RAIO-0917-56238

September 27, 2017

Docket: PROJ0769

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

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 8946 (eRAI No. 8946) 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. 8946 (eRAI No. 8946)," dated July 30, 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. 8946:

- 01-27

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,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8946

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Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8946

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Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 8946
Date of RAI Issue: 07/30/2017

NRC Question No.: 01-27

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. The Standard Review Plan (SRP) 15.0.2 acceptance criteria with respect to evaluation models specifies that the chosen mathematical models and the numerical solution of those models must be able to predict the important physical phenomena reasonably well from both qualitative and quantitative points of view.

Section 4.3.1.5, “Instability Mode: Geysering,” of the topical report, TR-0516-49417-P, discusses the treatment of metastable states in the stability analysis method, but may miss important details in capturing the phenomenon of subcooled boiling heating the fluid downstream of the reactor core.

In order to make an affirmative finding, NRC staff requests NuScale provide a detailed description of how heat deposition is handled in PIM. The heat deposition description should also address how subcooled boiling may result in the deposition of heat to fluid above the reactor core in the riser component. Justify any assumptions regarding the spatial distribution of heat deposition.

NuScale Response:

The energy balance in PIM applies to non-equilibrium two-phase flow. Subcooled boiling generated steam is at saturation while the liquid phase remains subcooled. The steam generated by the subcooled boiling process in the core is transported into the riser section where it is then subject to condensation by the subcooled liquid in the riser. Condensation imparts latent heat to the liquid phase as described by the energy balance equation in PIM. The rate of condensation is governed by the non-equilibrium phase change model in PIM.

The effect of subcooled boiling in the riser can be seen only for cases outside the permitted

operating range. Examples are given in the topical report Figures 9-10 and 9-14 which show void fraction for unstable and stable runs, respectively. The figures show that the core exit void fraction exceeds the riser exit value by nearly 0.04, which is due to the collapse of the subcooled bubbles exiting the core. These figures demonstrate that the subcooled boiling and subsequent condensation are modeled. However these processes are not considered as important in determining system stability by virtue of their small magnitude, and also because the concentration of the voids, should any be present, occurs in the center of the core and riser. Since the density head depends on the planar average of density, the radially smeared average void is the correct parameter not the local concentration due to spatial distribution. The PIM code is one-dimensional, which automatically uses the planar average and there is no direct accounting for radial distribution effects.

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.