RAIO-0219-64685

February 26, 2019

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 Supplemental Response to NRC Request for Additional Information No. 161 (eRAI No. 9043) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 161 (eRAI No. 9043)," dated August 11, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 161 (eRAI No.9043)," dated October 10, 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. 9043:

- 19-26

Enclosure 1 is the proprietary version of the NuScale Supplemental Response to NRC RAI No. 161 (eRAI No. 9043). 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. 9043, proprietary

Enclosure 2: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9043, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0219-64686

NuScale Power, LLC
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Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9043, proprietary

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Enclosure 2:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9043, nonproprietary

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

eRAI No.: 9043
Date of RAI Issue: 08/11/2017

NRC Question No.: 19-26

Regulatory Basis

10 CFR 52.47(a)(27) states that a Design Certification (DC) application must contain a Final Safety Analysis Report (FSAR) that includes a description of the design-specific probabilistic risk assessment (PRA) and its results. 10 CFR 52.47(a)(23) states that a DC application for light-water reactor (LWR) designs must contain an FSAR that includes a description and analysis of design features for the prevention and mitigation of severe accidents (e.g., challenges to containment integrity caused by core- concrete interaction, steam explosion, high-pressure melt ejection, hydrogen combustion, and containment bypass). Standard Review Plan 19.0 acceptance criteria for the applicant's severe accident analyses include a large release frequency of less than 10-6 per year and a conditional containment failure probability of less than 0.1. The staff must make a finding that the applicant has performed an adequate evaluation of the risk from severe accidents.

Request for additional information

The applicant's PRA and description and analysis of design features for prevention and mitigation of severe accidents included an analysis of in-vessel retention of corium in the reactor vessel lower plenum and the containment lower plenum. The staff reviewed the applicant's analysis of in-vessel retention documented in FSAR Chapter 19 and in the supporting documents "Analysis of In-Vessel Retention in the Reactor Pressure Vessel," ER-P020-3635-R0, and "Analysis of In-Vessel Retention in the Containment Vessel," ER-P020-4450-R0. The applicant is requested to include the following additional information in FSAR Chapter 19. For the staff to make a finding that the applicant has performed an adequate evaluation of the risk from severe accidents in accordance with SRP 19.0, the applicant is requested to respond to the questions below.

In-vessel Retention in the reactor pressure vessel (RPV)

a) The applicant used the critical heat fluxes measured in the Subscale Boundary Layer Boiling (SBLB) experiments to show that its predicted heat fluxes on the curved surfaces of the NuScale reactor vessel bottom head would not lead to failure. The geometry of the NuScale bottom head and surrounding containment is different from that of the SBSB experiments. For example, the bottom head has an integral seismic retention pin, and the SBLB experiments did not. The local critical heat flux depends on flow patterns (e.g., instabilities and recirculation can occur at junctions such as the where the seismic retention pin is joined to the hemispherical surface of the bottom head). In addition, the staff notes that different AP1000 reactor vessel bottom head and insulation configurations resulted in different experimentally measured critical heat fluxes in the AP1000 experimental program. The applicant is requested to provide justification for the use of the SBLB experimentally determined critical heat fluxes for the NuScale RPV bottom head.

b) The applicant performed ANSYS calculations assuming core debris relocated into the RPV lower plenum to estimate a heat flux of 330 kW/m2 at the junction of the hemispherical bottom head and the seismic retention pin. The applicant compared this to a critical heat flux of 400 kW/m2 from the SBLB experiments to demonstrate the robustness of its design to severe accident challenges and to assign an RPV lower head failure probability of zero in the Level 2 Containment Event Tree. This 20% difference between the estimated heat flux and the critical heat flux does not appear to be sufficiently large to conclude that RPV lower head failure probability is zero and in-vessel retention is certain even assuming that the SBLB experiments are representative of NuScale. Specifically, the applicant is requested to address the uncertainties in the analysis including the uncertainty in the assumed critical heat flux and uncertainties in the applicant's ANSYS prediction of the heat flux. Uncertainties could include the time of relocation into the lower plenum, amount of material relocating, and the amount of heat generation within the postulated metallic layer over the corium. The relocation time and amount of material relocating can affect the analysis of in-vessel retention through the decay power and the height of the debris bed and can vary based on scenario and phenomenological assumptions.

In-vessel retention in the containment vessel (CNV)

c) The applicant concluded that in-vessel retention in the CNV is certain because in-vessel retention in the RPV is certain and the CNV configuration is more favorable to cooling due to the presence of water in the CNV and because the same debris mass in the CNV has a greater surface area and a thinner body with a resulting lower heat flux. The applicant is requested to

address the uncertainty in the critical heat flux for the CNV bottom head, considering that (1) the SBLB test geometry was hemispherical and the CNV bottom head is not; and (2) the CVN bottom head has a skirt and is 5 inches above the pool floor.

d) The applicant's analysis did not include a case in which local heat fluxes could be increased by the focusing effect of a metallic layer overlying core debris. The applicant believes a molten metal layer on top of an oxidic melt is unrealistic in the containment lower plenum because of the presence of water there. However, conditions leading to a focusing effect could occur if failure of the reactor vessel lower head involves relocation of metals into the CNV lower plenum. The applicant is requested to justify its belief that water prevents conditions leading to a focusing effect in the CNV lower plenum.

e) The applicant states that to allow flow between the skirted region and the region outside the skirt, there are {{ }}2(a),(c) large {{ (}}2(a),(c) slots spaced evenly about the vessel just below the point where the skirt and the dome meet and {{ }}2(a),(c) smaller {{ }}2(a),(c) slots evenly spaced about the vessel just above the bottom of the skirt. The applicant performed an analysis to show that the steam generated under the skirt by core debris in the containment lower plenum can effectively escape through the top holes preventing conditions from reaching local dry-out and failure of the containment dome. The applicant is requested to consider and evaluate the potential of the complex geometry of the skirted region (which is heated from above) to cause complex flow patterns (e.g., a countercurrent flow of steam and water developing in the top slots) that could prevent sufficient steam from escaping.

NuScale Response:

As a result of public discussions held with the NRC on November 13, 2018, January 8, 2019, and January 29, 2019, NuScale is supplementing its response to RAI 9043 (Question 19-26) which was originally provided in letter RAIO-1017-56516, dated October 10, 2017. In those discussions, NuScale agreed to modify the FSAR by replacing the term "physically unrealistic" and similar terminology to more directly reflect insights from NuScale phenomenological analyses and to clarify the presence of analysis uncertainty. Other information provided in the original RAI response remains valid.

Impact on DCA:

FSAR Section 19.2 has been revised as described in the response above and as shown in the markup provided with the supplemental response to RAI No. 9108 in NuScale letter RAIO-0219-64684.

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0219-64686

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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 specific NuScale design values.

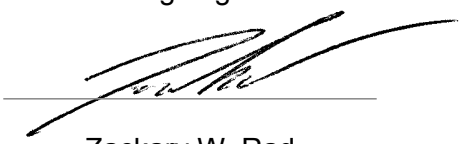
    NuScale has performed significant research and evaluation to develop a basis for this method and has invested significant resources, including the expenditure of a considerable sum of money.

    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. 161, eRAI No. 9043. 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 26, 2019.



Zackary W. Rad