RAIO-0219-64477

February 11, 2019

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 Supplemental Response to NRC Request for Additional Information No. 9351 (eRAI No. 9351) on the NuScale Topical Report, "Non-Loss of Coolant Accident Analysis Methodology," TR-0516-49416, Revision 1

REFERENCES:

1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 9351 (eRAI No. 9351)," dated May 14, 2018
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 9351 (eRAI No.9351)," dated July 13, 2018
3. NuScale Topical Report, "Non-Loss of Coolant Accident Analysis Methodology," TR-0516-49416, Revision 1, dated August 2017

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) supplemental response to the referenced NRC Request for Additional Information (RAI).

The Enclosures to this letter contain NuScale's supplemental response to the following RAI Question from NRC eRAI No. 9351:

- 15.00.02-32

The technical report TR-0516-49416, "Non-Loss of Coolant Accident Analysis Methodology" contained export controlled information. The markup pages in the enclosed RAI response for TR-0516-494162 are therefore labeled "Export Controlled," although these markup pages do not contain any export controlled information.

Enclosure 1 is the proprietary version of the NuScale Supplemental Response to NRC RAI No. 9351 (eRAI No. 9351). 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-8H12
Samuel Lee, NRC, OWFN-8H12
Rani Franovich, NRC, OWFN-8H12

Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9351, proprietary

Enclosure 2: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9351, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0219-64521

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9351, proprietary

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Enclosure 2:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9351, nonproprietary

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Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 9351
Date of RAI Issue: 05/14/2018

NRC Question No.: 15.00.02-32

TR-0516-49416-P supports the conclusions in the NuScale FSAR, which under 10 CFR 52.47 must describe the facility, present the design bases and the limits on its operation, and present a safety analysis of the structures, systems, and components and of the facility as a whole.

RG 1.203 describes the evaluation model development and assessment process (EMDAP), which the NRC staff considers acceptable for use in developing and accessing EMs used to analyze transient and accident behavior. Step 18 of the EMDAP discusses preparing input and performing calculations to assess system interactions: “The ability of the EM to model system interactions should also be evaluated in this step, and plant input decks should be prepared for the target applications. Sufficient analyses should be performed to determine parameter ranges expected in the nuclear power plant.”

Table 7-14 of TR-0516-49416-P provides the initial condition biases for the increase in feedwater flow event. The {{

}}2(a),(c), ostensibly based upon this statement in TR-0516- 49416-P, Section 7.2: {{

}}2(a),(c) No basis is provided to justify that these bias directions are bounding for MCHFR.

In addition, it appears the statement that the {{

}}2(a),(c). TR Table 7-15

determines the bounding increase in feedwater flow when {{

}}2(a),(c). TR Table 7-16 determines the bounding increase in feedwater flow when {{

}}2(a),(c). Based upon the information presented in Tables 7-15 and 7-16, it is not clear how the SG inventory is minimized or maximized by this combination of parameter biases. Further, it appears that some other combination, such as {{

}}2(a),(c), could provide a more limiting combination since this combination could lead to a larger secondary heat removal capacity, thereby providing lower temperature fluid to the core inlet.

In Table 7-14, {{

}}2(a),(c) It therefore appears that the bias in the SG tube plugging level was determined by {{

}}2(a),(c) .

Information Requested:

a. Provide additional justification, such as a single-effects sensitivity study, that demonstrates that the bias directions selected for {{

}}2(a),(c)are bounding for MCHFR, and that the limiting bias methodology is used for the FSAR analysis.

b. Provide the basis for the conclusion that the {{

}}2(a),(c)and that the combination of parameters in TR Table 7-16 maximizes the SG liquid inventory.

c. Provide the final steady-state SG secondary side pressure, temperature distribution, and liquid and vapor masses for the cases in Tables 7-15 and 7-16. Confirm that the

combinations of bias directions in Tables 7-15 and 7-16 encompass the limiting bias parameters for the increase in feedwater flow event and that these define the methodology used for the FSAR analysis.

d. Describe the methodology used to represent steam generator tube plugging for the FSAR analysis and provide a justification, such as a sensitivity study, that demonstrates that the biased low condition is limiting for the increase in feedwater flow event.

In addition to these requests, please update TR-0516-49416-P as appropriate, based on your responses.

NuScale Response:

The original response to this RAI question was sent in NuScale correspondence RAIO-0718-60877, dated July 13, 2018. Subsequently, several inconsistencies were identified in the the topical report Non-Loss of Coolant Acident Analysis Methodology, TR-0916-49416, related to the changes submitted with the response. This supplemental response corrects those inconsistencies as delineated below and as indicated in the changes to the non-LOCA topical report at the end of this response:

1. The entry in the second column (Bias/Conservatism) of Table 7-14 for SG heat transfer was changed from "Low" to "Varied" to be consistent with the entry in the third column (Basis).
2. The title of Table 7-15 was changed from "Representative increase in feedwater flow study - low SG performance with maximum power and minimum RCS flow" to " Representative increase in feedwater flow study - high SG performance with maximum power and minimum RCS flow."
3. The title of Table 7-16 was changed from "Representative increase in feedwater flow study - high SG performance with maximum power and minimum RCS flow" to " Representative increase in feedwater flow study - low SG performance with maximum power and minimum RCS flow."
4. The basis for SG tube plugging biased to a low value in the "Basis" column in the event-specific initial conditions, biases and conservatisms tables for each of the appropriate events was changed as indicated at the end of this response consistent with sensitivity calculations performed for the events. In addition, a description of the definition of "low

condition" and "high condition" regarding tube plugging biasing was added to Section 7.2.

In addition, the description of the modeling of the reactor cooling pool heat structure as described in Section 5.3.2.3 of the non-LOCA topical report was revised to be consistent with the Cooling Pool Vessel (CPV) modeling in NRELAP5 as indicated in the markup at the end of this response.

The response is revised to include clarity for the steam generator (SG) tube plugging sensitivity as presented in Table B-1. The last entry in the table is deleted and is replaced with the SG tube plugging comparisons in Table B-1a:

Table B-1 Single-Parameter Bias impact on SG Level

{{

}}2(a),(c)

Table B-1a Steam Generator Tube Plugging Bias impact on SG Level
{{

}}2(a),(c)

The text in the original response to request d is revised to accommodate the addition of Table B-1a. The original text which stated, "The base case for the increase in feedwater flow event scenario (Table B-1 in part b) of this response) was used for this evaluation b. The results, provided as the last entry in Table B-1, indicate that the predicted MCHFR is less limiting (higher) with steam generator tube plugging" is changed to "A nominal SG heat transfer case for the increase in feedwater flow event scenario (Table B-4 in part b) of this response) was used for the tube plugging sensitivity. The results, provided in Table B-1a, indicate that the predicted MCHFR is less limiting (higher) with steam generator tube plugging."

Impact on Topical Report:

Topical Report TR-0516-49416, Non-Loss of Coolant Accident Analysis Methodology, has been revised as described in the response above and as shown in the markup provided in this response.

- {{

}}2(a),(c)

{{

}}2(a),(c)

{{

}}2(a),(c)

discussed for every event. The selection of parameters to be studied is focused on the acceptance criteria challenged by the event.

Unless otherwise noted, initial RCS flow is biased to the low condition in all event simulations because this is bounding for MCHFR. {{

}}2(a),(c)

Steam generator tube plugging is considered for each event in Section 7.2.1.3 in the "Initial conditions, biases, and conservatisms" tables. The term, "Biased to the low condition" indicates no tube plugging is assumed. “Biased to the high condition” indicates {{ }}2(a),(c) steam generator tube plugging.

In the NPM design, the rod control system is set to “insert only” mode at full power to prevent automatic withdrawal of the control bank at full power. Although this plant feature exists, the feature is not credited during events where control rod withdrawal results in a bounding result.

The NPM utilizes a nonsafety-related turbine bypass system sized to handle full steam flow rate at 100 percent RTP. As such, the turbine bypass valves open following a turbine trip to control the RCS temperature without steam relief to the atmosphere. Since the turbine bypass system enhances heat removal by the secondary system, these actions are not credited for the non-LOCA transient analyses. {{

}}2(a),(c)

Separate analyses for subchannel CHF, fuel centerline temperature, and containment pressure calculations are performed using the appropriate licensed NuScale methodologies. Extended cooldown via the DHRS is considered as part of the system design.

Parameter	Bias / Conservatism	Basis
~~Automatic rod control~~	~~Enabled.~~	~~{{~~ ~~}}2(a)(c)~~
Decay heat	Biased to the low condition.	{{ }}2(a)(c)
Initial SG pressure(1)	High	{{ }}2(a)(c)
SG heat transfer	~~Low~~Varied	{{ }}2(a)(c)
~~PZR spray~~	~~Disabled~~	~~{{~~ ~~}}2(a)(c)~~
~~Letdown~~	~~Disabled~~	~~{{~~ ~~}}2(a)(c)~~

Parameter	Bias / Conservatism	Basis
~~PZR heaters~~	~~Nominal~~	~~{{~~ ~~}}2(a)(c)~~
RSV lift setpoint	Nominal	{{ }}2(a)(c)
SG tube plugging	Biased to the low condition.	{{ }}2(a)(c)
RCS Temperature Control Automatic rod control	Enabled.	{{
Boron concentration	Not credited.	}}2(a)(c)
PZR Pressure Control PZR spray (normal)	Disabled.	{{
(bypass)	Nominal.	
PZR heaters (non-prop.)	Nominal.	
(prop.)	Nominal.	}}2(a)(c)

{{

}}2(a),(c) Representative results for these studies are presented in Table 7-15 and Table 7-16.

Table 7-15 Representative increase in feedwater flow study – ~~low~~high ~~liquid inventory~~SG performance with maximum power and minimum RCS flow

{{

}}2(a),(c)

Table 7-16 Representative increase in feedwater flow study – ~~high~~low ~~liquid inventory~~SG performance with maximum power and minimum RCS flow

{{

}}2(a),(c)

Parameter	Bias / Conservatism	Basis
~~PZR spray~~	~~Disabled~~	~~{{~~ ~~}}2(a)(c)~~
~~Letdown~~	~~Disabled~~	~~{{~~ ~~}}2(a)(c)~~
~~PZR heaters~~	~~Nominal~~	~~{{~~ ~~}}2(a)(c)~~
RSV lift setpoint	Nominal	{{ }}2(a)(c)
SG tube plugging	Biased to the low condition.	{{ }}2(a)(c)
Steam flow increase	Varied	{{ }}2(a)(c)
RCS Temperature Control Automatic rod control Boron concentration	Enabled. Not credited.	{{ }}2(a)(c)

Parameter	Bias / Conservatism	Basis
~~Letdown~~	~~Automatic RCS inventory control is enabled.~~	~~{{~~ }}~~2(a)(c)~~
~~PZR heaters~~	~~Normal heater operation is allowed.~~	~~{{~~ }}~~2(a)(c)~~
RSV lift setpoint	Nominal	{{ }}2(a)(c)
SG tube plugging	Biased to the low condition.	{{ }}2(a)(c)
Initial containment pressure	Varied	{{ }}2(a)(c)
Initial pool temperature	Varied	{{ }}2(a)(c)
RCCW leak flow	Varied	{{ }}2(a)(c)
RCCW temperature	Varied	{{ }}2(a)(c)
RCS Temperature Control Automatic rod control Boron concentration	Enabled. Not credited.	{{ }}2(a)(c)

Parameter	Bias / Conservatism	Basis
RSV lift setpoint	Biased to the high condition.	{{ }}2(a)(c)
SG tube plugging	Biased to the low condition.	{{ }}2(a)(c)
RCS Temperature Control Automatic rod control Boron concentration	Disabled. Not credited.	{{ }}2(a)(c)
PZR Pressure Control PZR spray (normal) (bypass) PZR heaters (non-prop.) (prop.)	Disabled. Nominal. Disabled. Nominal.	{{ }}2(a)(c)
PZR Level Control Charging Letdown	Not credited. Disabled.	{{ }}2(a)(c)

Parameter	Bias / Conservatism	Basis
Steam generator heat transfer	Varied.	{{ }}2(a)(c)
~~PZR spray~~	~~Automatic PZR spray is disabled~~	~~{{ }}2(a)(c)~~
~~Letdown~~	~~Automatic RCS inventory control is disabled~~	~~{{ }}2(a)(c)~~
~~PZR heaters~~	~~Heat input held constant.~~	~~{{ }}2(a)(c)~~
RSV lift setpoint	Biased to the high condition.	{{ }}2(a)(c)
SG tube plugging	Biased to the low condition.	{{ }}2(a)(c)
RCS Temperature Control Automatic rod control Boron concentration	Disabled. Not credited.	{{ }}2(a)(c)
PZR Pressure Control PZR spray (normal) (bypass) PZR heaters (non-prop.) (prop.)	Disabled. Nominal. Disabled. Nominal.	{{ }}2(a)(c)

Parameter	Bias / Conservatism	Basis
SG tube plugging	Biased to the low condition.	{{ }}2(a)(c)
RCS Temperature Control Automatic rod control Boron concentration	Disabled. Not credited.	{{ }}2(a)(c)
PZR Pressure Control PZR spray (normal) (bypass) PZR heaters (non-prop.) (prop.)	Disabled. Nominal. Disabled. Nominal.	{{ }}2(a)(c)
PZR Level Control Charging Letdown	Not credited. Disabled.	{{ }}2(a)(c)

Parameter	Bias / Conservatism	Basis
Initial fuel temperature	Biased to the high condition	{{ }}2(a)(c)
~~Moderator temperature coefficient~~MTC	Consistent with BOC kinetics.	{{ }}2(a)(c)
Kinetics	Biased to BOC conditions.	{{ }}2(a)(c)
~~Automatic rod control~~	~~Disabled.~~	~~{{ }}2(a)(c)~~
Decay heat	Biased to the high condition.	{{ }}2(a)(c)
Initial SG pressure(1)	Varied.	{{ }}2(a)(c)
SG heat transfer	Varied.	{{ }}2(a)(c)
~~PZR spray~~	~~Automatic PZR spray is disabled~~	~~{{ }}2(a)(c)~~
~~Letdown~~	~~Automatic RCS inventory control is disabled~~	~~{{ }}2(a)(c)~~
~~PZR heaters~~	~~Lost on loss of power.~~	~~{{ }}2(a)(c)~~
RSV lift setpoint	Biased to the high condition.	{{ }}2(a)(c)
SG tube plugging	Biased to the low condition.	{{ }}2(a)(c)
RCS Temperature Control Automatic rod control Boron concentration	Enabled. Not credited.	{{ }}2(a)(c)

Table 7-48 Initial conditions, biases, and conservatisms – loss of normal feedwater flow

Parameter	Bias / Conservatism	Basis
Initial reactor power	RTP biased upwards to account for measurement uncertainty.	{{ }}2(a)(c)
Initial RCS average temperature	Varied.	{{ }}2(a)(c)
Initial RCS flow rate	Varied.	{{ }}2(a)(c)
Initial PZR pressure	Varied.	{{ }}2(a)(c)
Initial PZR level	Varied.	{{ }}2(a)(c)
Initial feedwater temperature	Varied.	{{ }}2(a)(c)
Initial fuel temperature	Biased to the high condition.	{{ }}2(a)(c)
~~Moderator temperature coefficient~~MTC	Consistent with BOC kinetics.	{{ }}2(a)(c)
Kinetics	Biased to BOC conditions.	{{ }}2(a)(c)
~~Automatic rod control~~	~~Disabled.~~	~~{{ }}2(a)(c)~~
Decay heat	Biased to the high condition.	{{ }}2(a)(c)
Initial SG pressure(1)	Varied.	{{ }}2(a)(c)
SG heat transfer	Varied.	{{ }}2(a)(c)
~~PZR spray~~	~~Automatic PZR spray is disabled~~	~~{{ }}2(a)(c)~~
~~Letdown~~	~~Automatic RCS inventory control is disabled~~	~~{{ }}2(a)(c)~~
~~PZR heaters~~	~~Held constant until loss of AC power.~~	~~{{ }}2(a)(c)~~
RSV lift setpoint	Biased to the high condition.	{{ }}2(a)(c)
SG tube plugging	Biased to the low condition.	{{ }}2(a)(c)

Parameter	Bias / Conservatism	Basis
~~Letdown~~	~~Automatic RCS inventory control is disabled~~	~~{{~~ ~~}}2(a)(c)~~
~~PZR heaters~~	~~Constant heat input.~~	~~{{~~ ~~}}2(a)(c)~~
RSV lift setpoint	Biased to the high condition.	{{ }}2(a)(c)
SG tube plugging	Biased to the low condition.	{{ }}2(a)(c)
RCS Temperature Control Automatic rod control Boron concentration	Disabled. Not credited.	{{ }}2(a)(c)

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0219-64521

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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 method by which NuScale develops its non-loss of coolant accident analysis methodology .

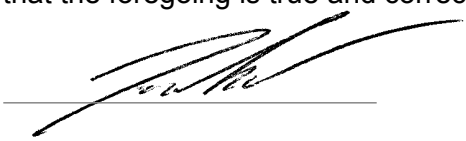
    NuScale has performed significant research and evaluation to develop a basis for this method and has invested significant resources, including the expenditure of a considerable sum of money.

    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/ 9351, eRAI No. 9351. 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 February 11, 2019.



Zackary W. Rad