RAIO-0918-61969

September 28, 2018

Docket No. 52-048

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. 451 (eRAI No. 9517) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 451 (eRAI No. 9517)," dated May 01, 2018

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. 9517:

- 15.06.05-6

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 451 (eRAI No. 9517). 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
Rani Franovich, NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9517, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9517, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0918-61970

NuScale Power, LLC
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Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9517, proprietary

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Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9517, nonproprietary

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Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 9517
Date of RAI Issue: 05/01/2018

NRC Question No.: 15.06.05-6

Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Appendix A, General Design Criterion (GDC) 35, “Emergency Core Cooling,” requires that a system to provide abundant emergency core cooling shall be provided. The system safety function shall be to transfer heat from the reactor core following any loss of reactor coolant at a rate such that (1) fuel and clad damage that could interfere with continued effective core cooling is prevented and (2) clad metal-water reaction is limited to negligible amounts. DSRS Section 15.6.5 provides guidance for complying with GDC 35. It requires that evaluation models meet the requirements of 10 CFR 50.46, which states that the evaluation model must include sufficient supporting justification to show that the analytical technique realistically describes the behavior of the reactor system during a loss-of-coolant accident.

In FSAR Chapter 15.6.5 and Section 9 of the “Loss-of-Coolant Accident Evaluation Model,” TR-0516-49422-P, Rev. 0, which is incorporated by reference into the FSAR, indicates that a stable natural recirculation flow pattern with the reactor recirculation valves and steam venting through the reactor vent valves (RVVs) is relied upon to remove decay heat passively via boiling in the core. The staff noted that its sensitivity calculations, using the applicant’s NRELAP5 LOCA input models, show that flows in core hot and average channels appear to be artificially exaggerated by high reverse flow in the bypass channel during the recirculation phase of the LOCA, a condition not noted in the LOCA TR. This appears to be an artifact of the 1-D core and riser modeling that causes excessive recirculation cooling via the bypass.

Please provide an analysis that quantifies NRELAP5 bypass flow rates during the ECCS recirculation phase and provide any updates to the LOCA methodology needed to resolve this issue to support the staff's GDC 35 finding.

NuScale Response:

As described in Section 5.1.2.2.1 of the LOCA EM topical report (Reference 1), the core bypass flow is comprised of the flow through the reflector channels and the flow through the guide and instrument tubes. The discussion in Section 5.1.2.1 of Reference 1 notes that the loss factors for the junctions to and from the bypass region are biased to achieve a conservatively high core bypass flow fraction. The targeted maximum bypass flow fraction of {{

}}[2(a),(c)] The LOCA methodology approach is to conservatively bound the bypass flow rate such that the hot channel would receive less flow to calculate the critical heat flux (CHF) margin conservatively.

In order to address the impact of the bypass flows calculated through the bypass/reflector channel, a sensitivity study is performed by {{

}}[2(a),(c)] as shown in Table 1. The analyses presented in this response were performed with NRELAP5 v1.4 and include error corrections to the LOCA EM. Revised pages of the LOCA EM topical report are provided with the response to RAI Question 15.06.05-12 of eRAI 9085 (Letter RAIO-918-61956). The injection line break scenario is considered for the break sizes ranging from 2.2 percent to 100 percent without single failure, with power available, and without DHRS operation to analyze the impact of varying initial bypass flow fractions from {{ }}[2(a),(c)]

Section 9.1 of Reference 1 describes the LOCA progressions for 100 percent injection line break. Figure 1 below shows the mass velocities or mass fluxes through the parallel core channels indicating recirculation between the bypass and core heated channels (average and hot channels) in the 100 percent injection line break. For the same LOCA scenario, Figure 2 shows the total RCS recirculation flow and the flow through individual core channels including the bypass region. As described in the revised Section 9.1.1 of LOCA EM topical report, {{

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

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}}2(a),(c)

Figure 4 shows the variation of the hot and bypass channel mass flux during 100 percent injection line break for different values of initial bypass/reflector flow fractions. The initial phase of the LOCA before the ECCS actuation, both bypass and hot assembly flows {{

}}2(a),(c)

As shown in Figure 5, the RCS and CNV pressures and the collapsed level above TAF during the 100 percent injection line break are very similar for different initial bypass flow fractions. The impact of bypass flow fraction on the key LOCA figures-of-merit is also demonstrated in Figure 6 where the peak containment pressure and the collapsed liquid level above TAF are shown for the injection line break LOCA with both AC and DC power available, without DHRS operation, and without any single failures. There is no impact on the peak containment pressure due to change in bypass flow rates. This is expected when the core flow distribution has little to do with the overall mass and energy balance for the containment pressure vessel. The change in bypass flow also showed negligible impact on the collapsed liquid level for all the break sizes.

Reference

1. TR-0516-49422, Revision 0, “Loss-of-Coolant Accident Evaluation Model”

Table 1 Core flow distribution for different bypass flow fraction sensitivity cases

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}}2(a),(c)

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}}2(a),(c)

Figure 1: Core flow distribution for 100 percent injection line break

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}}2(a),(c)

Figure 2 Total RCS recirculation flow and core flow distribution in 100 percent injection line break

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}}2(a),(c)

Figure 3 Density and flow distribution in parallel core channels during 100 percent injection line break.

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}}2(a),(c)

Figure 4: Hot channel and bypass flow rates during 100 percent injection line break with different bypass flow fractions

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}}2(a),(c)

Figure 5 Reactor coolant system pressure and collapsed level above TAF during 100 percent injection line break with different bypass flow.

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}}2(a),(c)

Figure 6 Peak CNV pressure and collapsed level above TAF during injection line break for different bypass flow fractions

Impact on DCA:

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

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0918-61970

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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 performs its loss of coolant accident analysis.

    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. 451, eRAI No. 9517. 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 September 27, 2018.

Zackary W. Rad