RAIO-0418-59403

April 03, 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. 9333 (eRAI No. 9333) 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. 9333 (eRAI No. 9333)," dated February 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 Questions from NRC eRAI No. 9333:

- 01-66
- 01-67

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 9333 (eRAI No. 9333). 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
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9333, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9333, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0418-59404

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9333, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9333, nonproprietary

Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 9333
Date of RAI Issue: 02/02/2018

NRC Question No.: 01-66

Title 10 of the Code of Federal Regulations (CFR), Part 50.34, “Contents of Application; technical information,” requires licensees to submit safety analyses that demonstrate how a given reactor complies with associated safety criteria. NuScale has submitted the PIM stability analysis methodology for NRC review and approval such that it may be used to demonstrate that the NuScale power module complies with the requirements of GDC 12 of 10 CFR 50 Appendix A. In reviewing that method, according to SRP 15.0.2, “Review of Transient and Accident Analysis Methods,” the reviewer must ensure that the field equations of the evaluation model are adequate to describe the set of physical phenomena that occur in the accident and ensure that the closure relationships are valid over the full range of conditions encountered.

According to software verification test results audited by NRC staff, it appears that there are certain analysis conditions that result in errors in the energy conservation, either on a nodal basis or on the basis of the entire system. These errors are encountered only under particular code uses. Per NuScale’s own quality procedures, these limitations on the conditions that can be accurately analyzed are supposed to be reflected in the code user’s manual. These documented limitations would then, also per NuScale’s procedures, preclude the code from being applied to analyze conditions that would violate the field equation accuracy. However, it does not appear as if the associated code limitations are documented in the PIM user’s manual provided in the stability topical report (TR), TR-0516-49417-P, or in NuScale’s most recent user’s manual for PIM.

In order to make an affirmative finding with regard to the above regulatory requirement important to safety, NRC staff requests that NuScale update the PIM user’s manual to include limitations on the use of the code consistent with the limitations identified during the initial software verification testing with respect to energy conservation and steam generator modeling options

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NuScale Response:

In the initial verification testing of PIM, the following anomaly is described and dispositioned.

> "*In testing in Appendix D, it was determined that energy error was not completely preserved at the end of steady state for the specific case where input conditions result in two-phase flow in the riser and with the effect of ambient heat losses included. This results in a very small difference of temperature in node 0 versus the last node as observed in the first time entry of the fort.11 file. Disabling ambient heat losses showed the energy is conserved. The energy error is very small, and initiation with two-phase flow conditions is not a standard analysis condition, it is only used in the Ledinegg calculations for high power/flow cases.*"

This has been added to the internal code error reporting process for disposition however resolution has not been prioritized due to the limited impact on uses of PIM. Due to the stylized nature of this software test a general user warning or limitaion is not necessary as previously dispositioned.

<u>Steam generator model</u>

In the initial verification testing of PIM, the following anomaly is described and dispositioned.

> *In application within the scope of Appendix D, it was identified that the simplified steam generator model (isgtyp=1) does not contain a test to make sure the specified secondary conditions are sufficient to remove all deposited heat from the primary. Specifically, if the primary core outlet temperature is too low, sufficient steam generator outlet conditions cannot be attained to remove the specified core power. Instead of exiting gracefully, the code is crashing on enthalpy error associated with the code attempting to find acceptable steam generator heat transfer.*"

The simple nature of PIM requires more attention to input parameters or the code will not be able to converge to a steady state solution. This is not a code error; however, the updated version of PIM includes a warning about the SG fouling factor to alert the users that specified initial conditions may not be realistic for the SG heat transfer models. This is not a code use limitation, rather an indication to the user to evaluate the specified initial conditions.

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.

Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 9333
Date of RAI Issue: 02/02/2018

NRC Question No.: 01-67

Title 10 of the Code of Federal Regulations (CFR), Part 50.34 “Contents of Application; technical information,” requires licensees to submit safety analyses that demonstrate how a given reactor complies with associated safety criteria. NuScale has submitted the PIM stability analysis methodology for NRC review and approval such that it may be used to demonstrate that the NuScale power module complies with the requirements of General Design Criteria (GDC) 12 of Title 10 CFR 50 Appendix A. SRP 15.0.2, “Review of Transient and Accident Analysis Methods,” which provides guidance for the review of transient and accident analysis methods, directs the reviewer to review the quality assurance program, and in particular the software configuration control and testing procedures to ensure compliance with the requirements of Title 10 CFR 50 Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Reprocessing Plants”.

During the NRC staff audit of the software test plan and associated procedures for PIM, the staff found that the regression testing requirements leave PIM susceptible to a condition the staff refers to as “code drift.” Code drift refers to a process whereby multiple, subsequent changes to an evaluation model or code result in a significant change in the results. Code drift can occur if each change results in only a small difference in the results from version to version in each change, but the difference continues to accumulate in a consistent direction. Title 10 CFR 50.46a(3)(i) codifies this concept for evaluation models (EMs) used for loss-of- coolant-accident (LOCA) analyses. For LOCA EMs, the impact to the figure of merit (peak cladding temperature in this case) must be integrated with each change (including error corrections) made to the EM. In this sense, because the integrated effect of the changes are considered, the reporting requirements are triggered when the accumulated effect becomes significant. Without tracking of the integrated effect of changes, it would be possible for changes to accumulate such that each change from an approved version results in code drift and a significant difference goes undetected.

In order to make an affirmative finding with regard to the above regulatory requirement mportant to safety, the NRC staff requests that NuScale describe how code drift is avoided through the regression testing process of PIM. In this description provide a description of the specific test cases, reference solutions, and acceptance criteria applied. Further, provide a brief description of any updates to the software test plan that may arise as a result of response to this request.

NuScale Response:

The PIM software is controlled under the software configuration control program implemented at NuScale per Section 2.3.3 of Section B in the Quality Assurance Program Description Topical Report, NP-TR-1010-859-NP-A. Testing requirements are covered in Section 2.11.2 of Section B of the same document.

As part of this configuration control, a test matrix is developed for the initial release of the pre-verified software package. Requests to modify the code, including new routines and abilities, are tracked in the NuScale Error Tracking System. As these requests are implemented into new versions of the software, the previously established test matrix is evaluated and new cases are added to cover the newly implemented code. All of the carry-over test results are compared against the established baseline results from the previous code version to ensure that there are no unintended changes to the performance of the software.

For PIM specifically, validation cases against NIST-1 for the initial version of the software are outlined in Section 6 of TR-0516-49417-P; additional functional testing was performed during initial development of the software. As part of bringing PIM into the configuration control as a pre-verified software package, these cases formed the baseline of the software test plan. With each ensuing revision of the software, the software test plan is updated, including a section covering regression testing and the requirements and acceptance criteria of such testing. This regression testing includes the test matrix developed for the previous revision. The results of the regression testing are then captured in the test report, confirming that no unintended changes to the software were introduced, and new versions of the software will produce identical results for analyses unaffected by code changes.

An example of the set of test cases performed during the production of Version 1.2 is shown in Table 1. Cases that show differences are noted and justification is provided. Figure 1 shows a case where a difference was encountered. The excerpt below provides the justification for this difference.

This process is sufficient to capture any code drift that would occur, as performance changes in the software would be captured in the testing phase. The latest software test report for PIM, covering version 1.2 of the software, notes:

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}}2(a),(c)

Therefore, no code drift has occurred through Version 1.2 of PIM, and any future code drift will be captured as part of the testing and verification process.

Table 1 Integration Tests Summary Table

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}}2(a),(c)

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}}2(a),(c)

Figure 1 Primary Mass Flow for Test Number 1 (Truncated Time Scale)

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-0418-59404

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. 9333, eRAI No. 9333. 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 4/3/2018.

Zackary W. Rad