RAIO-0219-64616

February 21, 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. 9306 (eRAI No. 9306) on the NuScale Topical Report, "Rod Ejection Accident Methodology," TR-0716-50350, Revision 0

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 9306 (eRAI No. 9306)," dated April 04, 2018
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 9306 (eRAI No.9306)," dated June 04, 2018
3. NuScale Topical Report, "Rod Ejection Accident Methodology," TR-0716-50350, Revision 0, dated December 2016

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. 9306:

- 15.04.08-1

Enclosure 1 is the proprietary version of the NuScale Supplemental Response to NRC RAI No. 9306 (eRAI No. 9306). 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,

Carrie Fosaaen
Supervisor, Licensing
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. 9306, proprietary

Enclosure 2: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9306, nonproprietary

Enclosure 3: Affidavit of Thomas A. Bergman, AF-0219-64617

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9306, 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 Supplemental Response to NRC Request for Additional Information eRAI No. 9306, 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 No. 52-048

eRAI No.: 9306
Date of RAI Issue: 04/04/2018

NRC Question No.: 15.04.08-1

In accordance with 10 CFR 50 Appendix A GDC 28, “Reactivity Limits,” the reactivity control systems must be designed with appropriate limits on potential reactivity increases so the effects of a rod ejection accident (REA) can result in neither damage to the reactor coolant pressure boundary nor result in sufficient disturbance to significantly impair the core cooling capability. SRP Section 15.4.8 provides review guidance related to the spectrum of REAs. For an applicant to accurately analyze its plant design for an REA, the underlying software used as part of the applicant’s methodology must be properly verified and validated.

Section 3.2.1.4 of Topical Report TR-0716-50350-P, “Rod Ejection Accident Methodology,” Revision 0, provides the validation of SIMULATE-3K, which is used to provide a three-dimensional nodal reactor kinetics solution. This section indicates that the SPERT-III benchmark and the NEACRP REA problem were used to validate SIMULATE-3K for the purpose of REA analyses. The references for the validation of SIMULATE-3K against SPERT- III and NEACRP appear to be based on conference proceedings. Neither a summary of results nor an analysis of bias or uncertainty is provided. The referenced conference proceedings are not part of the applicant’s Appendix B quality assurance program and, therefore, the robustness of the validation is not demonstrated. As such, the staff makes the following requests:

a. Provide a plot of the comparison between the SIMULATE-3K model and the SPERT-III benchmark results.

b. Provide a summary of the SIMULATE-3K comparison against the NEACRP REA benchmark problem.

c. Provide a reference for a complete verification/validation analysis of SIMULATE-3K under an Appendix B quality assurance program.

NuScale Response:

The original NuScale response as submitted in NuScale correspondence RAIO-0618-60285 and dated June 4, 2018, is augmented with the following information.

NuScale has performed a benchmark of the dynamic reactor response simulated by SIMULATE-3K (S3K) to the transient special power excursion reactor test III E-Core experiment (SPERT). This experiment performed by the Atomic Energy Commission (AEC) was a pressurized water nuclear research reactor that analyzed reactor kinetic behavior under conditions similar to commercial pressurized water reactors (Reference 1 and 2). The SPERT core resembled such reactor designs, but of a reduced size more closely resembling the NuScale core size. The fuel type, moderator, system pressure, and certain initial operating conditions considered for SPERT are also representative of NuScale as demonstrated in Table 1.

Table 1. Range of Applicability Comparison

Parameter	Units	SPERT	NuScale
Reactor Type	-	PWR	PWR
Fuel Material	-	Uranium dioxide	Uranium dioxide
UO2 Enrichment	w/o	4.8	≤4.95
Clad Material	-	Stainless Steel	Zircaloy Alloy (M5)
Active Fuel Length	in	38.3	78.74
Core Diameter	in	~26	~68
Rated Power	MWt	20	160
Rated Flow	kg/s	1,260	680
Design Core Exit Temp.	F	650	590
Design Pressure	psia	2,515	1,850

The original experiment included on the order of one hundred unique tests at five different sets of thermal-hydraulic statepoints, with varying initial static worths at each statepoint. For the purposes of this RAI supplement, one test from each statepoint that generally corresponds to the highest static worth for the statepoint is provided in tabulated and plotted format. Table 2 provides a summary and definition of the statepoint conditions of the selected cases.

Table 2. Summary of Selected Cases

Test #	Statepoint Condition	Initial Coolant Temp. (F)	Reactivity Insertion ($)
43	Cold Startup	78	1.210
70	Hot Startup	250	1.210
60	Hot Startup	500	1.230
81	Hot Standby	500	1.170
86	Full Power	500	1.170

Table 3 provides a tabulated comparison between SIMULATE-3K results and the experiment for the three key parameters of peak power, integrated energy, and reactivity compensation. Comparison plots for the selected cases are presented in Figure 1 through Figure 5. Due to the experimental values of the energy release to time of peak power and reactivity compensation at peak power being only approximate for hot standby and full power conditions (Tests #81 and #86), no comparison between SIMULATE-3K results and the experiment is performed for these parameters.

The following tables and figures for the selected comparisons of key parameters demonstrate that SIMULATE-3K compares to SPERT with generally excellent agreement; differences are within the experimental uncertainty (with few exceptions), and the major and minor phenomena are correctly predicted per the benchmark criteria defined in Reference 3. The most extreme difference in the benchmark is the peak power for test 81, which is {{ }}[2(a),(c)], as compared to the stated experimental uncertainty of ±15%. The magnitude in which {{ }}[2(a),(c)] of the stated uncertainty. Additionally, the experimental uncertainty of the initial reactivity insertion is between 0.03$ and 0.05$. Varying the initial reactivity insertion within the stated uncertainty is sufficient to be a possible explanation for the differences observed between the experiment and simulations. For these reasons, SIMULATE-3K exhibits no deficiencies in modeling the SPERT experiment and may be used with confidence in similar applications.

The SPERT peak power magnitudes are on the order of up to 3,000% rated power. For context, example NuScale peak power magnitudes presented in TR-0716-50350 are on the order of 600% of rated power and occur at the statepoints of medium power levels (~50% to ~80% of rated power). Thus, the example NuScale dynamic conditions are bounded by those of the experiment. Therefore, this benchmark provides justification that SIMULATE-3K can accurately model a rod ejection accident transient event and predict key reactivity and power-related parameters.

Table 3. Tabulated Results and Comparisons of Selected Cases

Test #	Peak Power (MW) [Exp. Uncertainty=±15%]			Integrated Energy (MW-sec) [Exp. Uncertainty=±17%]			Reactivity Compensation ($) [Exp. Uncertainty=±11%]		
	S3K	SPERT	% Diff	S3K	SPERT	% Diff	S3K	SPERT	% Diff
43	{{	280	{{	{{	6	{{	{{	0.22	{{
70		280			6.3			0.22	
60		410		}}2(a),(c)	8.5	}}2(a),(c)	}}2(a),(c)	0.24	}}2(a),(c)
81		330							
86	}}2(a),(c)	610	}}2(a),(c)						

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}}2(a),(c)

Figure 1. Test 43 SIMULATE-3K Comparison to SPERT

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}}2(a),(c)

Figure 2. Test 70 SIMULATE-3K Comparison to SPERT

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}}2(a),(c)

Figure 3. Test 60 SIMULATE-3K Comparison to SPERT

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}}2(a),(c)

Figure 4. Test 81 SIMULATE-3K Comparison to SPERT {{

}}2(a),(c)

Figure 5. Test 86 SIMULATE-3K Comparison to SPERT

References

1. U.S. Atomic Energy Commission, IDO-17281, “Reactivity Accident Test Results and Analyses for the SPERT III E-CORE - A Small, Oxide-Fueled, Pressurized Water Reactor”, March 1969, ADAMS Accession ML080320431
2. U.S. Atomic Energy Commission, IDO-17036, “SPERT III Reactor Facility” E-CORE Revision”, November 1965, ADAMS Accession ML080320408
3. U.S. Nuclear Regulatory Commission, “Transient and Accident Analysis Methods”, Regulatory Guide 1.203, December, 2005.

Impact on DCA:

There are no impacts to the DCA as a result of this response.

Enclosure 3:

Affidavit of Thomas A. Bergman, AF-0219-64617

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 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 rod ejection analysis for 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. 9306, eRAI 9306. 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 21, 2019.

Thomas A. Bergman