LO-0317-53210

March 8, 2017 Docket: PROJ0769

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
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SUBJECT: NuScale Power, LLC Submittal of Response to NRC Request for Additional Information Letter No. 12 for the Review of Topical Report TR-0116-20825, "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1 (PROJ0769).

REFERENCES:

1. Letter from NuScale Power, LLC to U.S. Nuclear Regulatory Commission, "NuScale Power, LLC Submittal of Topical Report TR-0116-20825, "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1 (NRC Project No. 0769)," dated July 1, 2016 (ML16187A017)
2. Letter from U.S. Nuclear Regulatory Commission to NuScale Power, LLC, "Request for Additional Information Letter No. 12 for the Review of Topical Report TR-0116-20825, "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1 (PROJ0769)," dated February 10, 2017 (ML17044A021)

In a letter dated July 1, 2016 (Reference 1), NuScale Power, LLC (NuScale) submitted the topical report entitled "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1. In a letter dated February 10, 2017 (Reference 2), the NRC Staff provided a Request for Additional Information (RAI) regarding the subject of the topical report.

The purpose of this letter is to provide NuScale responses to the NRC RAIs.

Enclosure 1 is the proprietary version of the NuScale responses to RAI Letter No. 12. 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 responses to RAI Letter No. 12.

This letter makes no regulatory commitments and no revisions to any existing regulatory commitments.

Please feel free to contact Stephanie Seely at 980-349-4897 or at sseely@nuscalepower.com if you have any questions.

Sincerely,

Thomas A. Bergman
Vice President, Regulatory Affairs
NuScale Power, LLC

Distribution: Frank Akstulewicz, NRC, TWFN-6C20
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Enclosure 1: NuScale Response to NRC Request for Additional Information Letter No. 12 for TR-0116-20825, "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1, proprietary version
Enclosure 2: NuScale Response to NRC Request for Additional Information Letter No. 12 for TR-0116-20825, "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1, nonproprietary version
Enclosure 3: Affidavit of Thomas A. Bergman, AF-0317-53213

Enclosure 1:

NuScale Response to NRC Request for Additional Information Letter No. 12 for TR-0116-20825, "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1, proprietary version

Enclosure 2:

NuScale Response to NRC Request for Additional Information Letter No. 12 for TR-0116-20825, "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1, nonproprietary version

NRC RAI Number: 8727 NRC RAI Date: February 10, 2017

NRC Review of: Applicability of AREVA Fuel Methodology for the NuScale Design, TR-0116-20825-P Revision 1

NRC RAI Question Number: 04.02-29594a

NRC RAI Question

Page 8 of TR-0116-20825-P Revision 1 provides design parameters for the NuScale fuel design. The staff notes that there are a few relevant parameters missing. Please provide the pellet dish and chamfer dimensions, plenum length, and plenum spring dimensions to allow staff to evaluate the void volume calculations.

NuScale RAI Question Response

Table 1, Table 2, and Table 3 provide the dimensions necessary to calculate the void volumes. Table 1 in concert with Figure 1 provides the pellet dimensions; the {{ }}2(a),(c) . Table 3 in concert with Figure 2 and Figure 3 provide the Fuel Plenum Spring dimensions. Table 2 provides additional useful information. These dimensions should be sufficient to calculate an approximate void volume.

Table 1. Pellet dimensions

Description	Value
Pellet diameter (A) (inch)	0.3195
Pellet height (B) (inch)	0.400
{{	
	}}2(a),(c)

Table 2. Additional fuel dimensions

Description	Value
{{	
	}}2(a),(c)
Fuel rod plenum length (inch)	5.311
Fuel rod inner diameter (inch)	0.326

Table 3. Fuel plenum spring dimensions

{{

}}2(a),(c)

{{

}}2(a),(c)

Figure 1. Pellet dimensions

{{

}}2(a),(c)

Figure 2. Fuel rod plenum spring

{{

}}2(a),(c)

Figure 3. Fuel rod plenum spring end detail

Impact of NRC RAI Question Response on TR-0116-20825:

This RAI response does not require revision to the report.

Attachments:

None.

NRC RAI Number: 8727 NRC RAI Date: February 10, 2017

NRC Review of: Applicability of AREVA Fuel Methodology for the NuScale Design, TR-0116-20825-P Revision 1

NRC RAI Question Number: 04.02-29594b

NRC RAI Question

Page 15 of TR-0116-20825-P Revision 1 discusses a clad creep analysis and states that "a revised {{ }}2(a),(c) ". It is unclear to the staff if this is a new methodology or is part of a previously approved methodology.

Provide a more detailed description of the revised approach used, whether it is a revised approach to a previously approved methodology or a new methodology, and the intent of its use. If this revised approach is being used for more than additional justification for the CROV methodology, then update the topical report to include this clarification.

NuScale RAI Question Response

The description on Page 15 of TR-0116-20825-P Revision 1 is not a new methodology. TR-0116-20825-P Revision 1, Section 3.3.1 describes a NuScale-specific adjustment to the approved methodology based on the unique characteristics of the NuScale design. The key characteristic of the NuScale design that differs from the design described in the approved methodology is the fuel column length.

As required by the approved methodology, "Program to Determine In-Reactor Performance of BWFC Fuel Cladding Creep Collapse," BAW-10084P-A, Revision 3 (Reference 1), the creep collapse analysis is performed {{ }}2(a),(c) that results in the shortest calculated collapse time. For a 12 foot fuel column, the axial location has been determined to be at the {{ }}2(a),(c) . The NuScale fuel column is only 78.74 inches long so the {{ }}2(a),(c) location noted in the approved methodology cannot be used. For NuScale, the {{ }}2(a),(c) used for the creep collapse analysis are conservative.

Due to the high initial fuel pellet density (96 percent theoretical density) of the NuScale design, the fuel pellets will experience low densification. The {{ }}2(a),(c) gap specified in the approved method was based in part on the {{ }}2(a),(c) . Given the low densification and shorter fuel column length, the resulting calculated axial gap for the NuScale design is {{ }}2(a),(c) noted in

the approved methodology. As opposed to changing the approved methodology by justifying a different axial gap, the existing {{ }}$^{2(a),(c)}$ is conservatively applied.

Impact of NRC RAI Question Response on TR-0116-20825:

This RAI response does not require revision to the report.

References:

1. BAW-10084P-A-03, Revision 3, “Program to Determine In-Reactor Performance of BWFC Fuel Cladding Creep Collapse,” August 1995.

Attachments:

None.

NRC RAI Number: 8727 NRC RAI Date: February 10, 2017

NRC Review of: Applicability of AREVA Fuel Methodology for the NuScale Design, TR-0116-20825-P Revision 1

NRC RAI Question Number: 04.02-29594c

NRC RAI Question

RAI Section 5.2.1.1 of TR 0116-20825 Revision 1 discusses the heat transfer model used by COPERNIC for the coolant-cladding interface and the applicability of this model to the NuScale design. It states that the {{

}}2(a),(c) .

Is two-phase flow anticipated in the NuScale reactor during normal operation or AOOs.

NuScale RAI Question Response

The NuScale Power plant is designed to operate with single-phase flow in the primary coolant system. The control system operates to maintain the core average outlet temperature at a maximum of 590 degrees F. The saturation temperature at the operating pressure of 1850 psia is 625 degrees F. NuScale employs a hot leg temperature analytical limit of 610 degrees F to ensure that subcooled margin is maintained.

Under full power steady state operation, the maximum expected equilibrium quality in the limiting core subchannel is {{ }}2(a),(c) (subchannel void fraction is 4 percent). With conservative assumptions for flow, flow distribution, and instrumentation error, and application of conservative hot channel factors to the limiting subchannel, the maximum predicted equilibrium quality is less than {{ }}2(a),(c) . The most limiting anticipated operational occurrence (AOO) in regards to thermal margin is Uncontrolled Control Rod Assembly Withdrawal from Power (FSAR Section 15.4.2); the limiting subchannel for this event is predicted to have a quality of approximately {{ }}2(a),(c) .

Just as in large pressurized water reactors (PWRs), some two-phase flow is anticipated in the limiting subchannel of the NuScale core. Thus, the application of the {{ }}2(a),(c) for calculation of cladding temperatures under subcooled boiling conditions is appropriate for the NuScale operating conditions and consistent with PWR experience.

Impact of NRC RAI Question Response on TR-0116-20825:

This RAI response does not require revision to the report.

Attachments:

None.

NRC RAI Number: 8727 NRC RAI Date: February 10, 2017

NRC Review of: Applicability of AREVA Fuel Methodology for the NuScale Design, TR-0116-20825-P Revision 1

NRC RAI Question Number: 04.02-29594d

NRC RAI Question

Page 23 of TR-0116-20825 Revision 1 discusses the applicability of the {{ }}$^{2(a),(c)}$ and Dittus-Boelter correlations to the NuScale reactor with natural circulation based on the Reynold's number being greater than that where forced convection has been seen.

Have any tests or analyses been performed to demonstrate that either of these correlations would be valid under typical conditions for the NuScale reactor (i.e. power, coolant temperature, and flow rate)? If so, provide a reference to, or summary of, the tests or analyses to minimize the need for future RAIs during the topical report review.

NuScale RAI Question Response

Pressure drop and critical heat flux (CHF) tests have been performed for the fuel design under typical NuScale reactor operating conditions. No tests have been performed specifically for single-phase heat transfer. However, pressure drop tests were performed for NuScale applicable Reynold's number ranges {{ }}$^{2(a),(c)}$ in the derivation of grid spacer and rod friction loss coefficients. The purpose of the pressure drop tests was to determine form loss coefficients for typical flow conditions for the NuScale reactor. Critical heat flux test data utilized in the NSP2 correlation (TR-0116-21012, Revision 0) development for the NuScale fuel design covers Reynold's number ranges of approximately {{ }}$^{2(a),(c)}$.

The Dittus-Boelter correlation is used extensively throughout the nuclear industry for turbulent forced convection flow in the single-phase liquid heat transfer regime. The use of the {{ }}$^{2(a),(c)}$ correlation, with its comparison to the Dittus-Boelter correlation in this topical report, is consistent with the correlations used in the NuScale Subchannel Methodology, TR-0915-17564. TR-0915-17564, Section 5.5 discusses the thermal margin to CHF calculations that employ the "EPRI" single-phase heat transfer correlation. This selection is a code requirement to remain consistent with two-phase flow models used within the code; however, the coefficients used in the EPRI correlation are those of the Dittus-Boelter correlation.

The Dittus-Boelter correlation is valid for ranges of Reynolds numbers greater than 10,000. With conservative assumptions consistent with the methodology in TR-0915-17564, the minimum Reynold's number at 5 percent rated power is {{ }}$^{2(a),(c)}$ with a maximum of {{ }}$^{2(a),(c)}$ at 100 percent rated power. Thus, the ranges in Reynold's numbers exhibited by typical NuScale conditions indicate that the Dittus-Boelter correlation is applicable.

Impact of NRC RAI Question Response on TR-0116-20825:

This RAI Response does not require report revisions.

Attachments:

None.

Enclosure 3:

Affidavit of Thomas A. Bergman, AF-0317-53213

NuScale Power, LLC

AFFIDAVIT of Thomas A. Bergman

I, Thomas A. Bergman, state as follows:

(1) I am the Vice President of 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 response reveals distinguishing aspects about the method by which NuScale develops its applicability of AREVA fuel methodology for the NuScale design.

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 entitled "NuScale Response to NRC Request for Additional Information Letter No. 12 for TR-0116-20825, "Applicability of AREVA Fuel Methodology for the NuScale Design," Revision 1." 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 March 8, 2017.

Thomas A. Bergman