

## NuScaleDCRaisPEm Resource

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**Subject:** Request for Additional Information No. 296 RAI No. 9231 (5.4.1)  
**Attachments:** Request for Additional Information No. 296 (eRAI No. 9231).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.

If you have any questions, please contact me.

Thank you.

Gregory Cranston, Senior Project Manager  
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301-415-0546

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## Request for Additional Information No. 296 (eRAI No. 9231)

Issue Date: 12/13/2017

Application Title: NuScale Standard Design Certification - 52-048

Operating Company: NuScale Power, LLC

Docket No. 52-048

Review Section: 05.04.02.01 - Steam Generator Materials

Application Section: 5.4.1, "Steam Generators," and 5.4.1.6, "Steam Generator Program" (also DSRS Section 5.4.2.2)

### QUESTIONS

#### 05.04.02.01-2

Section 52.6(a) of Title 10 of the *Code of Federal Regulations* (10 CFR) requires that information provided to the U.S. Nuclear Regulatory Commission (NRC) by an applicant for a standard design certification be complete and accurate in all material respects. Therefore, please revise Tier 2 of the Final Safety Analysis Report (FSAR) to address the following changes made in your August 3, 2017, supplements (Accession Nos. ML17215A977 and ML17215A978 in the NRC's Agencywide Documents Access and Management System (ADAMS)).

- a. It appears that "integral steam plenum" was inadvertently added twice to Table 5.2-4, "Reactor Coolant Pressure Boundary Component Materials Including Reactor Vessel, Attachments, and Appurtenances." The NRC staff believes that the intent was to also add "integral feed plenum."
- b. The figure referenced in the subsection entitled, "Thermal Relief Valves," of Section 5.4.1.2, "System Design," for illustrating the thermal relief valve on each feedwater line appears to be incorrect. The referenced figure, 5.4-8, is the steam generator (SG) flow restrictor assembly.
- c. The table referenced in Section 5.4.1.6, "Steam Generator Program," for SG tube wall thickness in the fourth paragraph appears to be incorrect. The referenced table, 5.4-3, "Steam Generator Piping, Tube and Piping Supports, and Flow Restrictor Materials," identifies materials specifications.

#### 05.04.02.01-3

Statements that the SG program is "based" on Nuclear Energy Institute (NEI) 97-06, "Steam Generator Program Guidelines," were added to Sections 5.4.1.1, "Design Basis," and 5.4.1.4, "Tests and Inspections," in your August 3, 2017, supplements. For consistency with other statements in the FSAR, this statement should be revised to make it clear that the SG program follows or conforms to NEI 97-06 because the term "based on" implies that there may be exceptions. If there are exceptions, then they should be identified and justified. This request is made to ensure that your SG program meets the requirements of General Design Criteria (GDC) 32, 10 CFR 50.55a, 10 CFR 50.36, Appendix B in 10 CFR Part 50, and 10 CFR 50.65 as they relate to implementation of a SG program to maintain the structural and leakage integrity of the SG tubes.

#### 05.04.02.01-4

The NRC staff notes that Table 5.4-2 in Tier 2 of the FSAR, "Steam Generator Design Data," includes the minimum steam and feed tubesheet thickness (i.e., the thickness of the ferritic base material of the tubesheets). Revise this table to include the steam and feed tubesheet cladding

thickness and the total thickness (tubesheet thickness plus cladding thickness). The NRC staff requests this information be added to the table because this material will form part of the reactor coolant pressure boundary (RCPB) since it is joined to the SG tube ends. Therefore, the selection, processing, fabrication, and testing of this cladding must meet the requirements of Appendix A in 10 CFR Part 50, GDC 1, GDC 30, and 10 CFR 50.55a. Adding this information will also meet the requirement in 10 CFR 52.6(a) to submit complete and accurate information in a standard design certification.

#### 05.04.02.01-5

Section 5.1.3.7 in Tier 2 of the FSAR, "Steam Generators," states that the tubes, tube supports, steam and feedwater piping inside containment, tube inlet flow restrictors, and steam and feed plenums makeup the NuScale SG system. Table 3.2-1 in Tier 2 of the FSAR, "Classification of Structures, Systems, and Components," notes that the SG system also includes the main steam and feedwater supply nozzles. Section 3.12.5.8.3 of Tier 2 of the FSAR, "Feedwater Line Stratification," states that the SG feedwater nozzles are located on the feedwater inlet plenums. Section 52.6(a) of 10 CFR requires that information provided to the NRC by an applicant for a standard design certification be complete and accurate in all material respects. Therefore, please revise Chapter 5 in Tier 2 of the FSAR to include:

- a. A statement that the SG system also includes the main steam and feedwater supply nozzles.
- b. Identification of the main steam and feedwater supply nozzles on Figures 5.4-4, "Integral Steam Plenum," and 5.4-5, "Feedwater Plenum."
- c. A statement of the location of the main steam and feedwater supply nozzles (e.g., the SG main steam supply nozzles are located on the steam plenums and the SG feedwater supply nozzles are located on the feedwater inlet plenums as shown in Figures 5.4-4 and 5.4-5).
- d. A description of how the nozzles are attached to the steam and feed plenums.
- e. The main steam and feedwater supply nozzle materials in Table 5.4-3, including the nozzle weld materials.

#### 05.04.02.01-6

Steam generator tube supports must be designed to meet the requirements of GDC 4, 14, 15, and 31 in Appendix A of 10 CFR Part 50, as they relate to maintaining the integrity of the RCPB. Given that this is a first-of-a-kind design, please provide the following information to address how the support structures meet these requirements:

- a. A description of the testing and analyses performed to evaluate the design of the tube support structures with respect to providing adequate support, limiting accumulation of corrosive or particulate materials, and resisting degradation. Please also include a discussion of the likelihood and extent of loose parts generated from the tube support structures.
- b. Clarification of the design requirements for the tube support structures and how they are addressed in the Tier 1 and Tier 2 material in the FSAR. Section 5.4.1.5 in Tier 2 of the FSAR, "Steam Generator Materials," states that the tube supports conform to the requirements of Subsection NG of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code. This appears to contradict Table 3.2-1 in Tier 2 of the FSAR, "Classification of Structures, Systems, and Components," which identifies the supports as Quality Group A, corresponding to ASME Code Class 1. In addition, it is not clear to the NRC staff whether or not Inspection, Test, Analysis, and Acceptance Criteria No. 2 in Table 2.1-4 in Tier 1 of the FSAR, "NuScale Power Module Inspections, Tests, Analyses, and Acceptance Criteria," regarding ASME Code Class 1 and 2 components applies to the SG tube support structures (Class NG).
- c. Table 5.2-7, "Reactor Vessel Internals Inspection Elements," and Figure 5.4-7, "Steam Generator Tube Support Tabs," in Tier 2 of the FSAR refer to plates. Given that the FSAR states that tube support plates used in the currently operating fleet are not used in the NuScale design, please confirm that the "plates" referred to in this table and figure are the vertical support bars and revise this table and figure to that effect.

- d. Table 5.2-7 refers to five tube support plate-to-tube support plate welds. Given that the FSAR states that tube support plates used in the currently operating fleet are not used in the NuScale design, please confirm that there are no tube support plate-to-tube support plate welds in the NuScale design and revise this table to that effect.

05.04.02.01-7

The NRC staff notes that Table 5.4-3 in Tier 2 of the FSAR indicates “Type 340/304L” for the SG Class 2 piping. Section 52.6(a) of 10 CFR requires that information provided to the NRC by an applicant for a standard design certification be complete and accurate in all material respects. Therefore, please revise this table to read “Type 304/304L.”

05.04.02.01-8

The flow restrictors in the SG tube ends must enable the full range of design flow rates and resist degradation that could lead to damage of the SG tubes and other downstream components in the steam and feedwater system. This is necessary for the flow restrictors to satisfy the requirements of 10 CFR Part 50, Appendix A, GDC 1, 4, 15, 30, and 31, as they relate to ensuring the integrity of the RCPB. Please provide the following information about the flow restrictors:

- a. A description of the inspection requirements for the flow restrictors. Table 3.2-1 in Tier 2 of the FSAR indicates that while the flow restrictors are safety-related, Quality Group and Safety Classifications are not applicable. This appears to be inconsistent with the statement in Section 5.4.1.5 in Tier 2 of the FSAR that the flow restrictors are Quality Group B, but designed, fabricated, constructed, tested, and inspected as non-ASME Code components.
- b. A description of the evaluations performed for potential degradation related to the flow restrictors and associated hardware, including a discussion of the likelihood and extent of loose parts generated from the flow restrictors, and the provisions for managing that degradation. In addition, a description of the evaluations performed to determine the impact of removing flow restrictors in order to plug tubes.
- c. Table 5.4-3 in Tier 2 of the FSAR includes components called “flow restrictor bolts,” “flow restrictor stud bolts,” and “flow restrictor mounting plate spacer.” Revise Figure 5.4-8 of Tier 2 of the FSAR to clarify their location and revise Section 5.4.1.2 in Tier 2 of the FSAR to clarify their functions.

05.04.02.01-9

Section 5.4.1.2 in Tier 2 of the FSAR states that the “chemistry of the primary and secondary water is controlled in accordance with industry guidelines suitably modified to address the unique NPM (NuScale Power Module) design and to ensure compatibility with the primary and secondary coolant.” In this case, the industry guidelines are the Electric Power Research Institute (EPRI) Pressurized Water Reactor Primary Water Chemistry Guidelines and Pressurized Water Reactor Secondary Water Chemistry Guidelines (EPRI Guidelines). Explain what is meant by “suitably modified” or, if the EPRI Guidelines will be followed without modification, revise Section 5.4.1.2 to state that water chemistry will be controlled “in accordance with” the EPRI Guidelines. The NRC staff requires this information because the primary and secondary coolant water chemistry should be controlled consistent with the requirements of GDC 4.

So that you may ensure consistency in your responses and changes to the FSAR, the NRC staff notes that related requests for information (RAI) have been issued under Sections 5.2.3 (RAI 9233), 9.3.4 (RAI 9194), and 10.4.6 (RAI 9117, Question 10.04.06-1).

#### 05.04.02.01-10

Compliance with ASME Code Section III (NB-2160, NB-3121, NC-2160, and NC-3121) requires an appropriate allowance for corrosion and other forms of degradation. Section 5.4.1.2 in Tier 2 of the FSAR states that “a lifetime degradation allowance of 0.010 inch is included in the design nominal wall thickness.” Please revise the FSAR to include a discussion of the basis for the degradation allowance specified.

#### 05.04.02.01-11

General Design Criteria 30 in Appendix A of 10 CFR Part 50 requires that components in the RCPB be designed, fabricated, erected, and tested to the highest quality standards practical. Appendix B of 10 CFR Part 50, which is applicable to reactor coolant system components, provides quality assurance requirements that ensure the highest quality standards practicable. Please address the following related to SG cleaning and cleanliness controls and quality assurance requirements:

- a. If the onsite cleaning and cleanliness controls of the SGs are included in the overall cleaning and cleanliness controls for the RCPB, then revise Section 5.4.1 in Tier 2 of the FSAR to include a statement to that effect and a reference to where a description of the applicable controls are located in the FSAR (e.g., Section 5.2.3.4.2 in Tier 2 of the FSAR, “Cleaning and Contamination Protection Procedures”).
- b. Revise Table 1.9-2 in Tier 2 of the FSAR, “Conformance with Regulatory Guides,” to state that Regulatory Guide (RG) 1.28, “Quality Assurance Program Criteria (Design and Construction),” applies to Section 5.4.1 in Tier 2 of the FSAR. Compliance with RG 1.28 is described in the NuScale Design Specific Review Standard (DSRS) acceptance criteria for Section 5.4.2.1.

#### 05.04.02.01-12

Provide a description of the analyses or tests that have been performed to evaluate the potential for and extent of sludge accumulation in the integral feed plena and possible adverse effects, such as blockage of flow through the tubes or concentration of corrosion products. This information is necessary to ensure the integral feed plena satisfy the requirements of 10 CFR Part 50, Appendix A, GDC 1, 4, 15, 30, and 31, as they relate to ensuring the integrity of the RCPB.

#### 05.04.02.01-13

Steam Generator preservice inspection (PSI) and inservice inspection (ISI) are required by 10 CFR 50.55a and are identified in SECY-05-0197, “Review of Operational Programs in a Combined License Application and Generic Emergency Planning Inspections, Tests, Analyses, and Acceptance Criteria,” dated October 28, 2005 (ADAMS Accession No. ML052770225), as operational programs to be implemented by licensees. Since SGs have distinct PSI and ISI requirements, please address the following:

- a. Reference the SG PSI and ISI programs separately by adding reference to Section 5.4 in Section 13.4 in Tier 2 of the FSAR, “Operational Programs.” For example, “Inservice inspection programs (refer to Section 5.2, Section 6.6, and Section 5.4)” and “Pre-service inspection programs (refer to Section 5.2 and Section 5.4).”

- b. Revise Table 1.8-2, "Combined License Information Items," and Section 5.4.1, "Steam Generators," in Tier 2 of the FSAR to add a COL information item that requires COL applicants referencing the NuScale design certification to prepare PSI and ISI programs for the SGs.

#### 05.04.02.01-14

General Design Criteria 32, 10 CFR 50.55a, 10 CFR 50.36, Appendix B in 10 CFR Part 50, and 10 CFR 50.65 include requirements to ensure that implementation of a SG program maintains the structural and leakage integrity of the SG tubes. Combined License Information Item 5.4-1 in Tier 2 of the FSAR requires that a COL applicant referencing the NuScale design certification develop and implement a SG program based on NEI 97-06, Revision 3, and applicable EPRI SG guidelines. Please revise the FSAR to address the following regarding the SG program COL item:

- a. For consistency with other statements in the FSAR, COL Information Item 5.4-1 should be revised to make it clear that the SG program follows or conforms to NEI 97-06. The term "based on" implies that there may be exceptions, in which case they should be identified and justified.
- b. The required program elements in COL Information Item 5.4-1 do not include maintenance of the SG secondary-side integrity (primary side for NuScale design) which is a program element in NEI 97-06. Please add an appropriate program element that meets the intent of the SG secondary-side integrity program element in NEI 97-06 to this COL item to be consistent with NEI 97-06.
- c. Given that a newer revision of NEI 97-06 may be available prior to a COL applicant referencing the NuScale design certification, please remove reference to a specific revision of NEI 97-06 from COL Information Item 5.4-1. The NRC staff notes that NEI 97-06, Revision 3, and EPRI, "Pressurized Water Reactor Primary-to-Secondary Leak Guidelines," Revision 4, are listed under References in Bases B 3.4.5.