RAIO-0917-55814

September 07, 2017

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. 9099 (eRAI No. 9099) on the NuScale Topical Report, "Subchannel Analysis Methodology," TR-0915-17564, Revision 1

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 9099 (eRAI No. 9099)," dated September 02, 2017
2. NuScale Topical Report, "Subchannel Analysis Methodology," TR-0915-17564, Revision 1, dated February 15, 2017

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. 9099:

- 04.04-10

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 9099 (eRAI No. 9099). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The proprietary enclosures have been deemed to contain Export Controlled Information. This information must be protected from disclosure per the requirements of 10 CFR § 810. 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@nuscaleower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
Bruce Bavol, NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9099, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9099, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0917-55815

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9099, proprietary

NuScale Power, LLC
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Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9099, nonproprietary

NuScale Power, LLC
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Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 9099
Date of RAI Issue: 09/02/2017

NRC Question No.: 04.04-10

In accordance with 10 CFR 50 Appendix A GDC 10, “Reactor design,” the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

To meet the requirements of GDC 10, as they relate to using a subchannel analysis methodology for determining the thermal margin available for the NuScale design in steady-state and transient events, the applicant’s methodology should clearly state which values are a part of the applicant’s methodology and which values are example values.

In Topical Report TR-0915-17564, Subchannel Analysis Methodology," Revision 1, Section 3.12.4, the applicant states that the flow area reduction factor was calculated to be {{ }}$^{2(a),(c),ECI}$ percent. The staff recognizes that this is an example value, as clarified by the applicant in a previous audit phone call; however, as the topical report currently reads, the staff interprets this value to be a final value which will ultimately be used as part of the methodology. Because this value is only an example value that is not going to be used as part of the finalized approved methodology, and the staff’s approval will not be predicated on example values, the applicant should clarify in the topical report that this value is only given as an example.

NuScale Response:

Section 3.12.4 of the Subchannel Analysis Methodology topical report (TR-0915-17564) has been revised to clarify that the flow area reduction factor is fuel design and CHF correlation dependent and that the value presented is only an example.

Impact on Topical Report:
Topical Report TR-0915-17564, Subchannel Analysis Methodology, has been revised as described in the response above and as shown in the markup provided in this response.

3.12.3 Uncertainty in Physical Data Inputs

Physical data that is used in the VIPRE-01 subchannel analysis has an uncertainty and must be accounted for in a thermal margins analysis because small deviations from nominal are allowed. The following items applicable to VIPRE-01 and subchannel calculation methods are:

- enthalpy rise engineering uncertainty ($F^{E}_{\Delta H}$)
- heat flux engineering uncertainty (F^{E}_{Q})
- LHGR engineering uncertainty (F^{E}_{LHGR})
- radial power distribution uncertainty
- fuel rod bowing and assembly bowing uncertainties
- core inlet flow distribution uncertainty
- core exit pressure distribution uncertainty

Each uncertainty is further described in detail for how it is accounted for in the VIPRE-01 model and calculation or post-processing thermal margin determination in the following subsections.

3.12.4 Enthalpy Rise Engineering Uncertainty

The enthalpy rise engineering uncertainty ($F^{E}_{\Delta H}$) is a penalty factor that is applied on the hot channel to account for fabrication uncertainties related to allowable manufacturing tolerances. This factor is also referred to as the enthalpy rise hot channel factor. The enthalpy rise hot channel factor accounts for variations in pellet diameter, pellet density, enrichment, fuel rod diameter, fuel rod pitch, inlet flow distribution, flow redistribution, and flow mixing.

In the NuScale subchannel methodology, this factor is calculated in two parts. The rod power component of the hot channel factor, which accounts for fuel stack length and uranium loading uncertainties ($F^{E}_{\Delta H1}$), was calculated to be {{ }}$^{2(a),(c),ECI}$ percent, based on the methodology defined in Reference 8.2.9. The $F^{E}_{\Delta H2}$ hot channel factor is dependent upon the VIPRE-01 modeling and two-phase flow correlations when used in combination with the variation in subchannel flow area due to fuel rod pitch and outer diameter variations. To determine the flow area reduction factor, the change in MCHFR for several different operating conditions was investigated.

The biased sensitivity consisted of reducing the rod pitch by the tolerance, and increasing the fuel rod and guide tube outer diameters by their respective tolerances. This reduces the flow area by the largest amount and the impact on MCHFR is calculated. To determine the actual value of $F^{E}_{\Delta H2}$, the same benchmark sensitivities are re-run with nominal geometry and only the hot rod $F_{\Delta H}$ peaking factor increased by a

factor to result in the same MCHFR as the biased case. The value~~results~~ of the $F^E_{\Delta H2}$ flow area reduction factor is fuel design and CHF correlation dependent; an example value for the NSP2 CHF correlation is~~was calculated to be~~ {{ }}2(a),(c),ECI percent. Because the~~se~~ $F^E_{\Delta H1}$ and $F^E_{\Delta H2}$ ~~two~~ enthalpy rise engineering uncertainty factors are derived using different methods, combining them using the RSS method is appropriate.

The total~~For the $F_{\Delta H}$~~ hot channel factor uncertainty~~, the~~ penalty factor is directly applied to the hot rod, which directly impacts the channel enthalpy rise and MCHFR. The $F_{\Delta H}$ radial power distribution for the licensing basemodel incorporates this factor. For the transients that use the fully-detailed model and pin-by-pin $F_{\Delta H}$ distribution, the hot channel factor for enthalpy rise is applied to the hot rod, independent of the location.

3.12.5 Heat Flux Engineering Uncertainty

The heat flux engineering uncertainty (F^E_Q) factor is a penalty factor that accounts for the manufacturing uncertainties that affect the local heat flux. This factor is often referred to as the heat flux hot channel factor. The heat flux hot channel factor is affected by variations in fuel enrichment, pellet density, pellet diameter, and fuel rod surface area. This is an interface with the fuels discipline, in which a value of {{ }}2(a),(c),ECI percent for F^E_Q is utilized as an example based on a RSS method for the fuel enrichment, pellet density, fuel rod outer diameter, and fuel pellet cross-sectional area. The methodology utilized to calculate this value is defined in Reference 8.2.9.

For application of the F^E_Q uncertainty, the heat flux from the conduction model is penalized. There is no method to account for this in VIPRE-01 that directly impacts only heat flux. Therefore, it is applied as a direct penalty to the VIPRE-01 calculated MCHFR. The equation for incorporating this penalty is shown in Section 3.3 as an increase on the CHF 95/95 limit, resulting in a reduced margin to the MCHFR calculated with VIPRE-01.

3.12.6 Linear Heat Generation Rate Engineering Uncertainty

The LHGR hot channel engineering uncertainty factor (F^E_{LHGR}) is similar to F^E_Q, with the only difference being that the fuel rod outer diameter is excluded because the fuel rod outer diameter does not significantly impact the LHGR of the pellet. A value of {{ }}2(a),(c),ECI percent for F^E_{LHGR} is used, based on the methodology defined in Reference 8.2.9. The F^E_{LHGR} hot channel factor is applicable for peak linear heat generation rate (PLHGR) FCM calculations. This uncertainty factor is used in Eq. 4-2 as a penalty on the PLHGR (Section 4.5.1).

3.12.7 Radial Power Distribution Uncertainty

The radial power distribution uncertainty is related to the software used to simulate the detailed core power distribution. This modeling method is justified from parametric sensitivity analysis in Section 6.4.2 in which different power distributions of the NuScale core demonstrate that rod powers a few rod rows beyond the hot rod or channel have a

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0917-55815

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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 methods by which NuScale develops its subchannel analysis methodology.

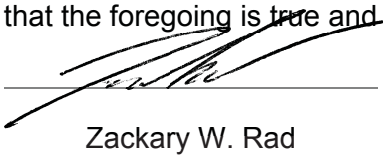
    NuScale has performed significant research and evaluation to develop a basis for this method and has invested significant resources, including the expenditure of a considerable sum of money.

    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 RAI No. 9099, eRAI 9099. 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 9/6/2017.



Zackary W. Rad