RAIO-0918-61819

September 17, 2018

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 Supplemental Response to NRC Request for Additional Information No. 8873 (eRAI No. 8873) 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. 8873 (eRAI No. 8873)," dated June 30, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 8873 (eRAI No.8873)," dated August 18, 2017
3. 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) supplemental response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's supplemental response to the following RAI Question from NRC eRAI No. 8873:

- 01-17

This supplemental response is associated with a July 11, 2018 teleconference.

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 Paul Infanger at 541-452-7351 or at pinfanger@nuscalepower.com.

Sincerely,

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

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
Bruce Bavol, NRC, OWFN-8G9A

Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8873

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8873

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Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 8873

Date of RAI Issue: 06/30/2017

NRC Question No.: 01-17

In accordance with 10 CFR 50 Appendix A GDC 10, “Reactor design,” 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 includes the requirement 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 5.6.2, “Decay Heat” of the topical report (TR), TR-0516-49417-P, states that the decay heat is treated as a static power level in the calculations. Section 8.2.2.2, “Event at 32 MW Conditions with 35 Percent Initial Decay Heat,” of the TR refers to sensitivity calculations performed at various levels of decay heat. It is not clear how the user determines an appropriate input, percentage of the initial thermal power, for licensing calculations using PIM.

In order to make an affirmative finding associated with the above regulatory requirement important to safety, NRC staff requests NuScale to describe the method for determining an appropriate decay heat level input for licensing calculations.

NuScale Response:

This response supplements the original RAI 01-17 (eRAI 8873) response which was submitted to the NRC on August 18, 2017 (ML17234A748). NuScale has modified Topical Report TR-0516-49417, Evaluation Methodology for Stability Analysis of the NuScale Power Module, Section 10.4 to clarify that stability analyses shall be performed using a conservative value of decay heat.

Impact on Topical Report:

Topical Report TR-0516-49417, Evaluation Methodology for Stability Analysis of the NuScale Power Module, has been revised as described in the response above and as shown in the markup provided in this response.

confirming the NPM stability performance. The application methodology addresses evolving design, performance, and operation by analyzing the effect of such evolutions in the stability analysis. Changes may stem from effects such as revision of the plant design, improved hydraulic and neutronic design of the nuclear fuel, cycle length changes, power uprates, and cycle-specific application (e.g., the initial core).

The following considerations are made in confirming the NPM stability performance and acceptability of the regional exclusion solution when addressing evolving design, performance, or operation of the NPM. These considerations are the key parameters affecting NPM stability performance. {{

}}2(a),(c)

Stability analyses are performed assuming a bounding conservative fraction of decay heat. This is done by performing the stability calculation using the decay heat value that results in the least stable response. The minimum value of decay heat is 0 and the maximum value of decay heat is obtained by assuming extended steady state operation at 100 percent power immediately prior to the analysis condition. These two cases must be considered because decay heat is destabilizing for MTC<0 and stabilizing for MTC>0, and so for conditions where MTC is greater than 0 the minimum value of decay heat is used.

Demonstration examples of the scope of analysis conditions are provided in this report to support the applicability of the analytical methods of the PIM code. Final analysis will be provided separately for the final design. An application of this methodology with a full analysis scope is expected to support or disposition the stability impact of future NPM design changes.

In order to utilize the methodology described in this report, the applicability of the regional exclusion stability protection solution by satisfying the condition that the conservative maximum (positive) MTC is within the value used for the generic analysis and the riser subcooling is within the technical specification value must be confirmed on a cycle-specific basis.

10.4.1 Stability Analysis Application Methodology Conditions

The following conditions and limitations must be met for a stability analysis using the methodology in this report:

- Fuel designs that are different than the reference design used in this topical report must be hydraulically compatible with the reference fuel design.
- The assumed decay heat must be a conservative value for the conditions at which stability is being calculated as described in Section 10.4.
- A default boiling coefficient value of γ = 5000 kg/m^3-s must be used. Any modification to the boiling model must preserve the degree of the intended conservatism which reduces subcooled boiling in a single-channel core application.
- A core average pellet-clad gap conductance must be determined in accordance with the methodology defined in Section 5.6.4.3 of this topical report. Different gap conductance values are used if obtained from a qualified thermo-mechanical code calculation.
- Nuclear parameters used in the stability analysis must be the limiting values over the entire cycle, whether this is beginning of cycle (BOC), end of cycle (EOC), or any time during the cycle.

11.0 Summary and Conclusions

A methodology for the evaluation of the stability of the NPM has been presented. The stability phenomena are considered from the fundamental level and screened for applicability to NPM. The ranking of these phenomena is the guide for the computational models developed for the stability analysis and is assessed versus NIST-1 data and supported by first principles analysis of trends.

No assumptions are made with regard to stability trends being in any way similar to past experience, particularly with BWRs. Important differences between BWR and the NPM stability trends are identified, namely: {{

- Negative moderator reactivity feedback is stabilizing in the case of the NPM, unlike BWRs. Note that a small positive moderator reactivity coefficient, which is destabilizing, is possible in principle for low exposure high boron and low-moderator temperature. }}2(a),(c),ECI