RAIO-1117-57087

November 09, 2017

Docket: PROJ0769

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 9095 (eRAI No. 9095) on the NuScale Topical Report, "Evaluation Methodology for Stability Analysis of the NuScale Power Module," TR-0516-49417, Revision 0

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 9095 (eRAI No. 9095)," dated September 10, 2017
2. NuScale Topical Report, "Evaluation Methodology for Stability Analysis of the NuScale Power Module," TR-0516-49417, Revision 0, dated July 2016

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's response to the following RAI Question from NRC eRAI No. 9095:

- 01-41

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com.

Sincerely,

Jennie Wike
Manager, Licensing
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8G9A
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9095

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Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9095

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Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 9095
Date of RAI Issue: 09/10/2017

NRC Question No.: 01-41

Title 10 of the Code of Federal Regulations (CFR), Part 50, Appendix A, General. Design Criterion (GDC) 10, “Reactor design,” states that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences. GDC12, "Suppression of reactor power oscillations," requires that oscillations be either not possible or reliably detected and suppressed. The Design-Specific Review Standard (DSRS), 15.9.A, “Design-Specific Review Standard for NuScale SMR Design, Thermal Hydraulic Stability Review Responsibilities,“ indicates that the applicant’s analyses should correctly and accurately identify all factors that could potentially cause instabilities and their consequences. The analyses should also demonstrate that design features that are implemented prevent unacceptable consequences to the fuel.

Section 5.5.6.1, Fluid Properties,” of the topical report (TR), TR-0516-49417-P, indicates that fluid properties are based on curve fits of the necessary fluid properties over the expected range of analysis. The fits are verified by comparison to a 1995 implementation of the IAPWS property formulations. Thermal-hydraulic modeling issues have been observed with applying the 1997 IAPWS standard at least, to conditions where the liquid becomes highly superheated.

In order to make an affirmative finding NRC staff requests NuScale to:
1) Provide the range over which the fluid property curves have been verified.
2) Compare the verification range to the range of conditions necessary for stability analysis. The analysis range described by this response should address relevant (i.e., credited) TS limits and MPS setpoints that constrain thermal-hydraulic conditions in the power module.
3) Does the range of application consider conditions where the liquid becomes highly superheated?

- If so, does this present any concern or issue when computational performance in this regime?
-Address any such computational performance issues with respect to ensuring accurate and acceptable calculation of key figures of merit using PIM.

NuScale Response:

Item 1:

The fluid properties were verified for pressure up to 150 bar, and liquid subcooling up to 200 °C. Thermal expansion of the liquid across the saturation point is assumed continuous, where the metastable side (superheated) cannot be compared with steam tables for verification.

Item 2:

The verification range of fluid properties is wider than needed for stability calculations and covers the range of analytical operating limits as shown in Figure 4.4-9 of the FSAR from which the Tech Spec limits and MPS setpoints will be established.

Item 3:

The stability calculations do not need highly superheated liquid. The liquid bulk flow remains in subcooled condition. Liquid superheat is possible under transients where pressure is reduced and for the computation of subcooled boiling. However, in cases where the rate of depressurization is slow, equilibration by vapor generation prevents any significant superheat during transients. No code performance issues were identified due to liquid superheat.

Impact on Topical Report:

There are no impacts to the Topical Report TR-0516-49417, Evaluation Methodology for Stability Analysis of the NuScale Power Module, as a result of this response.