

NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Wednesday, December 06, 2017 11:27 AM
To: RAI@nuscalepower.com
Cc: NuScaleDCRaisPEm Resource; Lee, Samuel; Chowdhury, Prosanta; Mitchell, Matthew; Makar, Gregory; Baval, Bruce
Subject: Request for Additional Information No. 294 RAI No. 9273 (5.4.1)
Attachments: Request for Additional Information No. 294 (eRAI No. 9273).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
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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Created By: Gregory.Cranston@nrc.gov

Recipients:

"NuScaleDCRaisPEm Resource" <NuScaleDCRaisPEm.Resource@nrc.gov>
Tracking Status: None
"Lee, Samuel" <Samuel.Lee@nrc.gov>
Tracking Status: None
"Chowdhury, Prosanta" <Prosanta.Chowdhury@nrc.gov>
Tracking Status: None
"Mitchell, Matthew" <Matthew.Mitchell@nrc.gov>
Tracking Status: None
"Makar, Gregory" <Gregory.Makar@nrc.gov>
Tracking Status: None
"Bavol, Bruce" <Bruce.Bavol@nrc.gov>
Tracking Status: None
"RAI@nuscalepower.com" <RAI@nuscalepower.com>
Tracking Status: None

Post Office: MWHPR09MB1200.namprd09.prod.outlook.com

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Request for Additional Information No. 294 (eRAI No. 9273)

Issue Date: 12/06/2017

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)

QUESTIONS

05.04.02.01-1

As part of the RCPB, SG tubes must be designed to meet the requirements of 10 CFR Part 50, Appendix A, GDC 32, as it relates to maintaining the integrity of the RCPB. As described in DSRS Section 5.4.2.2, the standard technical specifications (STS) provide for the establishment and implementation of a SG program for maintaining tube integrity. The STSs define structural integrity performance criteria and include a plant-specific tube plugging criterion based on a minimum acceptable tube wall thickness. As stated in DSRS Section 5.4.2.2, RG 1.121, "Bases for Plugging Degraded PWR Steam Generator Tubes," is an acceptable methodology for determining the minimum wall thickness that ensures adequate safety margins against both burst and collapse.

In Section 5.4.1.6.1 in Tier 2 of the FSAR and Technical Specification (TS) 5.5.4.c, the NuScale design proposes to plug SG tubes containing flaws with a depth of 40 percent or more of the nominal tube wall thickness. According to Table 1.9-2 in Tier 2 of the FSAR, the value was determined according to RG 1.121. However, the NRC staff was not able to determine that the proposed plugging criterion satisfies the structural integrity performance criterion due to the SG tubes in this design being more sensitive to buckling/collapse from external pressure than to burst from internal pressure. Therefore, the NRC staff requests the following information:

- a. In order to clarify that the tube plugging criterion is determined according to RG 1.121, revise Section 5.4.1.6 in Tier 2 of the FSAR to include a statement to that effect.
- b. An explanation for the statement in Section 5.4.1.2 in Tier 2 of the FSAR that tube integrity is maintained at 50 percent tube thickness degradation under all loading conditions, given that the plugging criterion in TS 5.5.4.c is 40 percent.
- c. The 40 percent plugging criterion is based on wear flaws caused by tube support tabs and having a limited circumferential and axial extent. As proposed, the 40 percent through-wall plugging criterion does not limit the axial or circumferential length of the flaws despite being determined for flaws of limited length. Discuss how you determined the axial length that satisfies the plugging criterion and whether that axial length was for both burst and collapse pressure. In addition, discuss your basis for using the von Mises strain in the flat-bottomed flaw under compression at external differential pressure to determine margins rather than the safety factor of 3 as proposed in your TS 5.5.4.b.1 and required for conformance to NEI 97-06 and RG 1.121.
- d. The NuScale design has higher pressure on the outside of the SG tubes which creates a compressive hoop stress on the SG tubes. However, cold-bending the SG tubes could introduce residual tensile stresses. Describe how you evaluated the residual stress in the cold-worked tubes and the potential for creating axial or circumferential inside diameter (ID) surface cracks. Describe how you determined that all potential cracks on the ID surface would not contribute to failure from external pressure. If the bend radius thermal stress relief specification developed for large light-water reactors was used to limit residual stress, how was that specification found to be adequate for the

loads applied to NuScale SG tubes? In addition, failure pressure may be sensitive to the ovalization in helically fabricated tubes, therefore, did your analyses with respect to ovalization include the tube bend radius for helical and transition regions where the tube is thinned from bending?

- e. Combined License (COL) Item 5.4-1 on Page 5.4-13 of Tier 2 of the FSAR states that a COL applicant referencing the NuScale Power Plant design certification will develop and implement a SG program that includes tube plugging. To meet the requirements of 10 CFR 50.36, the SG program is described in the TSs. While “40%” in your proposed TS 5.5.4.c is not bracketed (bracketed would mean the “40%” is preliminary), it is the NRC staff’s understanding from a September 12, 2017, audit status teleconference, that NuScale intends to bracket “40%” in the TSs. In order for the design to fully describe the basis for your proposed tube plugging criterion, add a description to the FSAR of how plant-specific factors were included in the tube plugging criterion and may, therefore, result in COL applicants proposing a criteria other than 40 percent.