RAIO-0218-58872

February 27, 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 Response to NRC Request for Additional Information No. 9176 (eRAI No. 9176) 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. 9176 (eRAI No. 9176)," dated January 03, 2018
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 Enclosures to this letter contain NuScale's response to the following RAI Question from NRC eRAI No. 9176:

- 01-65

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 9176 (eRAI No. 9176). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The enclosed affidavit (Enclosure 3) supports this request. Enclosure 2 is the nonproprietary version of the NuScale response.

This letter and the enclosed responses 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

Distribution: Samuel Lee, NRC, OWFN-8G9A
Prosanta Chowdhury NRC, OWFN-8G9A
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9176, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9176, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0218-58873

NuScale Power, LLC
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Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9176, proprietary

NuScale Power, LLC
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Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9176, nonproprietary

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Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 9176
Date of RAI Issue: 01/03/2018

NRC Question No.: 01-65

Title 10, the code of federal regulations (CFR), Part 50, Appendix A, General Design Criterion (GDC) 12- 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.

In Section 8.1.5, "Stability at {{ }}$^{2(a),(c)}$ MW," of the topical report (TR), TR-0516-49417-P, PIM stability analyses are briefly discussed for two different feedwater temperatures, {{ }}$^{2(a),(c)}$. Both PIM analyses were performed at {{ }}$^{2(a),(c)}$ of rated power ({{ }}$^{2(a),(c)}$) and correspond to conditions before and after turbine and the feedwater-heater system are brought online. Since the TR is seeking NRC approval for both the PIM code and the proposed stability solution, comparison of both feedwater temperature cases is needed to assess PIM predictive capabilities. Transient flow results (coolant flow vs time) for the {{ }}$^{2(a),(c)}$ (feedwater temperature) case are shown in Figure 8-11 while results for the {{ }}$^{2(a),(c)}$ case were not presented since they were found to be slightly more stable. However, the effect of feedwater flow temperature on steam generator feedback gain, and subsequently stability behavior cannot be examined with only the {{ }}$^{2(a),(c)}$ results. Section 7.2, "Stability Trend with Variation of Power," develops a simplified analysis to estimate the effect steam generator (SG) feedback on decay ratio (DR) and reactor power (ratio). Therefore, it appears that the effect of SG feedback on DR, in this case, due to feedwater temperature could be characterized by applying the normalized DR expressions, Eq. 7-26 or Eq. 7-27, and comparing the PIM predicted results for the {{ }}$^{2(a),(c)}$ feedwater temperature simulations.

In order to make an affirmative finding associated with the above regulatory requirement important to safety, NRC staff requests NuScale to:

(1) Provide: the DR, circuit transit time, and period results of both the {{ }}$^{2(a),(c)}$ feedwater temperature PIM calculations.

(2) Explain the DR difference between the results for feedwater temperatures of {{ }}$^{2(a),(c)}$.

-Relate the differences in DR results to those that can be attributed to differences in the SG gain, using the gain definition(s) and normalized DR expressions defined in section 7.2 of the TR
- Describe the impact of any observed differences in DR for {{ }}$^{2(a),(c)}$ feedwater result, at low power.

NuScale Response:

Item 1:

For the {{ }}$^{2(a),(c)}$ power case, the flow rate input to PIM is the same regardless of the feedwater temperature input. In this case, the primary circuit transit time is the same regardless of whether the turbine is engaged or not. That transit time is given in Table 8-1 of TR-0516--49417-P as 122.5 sec. As indicated in the TR, the higher feedwater temperature of {{ }}$^{2(a),(c)}$ is associated with slightly more stable response compared with the no turbine case and with a feedwater temperature of {{ }}$^{2(a),(c)}$. To demonstrate the impact of the different feedwater temperatures the two cases with temperatures {{ }}$^{2(a),(c)}$ are run with PIM. The flow rate responses for both cases are plotted together in Figure 1. The results show that the {{ }}$^{2(a),(c)}$ case is slightly more stable than the {{ }}$^{2(a),(c)}$ case presented in the TR. The decay ratios are calculated from the sequence of peaks and valleys of the flow rate responses. The decay ratio for the {{ }}$^{2(a),(c)}$ case is {{ }}$^{2(a),(c)}$and for the {{ }}$^{2(a),(c)}$ case the decay ratio is {{ }}$^{2(a),(c)}$.

{{

}}$^{2(a),(c)}$

Figure 1 PIM Calculated Flow Rate Response for Two Feedwater Temperatures Cases of {{ }}$^{2(a),(c)}$ and BOC Conditions

Item 2:

Equation 7-27 of TR-0516--49417-P calculates the relative change in decay ratio which depends on the fraction of power relative to the rated value. The calculation also depends on the SG dimensionless parameter, S_0, obtained from the Equation 7-24 in the TR. At the fixed power of {{ }}$^{(2)(a),(c)}$ of rated, the variable term of the SG dimensionless parameter is {{ }}$^{(2)(a),(c)}$. In the TR analysis, the average sink temperature is taken as the saturation temperature at the secondary side pressure, which is appropriate since the boiling condition is

the dominant state inside the SG tubes. The assumption of sink temperature equal to the saturation temperature was made regardless of the feedwater inlet temperature and thus the model does not resolve this effect. However, relaxing this assumption by allowing lower sink temperature than saturated temperature to account for lower feedwater temperature, the effect of feedwater temperature on decay ratio can be calculated parametrically. The following parameters are used to establish a base decay ratio: {{

}}$^{(2)(a),(c)}$. For the low sink temperature variation, let {{ }}$^{(2)(a),(c)}$. The decay ratio is calculated from the TR equations 7-24 and 7-27 for the base and the low sink temperature cases. The result shows that the exaggerated low sink temperature decay ratio is higher than the base case by {{ }}$^{(2)(a),(c)}$. For the more reasonable sink temperature of {{ }}$^{(2)(a),(c)}$ a decay ratio increase of {{ }}$^{(2)(a),(c)}$ difference is calculated relative to the base case.

The first principle calculations demonstrate that a small increase in decay ratio is expected for reduced sink temperature confirming the observation from PIM results. PIM results agree with the simple first principles analysis. However, the comparison cannot be quantified precisely as the effect is small, but it should be noted that the magnitude of the oscillation is approximately 0.02% over a minute.

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.

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0218-58873

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NuScale Power, LLC

AFFIDAVIT of Zackary W. Rad

I, Zackary W. Rad, state as follows:

1. I am the Director, Regulatory Affairs of NuScale Power, LLC (NuScale), and as such, I have been specifically delegated the function of reviewing the information described in this Affidavit that NuScale seeks to have withheld from public disclosure, and am authorized to apply for its withholding on behalf of NuScale.
2. I am knowledgeable of the criteria and procedures used by NuScale in designating information as a trade secret, privileged, or as confidential commercial or financial information. This request to withhold information from public disclosure is driven by one or more of the following:
    a. The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by NuScale competitors, without a license from NuScale, would constitute a competitive economic disadvantage to NuScale.
    b. The information requested to be withheld consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage, as described more fully in paragraph 3 of this Affidavit.
    c. Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.
    d. The information requested to be withheld reveals cost or price information, production capabilities, budget levels, or commercial strategies of NuScale.
    e. The information requested to be withheld consists of patentable ideas.
3. Public disclosure of the information sought to be withheld is likely to cause substantial harm to NuScale's competitive position and foreclose or reduce the availability of profit-making opportunities. The accompanying Request for Additional Information response reveals distinguishing aspects about the methods by which NuScale develops its stability analysis of the NuScale power module.

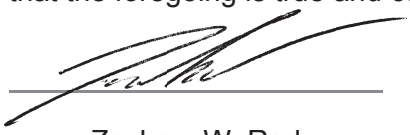
    NuScale has performed significant research and evaluation to develop a basis for these methods and has invested significant resources, including the expenditure of a considerable sum of money.

    The precise financial value of the information is difficult to quantify, but it is a key element of the design basis for a NuScale plant and, therefore, has substantial value to NuScale.

    If the information were disclosed to the public, NuScale's competitors would have access to the information without purchasing the right to use it or having been required to undertake a similar expenditure of resources. Such disclosure would constitute a misappropriation of NuScale's intellectual property, and would deprive NuScale of the opportunity to exercise its competitive advantage to seek an adequate return on its investment.

4. The information sought to be withheld is in the enclosed response to NRC Request for Additional Information RAI No. 9176, eRAI No. 9176. The enclosure contains the designation "Proprietary" at the top of each page containing proprietary information. The information considered by NuScale to be proprietary is identified within double braces, "{{ }}" in the document.
5. The basis for proposing that the information be withheld is that NuScale treats the information as a trade secret, privileged, or as confidential commercial or financial information. NuScale relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC § 552(b)(4), as well as exemptions applicable to the NRC under 10 CFR §§ 2.390(a)(4) and 9.17(a)(4).
6. Pursuant to the provisions set forth in 10 CFR § 2.390(b)(4), the following is provided for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:
    a. The information sought to be withheld is owned and has been held in confidence by NuScale.
    b. The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, chief technology officer or other equivalent authority, or the manager of the cognizant marketing function (or his delegate), for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside NuScale are limited to regulatory bodies, customers and potential customers and their agents, suppliers, licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or contractual agreements to maintain confidentiality.
    c. The information is being transmitted to and received by the NRC in confidence.
    d. No public disclosure of the information has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or contractual agreements that provide for maintenance of the information in confidence.
    e. Public disclosure of the information is likely to cause substantial harm to the competitive position of NuScale, taking into account the value of the information to NuScale, the amount of effort and money expended by NuScale in developing the information, and the difficulty others would have in acquiring or duplicating the information. The information sought to be withheld is part of NuScale's technology that provides NuScale with a competitive advantage over other firms in the industry. NuScale has invested significant human and financial capital in developing this technology and NuScale believes it would be difficult for others to duplicate the technology without access to the information sought to be withheld.

I declare under penalty of perjury that the foregoing is true and correct. Executed on 2/27/2018.



Zackary W. Rad