NuScale Power™

RAIO-1117-57350

November 30, 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 Supplemental Response to NRC Request for Additional Information No. 8931 (eRAI No. 8931) on the NuScale Topical Report, "NuScale Power Critical Heat Flux Correlation NSP2," TR-0116-21012, Revision 0

REFERENCES:

1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 8931 (eRAI No. 8931)," dated July 30, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 8931 (eRAI No.8931)," dated September 25, 2017
3. NuScale Topical Report, "NuScale Power Critical Heat Flux Correlation NSP2," TR-0116-21012, Revision 1, dated November 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) resulting from the revision of the topical report submitted in Reference 3.

The Enclosures to this letter contain NuScale's supplemental response to the following RAI Questions from NRC eRAI No. 8931:

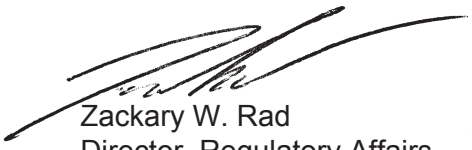
- 04.04-4
- 04.04-5
- 04.04-6
- 04.04-7

Enclosure 1 is the proprietary version of the NuScale Supplemental Response to NRC RAI No. 8931 (eRAI No. 8931). 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 Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com.

Sincerely,



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

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8931, proprietary

Enclosure 2: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8931, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-1117-57351

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8931, proprietary

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Enclosure 2:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8931, nonproprietary

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NuScale Power™

Response to Request for Additional Information

eRAI No.: 8931
Date of RAI Issue: 07/30/2017

NRC Question No.: 04.04-4

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Section 47 and Section 79 require a final safety analysis report (FSAR) to analyze the design and performance of the structures, systems, and components (SSCs). Safety evaluations, performed to support the FSAR, include accident analyses to (1) demonstrate that specified acceptable fuel design limits (SAFDLs) are not exceeded during normal operation, including the effects of anticipated operational occurrences (AOOs), and (2) determine the number of fuel failures associated with critical heat flux (CHF) that need to be included in the radiological consequences for postulated accidents. An approved CHF correlation is used in establishing a SAFDL for use in such analyses. Thus, an approved CHF correlation is used to establish a partial basis for demonstrating compliance with the following applicable regulations from Title 10 of the Code of Federal Regulations (10 CFR) which include the General Design Criteria (GDCs) of Appendix A to 10 CFR Part 50:

GDC 10, *Reactor design*, which requires that the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs.

10 CFR 52.47(a)(2)(iv)(A), 10 CFR 52.47(a)(2)(iv)(B), and GDC 19 as they relate to the evaluation and analysis of the radiological consequences of postulated accidents.

NRC staff conducted an audit of the calculations supporting the development of the NSP2 CHF correlation at the NuScale office in Rockville, MD on June 13-15, 2017 (ML17138A113). During the audit NRC staff identified additional information that needed to be added to Appendix A of TR-0116-21012. This information is necessary for NRC staff to establish a finding that the correlation coefficients and limit were calculated from an appropriate database using appropriate methods. Accordingly, NRC staff request that NuScale update Appendix A of TR-0116- 21012 to include columns for (1) the Tong Factor, (2) measured-to-predicted values, and (3) inlet subcooling temperature.

NuScale Response:

This response revises the changes to the topical report previously provided in the response to this RAI. TR-0116-21012, Table A-3, "Local Conditions for AREVA K9000, K9100, K9200 and K9300 Tests (NSP2)" has been revised to correct local condition values for the K9100 data and new Table A-4, "Local Conditions for AREVA K9000, K9100, K9200 and K9300 Tests (NSP4)" has been added to provide the local conditions used in development of the NSP4 correlation. These changes are reflected in TR-0115-21102, Revision 1 (submitted by separate letter), and are not duplicated in this supplementary response. Revised Table A-3 and new Table A-4 include columns for the Tong factor, measured-to-predicted values and inlet subcooling temperature.

Impact on DCA:

TR-0116-21012 has been revised as described in the response above. The revised TR-0116-21012, Revision 1 was transmitted by a separate letter.

Response to Request for Additional Information

eRAI No.: 8931
Date of RAI Issue: 07/30/2017

NRC Question No.: 04.04-5

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Section 47 and Section 79 require a final safety analysis report (FSAR) to analyze the design and performance of the structures, systems, and components (SSCs). Safety evaluations, performed to support the FSAR, include accident analyses to (1) demonstrate that specified acceptable fuel design limits (SAFDLs) are not exceeded during normal operation, including the effects of anticipated operational occurrences (AOOs), and (2) determine the number of fuel failures associated with critical heat flux (CHF) that need to be included in the radiological consequences for postulated accidents. An approved CHF correlation is used in establishing a SAFDL for use in such analyses. Thus, an approved CHF correlation is used to establish a partial basis for demonstrating compliance with the following applicable regulations from Title 10 of the Code of Federal Regulations (10 CFR) which include the General Design Criteria (GDCs) of Appendix A to 10 CFR Part 50:

GDC 10, *Reactor design*, which requires that the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs.

10 CFR 52.47(a)(2)(iv)(A), 10 CFR 52.47(a)(2)(iv)(B), and GDC 19 as they relate to the evaluation and analysis of the radiological consequences of postulated accidents.

TR-0116-21012 does not contain plots to demonstrate the measured-to-predicted performance of the CHF correlation. NRC staff relies upon such information to support a finding that the CHF correlation and limit establish a 95/95 limit. Accordingly, NRC staff request that NuScale provide the following plots:

a. Measured-to-Predicted vs Pressure
b. Measured-to-Predicted vs Mass Flux
c. Measured-to-Predicted vs Quality
d. Measured-to-Predicted vs Boiling Length
e. Measured-to-Predicted vs Inlet Enthalpy
f. Measured-to-Predicted vs Hydraulic Diameter Ratio

NuScale Response:

This response supplements and revises the original response previously provided by NuScale. The previously provided measured-to-predicted (M/P) bias plots for pressure, mass flux, quality, boiling length, hydraulic-to heated diameter ratio and inlet enthalpy have been revised to address an error concerning the K9100 local condition data used for validation of the NSP2 correlation, as depicted by Figures 6-15 through 6-20 of TR-0116-21012, Revision 1. Additionally, new M/P bias plots for these parameters have been developed to demonstrate the lack of bias associated with the NSP4 correlation, as depicted by Figures 7-3 through 7-8 of TR-0116-21012, Revision 1.

Impact on DCA:

TR-0116-21012 has been revised as described in the response above. The revised TR-0116-21012, Revision 1 was transmitted by a separate letter.

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Response to Request for Additional Information

eRAI No.: 8931
Date of RAI Issue: 07/30/2017

NRC Question No.: 04.04-6

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Section 47 and Section 79 require a final safety analysis report (FSAR) to analyze the design and performance of the structures, systems, and components (SSCs). Safety evaluations, performed to support the FSAR, include accident analyses to (1) demonstrate that specified acceptable fuel design limits (SAFDLs) are not exceeded during normal operation, including the effects of anticipated operational occurrences (AOOs), and (2) determine the number of fuel failures associated with critical heat flux (CHF) that need to be included in the radiological consequences for postulated accidents. An approved CHF correlation is used in establishing a SAFDL for use in such analyses. Thus, an approved CHF correlation is used to establish a partial basis for demonstrating compliance with the following applicable regulations from Title 10 of the Code of Federal Regulations (10 CFR) which include the General Design Criteria (GDCs) of Appendix A to 10 CFR Part 50:

GDC 10, *Reactor design*, which requires that the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs.

10 CFR 52.47(a)(2)(iv)(A), 10 CFR 52.47(a)(2)(iv)(B), and GDC 19 as they relate to the evaluation and analysis of the radiological consequences of postulated accidents.

NRC staff conducted an audit of the calculations supporting the development of the NSP2 CHF correlation at the NuScale office in Rockville, MD on June 13-15, 2017 (ML17138A113). An analysis of the measured-to-predicted data, conducted during the audit, showed a subregion of reduced margin exists within the application domain of the NSP2 CHF correlation. This caused NRC staff to question whether the NSP2 correlation limit, proposed in Rev. 0 of TR-0116-21012, is suitable for application within this subregion. Accordingly, NRC staff is requesting that NuScale provide a means for adequate treatment of the low-margin subregion such that the correlation will ensure at the 95/95 level that CHF will not be experienced at the CHF correlation limit.

NuScale Response:

This supplemental response revises figures in the original response previously provided by NuScale as a result of Revision 1 to the topical report. A revised 3D plot of pressure, mass flux, and quality is illustrated in Figure 1 for the NuFuel-HTP2™ data (K9000 - K9300 tests) using the NSP2 CHF correlation, reflecting corrections of the K9100 HTP2™ data. A 3D plot of pressure, mass flux, and quality is illustrated in Figure 2 for the NuFuel-HTP2™ data (K9000 - K9300 tests) using the NSP4 CHF correlation. The red points in both figures represent the lowest 5% of M/P values and the black and blue points represent the remaining 95% of M/P values. From these figures it is evident that the lowest M/P values are not clustered in one particular subregion, so the current correlation limit is reasonable and acceptable.

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

Figure 1- 3D Plot of P, G, and X for NuFuel-HTP2™ Data with NSP2

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

Figure 2- 3D Plot of P, G, and X for NuFuel-HTP2™ Data with NSP4

Impact on DCA:

There is no impact on TR-0116-21012 as a result of this response.

NuScale Power™

Response to Request for Additional Information

eRAI No.: 8931
Date of RAI Issue: 07/30/2017

NRC Question No.: 04.04-7

Title 10 of the *Code of Federal Regulations* (10 CFR) Part 52, Section 47 and Section 79 require a final safety analysis report (FSAR) to analyze the design and performance of the structures, systems, and components (SSCs). Safety evaluations, performed to support the FSAR, include accident analyses to (1) demonstrate that specified acceptable fuel design limits (SAFDLs) are not exceeded during normal operation, including the effects of anticipated operational occurrences (AOOs), and (2) determine the number of fuel failures associated with critical heat flux (CHF) that need to be included in the radiological consequences for postulated accidents. An approved CHF correlation is used in establishing a SAFDL for use in such analyses. Thus, an approved CHF correlation is used to establish a partial basis for demonstrating compliance with the following applicable regulations from Title 10 of the Code of Federal Regulations (10 CFR) which include the General Design Criteria (GDCs) of Appendix A to 10 CFR Part 50:

GDC 10, *Reactor design*, which requires that the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs.

10 CFR 52.47(a)(2)(iv)(A), 10 CFR 52.47(a)(2)(iv)(B), and GDC 19 as they relate to the evaluation and analysis of the radiological consequences of postulated accidents.

TR-0116-21012 mathematically defined the application domain of the NSP2 correlation. As with all application domains, the NSP2 application domain contains regions which contain no data and regions in which the correlation wil not be used. Therefore, NuScale should identify the expected domain and ensure that the expected domain contains an adequate number of data points. NRC staff needs to establish a finding that there is adequate data density throughout the expected domain. Accordingly, NRC staff request that NuScale provide, at a minimum, the following plots to identify the expected domain of the NSP2 correlation (i.e., the region on each plot where the NSP2 correlation is expected to be used during steady state and transient analysis):

a. Pressure vs Mass Flux
b. Pressure vs Quality

c. Mass Flux vs Quality

NuScale Response:

This response revises figures in the original response previously provided by NuScale. Updated comparisons between the NuFuel-HTP2™ data (K9000 through K9300 tests) and the anticipated operation domain are illustrated in Figures 1 through 6. These updates address a minor error in the K9100 data and do not significantly change the comparisons for NuFuel-HTP2™ data. Stern data is not included in these figures because there was no change to the Stern data. Figures 1 through 3 have been revised to illustrate local condition comparisons, while Figures 4 through 6 are revised to illustrate inlet condition comparisons.

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}}2(a),(c)

Figure 1. NuFuel-HTP2™ local mass flux vs. pressure data with operating domain

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

Figure 2. NuFuel-HTP2™ local quality vs. pressure data with operating domain

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

Figure 3. NuFuel-HTP2™ local quality vs. local mass flux data with operating domain

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

Figure 4. NuFuel-HTP2™ inlet mass flux vs. pressure data with operating domain

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

Figure 5. NuFuel-HTP2™ inlet quality vs. pressure data with operating domain

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

Figure 6. NuFuel-HTP2™ inlet quality vs. inlet mass flux data with operating domain

Impact on DCA:

There is no impact to TR-0116-21012 as a result of this response.

Enclosure 3:

Affidavit of Zackary W. Rad, AF-1117-57351

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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 process by which NuScale develops its critical heat flux analyses.

    NuScale has performed significant research and evaluation to develop a basis for this process 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 Supplemental Response to NRC Request for Additional Information RAI No. 8931, eRAI No. 8931. 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 11/30/2017.

Zackary W. Rad