutdown crud burst for a NuScale NPM. In its justification, NuScale should demonstrate why this assumption is reasonably conservative in predicting peak radiation source term in components, such as the CVCS Mixed Bed demineralizer, and how that affects the radiation zone near these components and to areas adjacent to these components.