RAIO-0218-58724

February 16, 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. 9171 (eRAI No. 9171) 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. 9171 (eRAI No. 9171)," dated December 18, 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 Enclosures to this letter contain NuScale's response to the following RAI Question from NRC eRAI No. 9171:

- 01-62

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 9171 (eRAI No. 9171). 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: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
Bruce Bavol, NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9171, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9171, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0218-58725

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
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Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9171, proprietary

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Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9171, nonproprietary

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Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 9171
Date of RAI Issue: 12/18/2017

NRC Question No.: 01-62

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.

NuScales's Response to the NRC Request for Supplemental Information to TR-0516-49417-P Revision 0, ML163338A014, provides results from the {{

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

In order to make an affirmative finding that the test conditions are representative, or bounding, of normal operating conditions, such that they adequately demonstrate compliance with the associated, above regulatory requirement important to safety, NRC staff requests NuScale to:

1. Provide a list of the tests that achieved unstable conditions.
2. Provide figures similar to Figure 6 for these other tests.
3. Provide the thermal-hydraulic conditions for these tests (i.e., mass flow rate, inlet temperature, outlet temperature, and pressure).
4. Compare the operating conditions for {{ }}$^{2(a),(c)}$ to NuScale power module normal operating conditions over a range of power from {{ }}$^{2(a),(c)}$ of rated.

NuScale Response:

Discussion Concerning Figure 6

Figure 6 of the response to the NRC request for supplemental information on TR-0516-49417-P,

LO-1216-52161, Rev. 0, was provided to confirm the statements made in the stability TR that flow oscillations in the SG tubes are self-canceling and do not impact the dynamic response of the primary flow or its stability. Figure 6 of the supplement to the TR shows significant oscillations with reverse flow at the inlet of the SG tubes while the primary temperature measurement shows no corresponding oscillations. There has been no intent to claim unconditional stability of individual SG tubes as needed or expected for the safe and normal stable operation of the NPM.

Item 1:

The SIET-TF2 geometry comprises {{

}}2(a),(c)

{{

}}2(a),(c)

Each test was characterized with a given set of conditions (primary side pressure, flow rate, and inlet temperature; secondary side pressure and inlet temperature). Within each test, several runs were set up where the secondary flow was specified. The secondary flow was varied by steps from one run to another. The reduction of the secondary mass flow rate eventually resulted in the onset of flow oscillations.

A summary of the SIET-TF2 experiments is given in Table 1.

Table 1 SIET-TF2 Test Conditions

{{

}}[2(a),(c)]

Table 2 SIET-TF2 Test Runs Secondary Flow

{{

}}[2(a),(c)]

The onset of instability for test {{ }}[2(a),(c)] occurred as the secondary flow rate is transitioned from {{ }}[2(a),(c)]. For test {{ }}[2(a),(c)], the onset of instability occurred as the inlet flow transitioned from {{ }}[2(a),(c)].

For test {{ }}[2(a),(c)], unstable oscillations were observed at all secondary flow runs at

{{ }}[2(a),(c)]. Unstable oscillations were observed at the {{ }}[2(a),(c)].

Other tests did not result in unstable oscillations.

Item 2:

The Figure 6 of the supplemental response to the TR is representative of the observed onset and growth of oscillations as they reach large amplitude with inlet flow reversal.

The following figures (1 through 11) provide test results similar to Figure 6 of the supplemental response to the TR but with absolute instead of relative quantities. These tests document the runs for which the flow was found to be unstable or stable but with significant flow fluctuations at the inlet of some of the instrumented coils. A corresponding set of figures (12 through 22) show the autocorrelation functions of the flow signals. For the unstable cases, the autocorrelation functions are shown to be sinusoidal with no or minimal decay, while the runs showing lower amplitude flow fluctuations correspond to decaying sinusoidal autocorrelation functions.

The instrumentation range was exceeded for some of the test runs indicating that the actual flow oscillation amplitude was larger than the range shown in the corresponding figures. Even then, the figures show no oscillatory primary temperature response confirming the conclusion that the effect of individual coil flow oscillations cancel out.

{{

}}2(a),(c)

Figure 1 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

{{

}}2(a),(c)

Figure 2 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

{{

}}2(a),(c)

Figure 3 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

{{

}}2(a),(c)

Figure 4 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

{{

}}2(a),(c)

Figure 5 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

{{

}}2(a),(c)

Figure 6 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

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}}2(a),(c)

Figure 7 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

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}}2(a),(c)

Figure 8 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

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}}2(a),(c)

Figure 9 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

{{

}}2(a),(c)

Figure 10 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

{{

}}2(a),(c)

Figure 11 Instrumented coil and total mass flow rate and primary flow temperature drop for test {{ }}2(a),(c)

{{

}}2(a),(c)

Figure 12 Autocorrelation functions from coil mass flow rate data for test {{ }}2(a),(c)

{{

}}[2(a),(c)]

Figure 13 Autocorrelation functions from coil mass flow rate data for test {{ }}[2(a),(c)]

{{

}}[2(a),(c)]

Figure 14 Autocorrelation functions from coil mass flow rate data for test {{ }}[2(a),(c)]

{{

}}[2(a),(c)]

Figure 15 Autocorrelation functions from coil mass flow rate data for test {{ }}[2(a),(c)]

{{

}}[2(a),(c)]

Figure 16 Autocorrelation functions from coil mass flow rate data for test {{ }}[2(a),(c)]

{{

}}2(a),(c)

Figure 17 Autocorrelation functions from coil mass flow rate data for test {{ }}2(a),(c)

{{

}}2(a),(c)

Figure 18 Autocorrelation functions from coil mass flow rate data for test {{ }}2(a),(c)

{{

}}[2(a),(c)]

Figure 19 Autocorrelation functions from coil mass flow rate data for test {{ }}[2(a),(c)]

{{

}}[2(a),(c)]

Figure 20 Autocorrelation functions from coil mass flow rate data for test {{ }}[2(a),(c)]

{{

}}2(a),(c)

Figure 21 Autocorrelation functions from coil mass flow rate data for test

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

{{

}}2(a),(c)

Figure 22 Autocorrelation functions from coil mass flow rate data for test

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

Item 3:

The test conditions are provided in Table 1 as part of the response to Item 1. The remaining information is the mass flow rate of the secondary flow at the onset of instability. These data are provided in Table 2

Item 4:

The SIET-TF2 test geometry is compared with the NPM in Table 3. The operating conditions for the NPM are provided in Table 4, and the conditions for the tests are provided in Table 1 and 2. It is important to note that the possibility and magnitude of density waves in the SG tubes are not a significant phenomenon for the stability of the primary flow, as evidenced by test results demonstrating the lack of heat transfer oscillations when flow in individual coils oscillated.

Table 3 Comparison between NPM and SIET-TF2 Test Geometry

{{

}}2(a),(c)

Table 4 Primary and secondary operating conditions for the NPM

{{

}}2(a),(c)

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-0218-58725

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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.

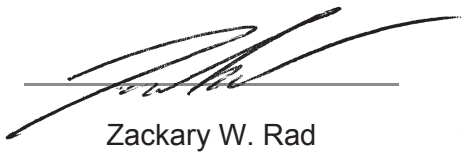
    NuScale has performed significant research and evaluation to develop a basis for this methods and has invested significant resources, including the expenditure of a considerable sum of money.

    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 No. 9171, eRAI No. 9171. 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 2/16/2018.



Zackary W. Rad