RAIO-0618-60298

June 04, 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. 9441 (eRAI No. 9441) 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. 9441 (eRAI No. 9441)," dated April 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. 9441:

- 15.09-7

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 9441 (eRAI No. 9441). 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 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 Response to NRC Request for Additional Information eRAI No. 9441, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9441, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0618-60299

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9441, proprietary

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9441, nonproprietary

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 9441
Date of RAI Issue: 04/03/2018

NRC Question No.: 15.09-7

In accordance with Title 10 of CFR Part 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. Title 10 of CFR, Part 50, Appendix A, GDC 12, “Suppression of reactor power oscillations,” requires that instabilities that could challenge thermal limits either be detected and suppressed or excluded. 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.

NuScale Topical Report TR-0516-49417, "Evaluation Methodology for Stability Analysis of the NuScale Power Module," includes a Phenomena Identification and Ranking Table that provides the importance ranking of phenomena and parameters affecting the NuScale stability analysis. In RAI 8869, the staff requested additional information regarding the rationale for the importance ranking of the heat transfer of the steam generator. In the response to RAI 8869, the applicant states heat transfer in the steam generator is not highly important because the stability characteristics are insensitive to variations in steam generator heat transfer because such variations would be compensated by changes in the primary side temperature. Primary side temperature is an important parameter affecting the prevalence of void formation in the core and it also affects the margins available to riser flashing and riser voiding; all of which could affect stability margins. The staff reviewed the response to the original RAI, RAI 8869, and found that the response was insufficient for the staff to reach a conclusion regarding the importance of the steam generator heat transfer phenomenon.

In order to make an affirmative finding with regard to the above regulatory requirement important to safety, the NRC staff requests the following supplemental information:

- Provide additional rationale explaining the importance ranking for this phenomenon given that the heat transfer affects subcooling margin in the riser. It is acceptable to formulate this rationale using the example provided in the original RAI response (i.e., fouling). This discussion should address the impact of AOOs.

- Provide a description of any limits that apply to primary side temperature either through technical specifications or other operational, physical, or plant design limitations. In this description consider operational parameters that could affect steam generator heat transfer such as fouling, instrumentation and control system bias and uncertainty, and steam generator tube plugging.

- Justify the initial conditions assumed in the AOO calculations presented in the topical report. Provide an explanation for each event discussed in Section 8.2 of the topical report that evaluates the impact regarding steam generator heat transfer. If a higher initial temperature would produce a more adverse response from the standpoint of stability performance or margin compared to the reference results, provide calculation results using the limiting temperature to demonstrate the impact. The response should provide a level of detail regarding these calculations consistent with the detail presented in the topical report.

- If more limiting initial conditions or AOO scenarios are identified as a result of this RAI, revise the topical report accordingly to ensure that analysis of such conditions and scenarios is reflected in the analysis methodology.

NuScale Response:

Item 1

It should be noted that the fouling effect on reducing the steam generator (SG) heat transfer coefficient is a slow process and does not occur during a transient to influence the event trajectory. Fouling, and other effects that influence the effective SG heat transfer such as tube plugging, are fixed parameters during a transient. In the PIM calculations, the initial steady state is over-determined in the sense that power, flow, and core inlet or exit temperature are given. Since the SG pressure is also input, the heat transfer sink temperature is dominated by the saturation temperature at that pressure. In essence, an overall heat transfer coefficient of the SG is already determined by these parameters as the temperature difference across the primary and secondary sides is known and the total power is known. The code calculates the profile of heat transfer and adjusts the heat transfer coefficient relative to the SG heat transfer coefficient that is calculated from the heat transfer correlations and the tube wall resistance. The adjustment ratio is termed the “fouling factor” which accounts not only for physical buildup of deposits on the tube wall but also for the model differences between PIM and the detailed calculation (with NRELAP5) from which the coolant temperature input is obtained. The fouling adjustment factor is assumed invariant and used to correct the internally calculated SG heat transfer coefficient during the transient.

A simple quantitative examination of this effect is presented by considering the average coolant temperature to be {{ }}$^{2(a),(c)}$, saturation temperature in the SG secondary side of

---

{{ }}[2(a),(c)]; a fouling factor of 1.2 results in increasing the temperature difference across the SG by {{ }}[2(a),(c)]. Since the sink temperature inside the SG is unaffected, the coolant temperature increases by {{ }}[2(a),(c)]. The riser inlet subcooling under normal operation is {{ }}[2(a),(c)] for power in the range of 100~20% of rated, which is significantly higher than the assumed fouling effect of {{ }}[2(a),(c)]. It should be noted that PIM flags a warning in case fouling factor exceeds 1.2 where typically smaller value of nearly 1.1 is calculated. In the case over-determined input is not used and no fouling adjustment is needed, the PIM computed coolant temperature would be lower which increases the riser subcooling rather than diminishes it.

Item 2

The primary side temperature is limited on the low side by criticality consideration to {{ }}[2(a),(c)]. On the high side, riser inlet subcooling of a minimum of {{ }}[2(a),(c)] must be maintained. The value of {{ }}[2(a),(c)] subcooling takes into account instrument uncertainties. Typical primary side temperature is provided in Table 3-1 of TR-0516-49417, "Evaluation Methodology for Stability Analysis of the NuScale Power Module." The operation state including the primary flow pressure and temperature are controlled by the operator and protected by automated system. The plant cannot be operated in case of SG degradation of performance (e.g. due to physical fouling or tube plugging) that results in failure to maintain operation within these criteria. For any permitted operation, the riser inlet subcooling margin is needed to assure stable operation is enforced.

Item 3

The only transient that results in instability due to riser voiding is the depressurization scenario. The initial conditions are typical steady state operation at rated power. There is no need to perform fresh PIM calculations assuming a higher initial coolant temperature (lower initial riser inlet subcooling), for the same calculated instability will be reproduced at earlier time at which the inlet subcooling vanishes. Therefore there is no effect of the initial subcooling value on the severity of the instability. At either case, the plant protection system would scram well before the inception of oscillations.

Item 4

No more limiting transient scenarios were identified as due to different initial riser inlet subcooling state.

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-0618-60299

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

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 method 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 method 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. 9441, eRAI 9441. 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 June 4, 2018.

Zackary W. Rad