RAIO-0618-60250

June 01, 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. 9439 (eRAI No. 9439) 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. 9439 (eRAI No. 9439)," dated April 02, 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. 9439:

- 15.09-6

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 9439 (eRAI No. 9439). 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,

Jennie Wike
Manager, Licensing
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. 9439, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9439, nonproprietary

Enclosure 3: Affidavit of Thomas A. Bergman, AF-0618-60251

NuScale Power, LLC
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Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9439, proprietary

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Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9439, nonproprietary

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Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 9439
Date of RAI Issue: 04/02/2018

NRC Question No.: 15.09-6

Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Appendix A, General Design Criterion (GDC), “Reactor design,” requires 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 (SAFDLs) are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences (AOOs). Title 10 of CFR, Part 50, Appendix A, GDC 12, “Suppression of reactor power oscillations,” requires that the reactor core and associated coolant, control, and protection systems shall be designed to assure that power oscillations which can result in conditions exceeding SAFDLs are not possible or can be reliably and readily detected and suppressed.

Standard Review Plan (SRP) Section 15.0.2, ”Review of Accident and Transient Analysis Methods,” states that the reviewers should confirm that sources of code uncertainty have been addressed, including uncertainties in plant model input parameters for plant operating conditions.” SRP 15.0.2 refers to Regulatory Guide 1.203, “Transient and Accident Analysis Methods,” which indicates that model and correlation information including original source, supporting database, accuracy and applicability should be documented as part of a models and document evaluation report. SRP 15.0.2 also states that the chosen mathematical models and numerical solution of those models must be able to predict important physical phenomena reasonably well from both qualitative and quantitative points of view.

The staff reviewed the response to the original RAI, RAI 8802, and found that the response was insufficient for the staff to reach a conclusion regarding the adequacy of the stability analysis methodology. The following supplemental information is therefore requested in order to make an affirmative finding associated with the above regulatory requirement important to safety:

1. Explain the methodology by which SIMULATE5 results are used to provide reactivity parameters to determine the kinetics parameters used in PIM. This explanation should include:
    - a description of the SIMULATE5 cases that are run,
    - a listing of the SIMULATE5 outputs that are considered (e.g., multiplication factor, delayed neutron fraction, moderator densitymoderator density coefficient, etc.), and

- a description of any response surface generated from the SIMULATE5 results.

2. Provide the SIMULATE5 results used to determine the default reactivity coefficient fits and kinetics parameters used in PIM.
3. Using the current results, coefficients, response surface and kinetics parameters (as applicable) as an illustrative example, demonstrate how off-rated conditions are accounted for in the modeling of reactivity feedback in PIM.

The original RAI response appears to disagree with the provisions of the TR (NuScale Topical Report TR-0516-49417, "Evaluation Methodology for Stability Analysis of the NuScale Power Module") in Section 5.6.1 and Section 10.4 of the TR with respect to the source of the nuclear data and evaluating cycle-specific reactivity parameters, respectively. The TR states in Section 5.6.1:

> "These reactivity components can be obtained by fitting CASMO5 lattice code calculations..."

Furthermore, Section 10.4 of the stability TR states:

> "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."

However, the original RAI response states:

> "The neutron kinetics parameters in PIM were prepared by processing SIMULATE5 analyses of a representative NuScale reactor core (RXC) on a generic basis; there is no intention of representing cycle-specific data."

4. Provide clarification and correction of inconsistent language in the stability TR with respect to nuclear data sources and evaluation of cycle-specific reactivity parameters as indicated below:
   - Revise Section 5.6.1 of the TR to clarify that the coefficients are derived from SIMULATE5 analyses of a representative NuScale reactor core on a generic basis.
   - Provide the moderator density reactivity coefficient multiplier used in the generic analysis. Does the multiplier ensure that the generic analysis is conservatively bounding?
   - Reconcile the original RAI response with Section 10.4 by clarifying the following points and update the TR language accordingly:

- Explicitly confirm that the methodology requires kinetic parameters (e.g., MTC) to be evaluated on a cycle-specific basis and compared to the generic stability analysis value to ensure the applicability of the TR to the cycle- specific core design.
- Is approval sought to allow a licensee to re-perform the PIM stability analyses on a cycle-specific basis if the MTC is outside of the bounds generically analyzed in the current TR? If such an approval is sought, confirm that the methodology described in Part 1 of this supplemental RAI response is what would be followed on a cycle-specific basis.

NuScale Response:

The neutron kinetics parameters to PIM are provided by CASMO5/SIMULATE5 code system. When the kinetic parameters source is cited as SIMULATE5, it is by necessity implying the lattice code CASMO5 as the originating source of the nuclear cross sections. The lattice code CASMO5 was mentioned explicitly as the direct source of the neutron point kinetics parameters in the response to RAI 9097 Q43. The same CASMO5 kinetics parameters can be equivalently tapped from the core simulator code SIMULATE5; there is effectively no difference between the two paths of data which differ only in bookkeeping and either path will be used as may be appropriate for the end use. Specifically, the analysis presented in TR-0516-49417, "Evaluation Methodology for Stability Analysis of the NuScale Power Module" and as mentioned in the response to RAI 9097 Q43 used CASMO5 results directly, while it may be more suitable for the work flow to tap equivalent data from SIMULATE5 runs that may be already available and overlapping with the needs of other codes such as NRELAP5.

Item 1

The methodology for obtaining the reactivity parameters for the PIM calculations in the TR utilized the lattice code CASMO5 directly (not through SIMULATE5). The runs were described in the response to RAI 9097 Q43. Additional details are provided here in Tables 5 and 6 of the multiplication factor as a function of moderator density at different exposure points while the fuel temperature is fixed; these data provide the moderator density coefficient (MDC) fit. Also, tables of the multiplication factor at different exposures while varying the fuel temperature are provided here Tables 7 and 8; these data are used to fit the Doppler reactivity coefficient. The fits of the MDC and Doppler constitute the response surfaces, which are given in sections 5.6.1.1 and 5.6.1.2 of the TR.

Item 2

The results are those of CASMO5 directly (not SIMULATE5) calculations. The input parameters are summarized in Tables 1 through 4. The resulting multiplication factors for these calculations are tabulated in Tables 5 through 8 respectively.

Table 1 BOC Statepoint Parameters as a Function of Moderator Density

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

Table 2 EOC Statepoint Parameters as a Function of Moderator Density

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

Table 3 BOC Statepoint Parameters as a Function of Fuel Temperature

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

Table 4 EOC Statepoint Parameters as a Function of Fuel Temperature

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

Table 5 BOC Statepoint Reactivity as a Function of Moderator Density

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

Table 6 EOC Statepoint Reactivity as a Function of Moderator Density

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

Table 7 BOC Statepoint Reactivity as a Function of Fuel Temperature

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

Table 8 EOC Statepoint Reactivity as a Function of Fuel Temperature

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

Item 3

As shown in the tables of item 2 above, the range of moderator density used in the fits ranges from 0.97 g/cc to 0.43 g/cc, and fuel temperature in the range of 400 K to 1120 K, which is sufficiently wide to cover off-rated conditions.

The apparent disagreement in the TR and previous RAI response can be reconciled by confirming that the CASMO5 and SIMULATE5 data paths are equivalent.

Regarding the self-imposed limitations in the TR, “In order to utilize…” regarding the moderator temperature coefficient and the riser subcooling, these were placed to guard against large qualitative changes of the fuel type and/or operating conditions. For example, should fuel materials (not currently under consideration) be introduced, significant impact on moderator reactivity cannot be excluded and a reevaluation of the stability analysis is triggered. On the other hand, under the current fuel type designs common for PWR with UO_2 fuel, the default generic reactivity coefficients are considered sufficiently representative of subsequent loading where the variability is mostly due to exposure, not the fuel design the exposure range has been tested in the full range from BOC to EOC conditions so no further variability of the reactivity coefficients is needed.

Item 4

- Section 5.6.1 already includes a test for reasonableness of the reactivity coefficients which implies their applicability on a generic basis for current fuel designs. However, the TR is devoted to the methodology description where the input data are not restricted or frozen to specific values, thus allowing the methodology a general scope of applicability.
- The moderator reactivity multiplier is always set to unity in the analyses reported in the TR.
- The response to RAI 8802 and the TR section 10.4 are reconciled by stating that the kinetics parameters do NOT require cycle-specific evaluation unless a new fuel type is introduced, in which case new fits of the reactivity coefficients are used or a multiplier modifying the generic set is used.
- Approval is sought to allow performing new PIM stability analyses on a cycle-specific basis if the MTC is outside of the bounds generically analyzed in the current TR, which would be triggered by introducing new fuel types or operating conditions. In such eventuality the methodology described in Part 1 of this supplemental RAI response is what would be followed on a cycle-specific basis to cover the transition from the current to new fuel type and/or reload strategy.

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 Thomas A. Bergman, AF-0618-60251

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NuScale Power, LLC

AFFIDAVIT of Thomas A. Bergman

I, Thomas A. Bergman, state as follows:

1. I am the Vice President, 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. 9439, eRAI No. 9439. 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 1, 2018.

Thomas A. Bergman