RAIO-0918-61793

September 17, 2018

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. 9492 (eRAI No. 9492) on the NuScale Topical Report, "Loss-of-Coolant Accident Evaluation Model," TR-0516-49422, Revision 0

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 9492 (eRAI No. 9492)," dated July 18, 2018
2. NuScale Topical Report, "Loss-of-Coolant Accident Evaluation Model," TR-0516-49422, Revision 0, dated December 2016

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. 9492:

- 15.06.05-21

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 9492 (eRAI No. 9492). 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 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. 9492, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9492, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0918-61794

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Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9492, proprietary

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Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9492, nonproprietary

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Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 9492
Date of RAI Issue: 07/18/2018

NRC Question No.: 15.06.05-21

Title 10 of the Code of Federal Regulations (10 CFR) Part 50.46 (a)(1)(ii) states, "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. Comparisons to applicable experimental data must be made and uncertainties in the analysis method and inputs must be identified and assessed so that the uncertainty in the calculated results can be estimated. This uncertainty must be accounted for, so that, when the calculated ECCS cooling performance is compared to the criteria set forth in paragraph (b) of this section, there is a high level of probability that the criteria would not be exceeded." Regulatory Guide 1.203 describes a process that the staff of the U.S. Nuclear Regulatory Commission (NRC) considers acceptable for use in developing and assessing evaluation models (EMs) that may be used to analyze transient and accident behavior that is within the design basis of a nuclear power plant.

As stated in RG 1.203, an EM is the calculational framework for evaluating the behavior of the reactor system during a postulated transient or design-basis accident. As such, the EM may include one or more computer programs, special models, and all other information needed to apply the calculational framework to a specific event, as illustrated by the following examples: (1) Procedures for treating the input and output information (particularly the code input arising from the plant geometry and the assumed plant state at transient initiation), (2) Specification of those portions of the analysis not included in the computer programs for which alternative approaches are used, and (3) All other information needed to specify the calculational procedure.

The entirety of an EM ultimately determines whether the results are in compliance with applicable regulations. Therefore, the development, assessment, and review processes must

consider the entire EM.

The validation of the loss of coolant accident (LOCA) methodology depends heavily upon benchmarks of experimental data to confirm the performance of the codes and methods over the applicable range of reactor system operating conditions. Integral and separate effects data for the NuScale Power Module are based on the NIST-1 facility data presented in Section 7 of the LOCA topical report (LTR) (TR-0516-49422-P, Rev. 0). However, NRC staff has determined that comparisons of addition data are necessary to find that the test results and NRELAP5 benchmarks validate the applicant's EM.

The applicant is requested to provide assessment plots and discussions from the following tests: HP-02 (EC-T080-3822-R1):

Initial and boundary condition plots for RUN3, similar to the plots for RUN 1 (Figures 4-1 to 4-4, Figures 4-20 to 4- 22 in the report). HTP temperature (TW-5XXXX) plot at various elevations for RUN 3. The TW-5XXX measurements capture heat transfer effects through the heat transfer plate and are important to assess and understand the overall heat transfer phenomena. RUN 3 is chosen for its highest CNV operating pressure that is closest to NIST-1 integral tests.

HP-05 plots along with NRELAP5 results:

DP-1101C (core DP), DP-1501C (SG DP) ,FCM-2201 (FW rate) , PT-2501a (Steam pressure). and core_pwr (core power). These are important to gauge the performance of NRELAP pressure drop calculation.

HP-06b (EC-T080-4872-R0):

Figure 4-23 RPV pressure, mid-term.

Figure 4-25, RPV level, mid-term.

Figure 4-26 secondary side pressure, mid-term. Figure 4-27 CNV pressure, mid-term.

Figure 4-28, CNV level, mid-term.

Figure 4-29, 4-31, and 4-33 CNV fluid temp, mid-term.

Figure 4-35, 4-37, and 4-39 CNV wall temp, mid-term.

Figure 4-40, 4-42, and 4-44 (HTP temp), mid-term.

Figure 4-46, 4-47, and 4-48 (CPV fluid temp), mid-term.

(Staff noted most plots for the {{

}}2(a),(c)

HP-43: EC-T080-5045_R0:

Figure 4-1 HP-43 pre-break CNV wall temperature TW-4X01~04

Figure 4-2 HP-43 pre-break HTP wall temperature TW-50XY to TW-59XY Figure 4-14 PZR pressure PT-1401a, short-term.

Figure 4-15 PZR level Ldp1401Cal, short-term. Figure 4-16 RPV level, short-term.

Figure 4-19 PT-2326, 2334, 2501 secondary side pressure, short-term. Figure 4-20 FVM-3221 RVV orifice mass flow 200s, short-term.

Figure 4-21 DP-3221, short-term. Figure 4-22 CNV pressure, short-term. Figure 4-23 CNV level, short-term.

Figure 4-24 PZR pressure, mid-term. Figure 4-26 RPV level, mid-term.

Figure 4-28 CNV pressure, mid-term. Figure 4-29 CNV level, mid-term.

Figure 4-67 "Cd Cases" on FVM-3221, 200s, short-term.

(Since HP-43 is the only NIST-1 test simulating the 3-RVV configuration.)

NuScale Response:

The requested plots from several NuScale test assessment reports are reproduced in this response along with short discussions of each assessment.

The NIST-1 HP-02 test is intended to provide a better understanding of the {{

}}[2(a),(c)] Figure 1 through Figure 10 of this response provide the requested plots from the assessment between Run 3 of the HP-02 test and the NRELAP5 HP-02 model. The NRELAP5 assessment of the NIST

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k was complete, and corrected minor modeling errors. Figure 1 through Figure 4 of this response represent initial temperature distributions. Figure 5 through Figure 7 of this response represent the secondary side boundary conditions. Figure 8 through Figure 10 represent the temperature profile at a given elevation from the CNV, through the HTP, to the CPV at various levels consistent with the NIST-1 facility instrument elevations for each run. For the upper regions, NRELAP5 provides {{

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

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}}2(a),(b),(c),ECI

Figure 1: HP-02 Run 3 Containment Vessel Shell Initial Temperature Distribution

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}}2(a),(b),(c),ECI

Figure 2: HP-02 Run 3 Containment Vessel Fluid Initial Temperature Distribution

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}}2(a),(b),(c),ECI

Figure 3: HP-02 Run 3 Heat Transfer Plate Initial Average Temperature Distribution

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}}2(a),(b),(c),ECI

Figure 4: HP-02 Run 3 Cooling Pool Vessel Fluid Initial Temperature Distribution

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}}2(a),(b),(c),ECI

Figure 5: HP-02 Run 3 Steam Mass Flow Rate

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}}2(a),(b),(c),ECI

Figure 6: HP-02 Run 3 Steam Pressure

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}}2(a),(b),(c),ECI

Figure 7: HP-02 Run 3 Steam Temeprature

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}}2(a),(b),(c),ECI

Figure 8: HP-02 Run 3 Temperature Profile from CNV to CPV (through HTP) for Level 1

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}}2(a),(b),(c),ECI

Figure 9: HP-02 Run 3 Temperature Profile from CNV to CPV (through HTP) for Level 4

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}}2(a),(b),(c),ECI

Figure 10: HP-02 Run 3 Temperature Profile from CNV to CPV (through HTP) for Level 8

The HP-05 test is intended to {{

}}[2(a),(c)] The NRELAP5 assessment of the NIST-1 HP-05 test was revised. The revised assessment was performed with NRELAP5 v1.4, addressed instrument non conformances identified after the prior assessment work was complete, and corrected identified modeling errors. Figure 11 through Figure 15 of this response provide the requested plots from the assessment between HP-05 test data and the NRELAP5 HP-05 model. Figure 16 through Figure 18 of this response show comparisons between the measured data and NRELAP5 prediction of the primary mass flow rate, core outlet temperature, and core inlet temperature. The NRELAP5 case presented in these figures is from a calculation where the {{

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

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}}2(a),(b),(c),ECI

Figure 11: HP-05 Core Pressure Drop (DP-1101C)

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}}2(a),(b),(c),ECI

Figure 12: HP-05 Steam Generator Pressure Drop (DP-1501C)

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}}2(a),(b),(c),ECI

Figure 13: HP-05 Feedwater Flow Rate

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}}2(a),(b),(c),ECI

Figure 14: HP-05 Steam Pressure

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}}2(a),(b),(c),ECI

Figure 15: HP-05 Core Power

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}}2(a),(b),(c),ECI

Figure 16: HP-05 Primary Mass Flow (FDP-1201C)

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}}2(a),(b),(c),ECI

Figure 17: HP-05 Core Outlet Temperature (TF-1201)

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}}2(a),(b),(c),ECI

Figure 18: HP-05 Core Inlet Temperature (TF-1602)

The HP-06b test is intended to provide a better understanding of phenomena {{

. }}[2(a),(c)] Figure 19 through Figure 35 represent the assessment between HP-06b mid-term data and the NRELAP5 HP-06b model. The figures of merit for the mid-term response (RPV pressure, RPV level, CNV pressure, and CNV level) were {{

}}[2(a),(b),(c),ECI] by NRELAP5. CNV temperature, CNV wall temperature, HTP temperature, and CPV temperature, were {{

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

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

Figure 19: HP-06b Mid-term RPV pressure

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}}2(a),(b),(c),ECI

Figure 20: HP-06b Mid-term RPV level

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}}2(a),(b),(c),ECI

Figure 21: HP-06b Mid-term Secondary Side Pressure

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}}2(a),(b),(c),ECI

Figure 22: HP-06b Mid-term CNV Pressure

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}}2(a),(b),(c),ECI

Figure 23: HP-06b Mid-term CNV Level

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}}2(a),(b),(c),ECI

Figure 24: HP-06b Mid-term CNV Fluid Temperatures (Lower Region)

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}}2(a),(b),(c),ECI

Figure 25: HP-06b Mid-term CNV Fluid Temperatures (Mid Region)

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}}2(a),(b),(c),ECI

Figure 26: HP-06b Mid-term CNV Fluid Temperatures (Upper Region)

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}}2(a),(b),(c),ECI

Figure 27: HP-06b Mid-term CNV Wall Temperatures (Lower Region)

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}}2(a),(b),(c),ECI

Figure 28: HP-06b Mid-term CNV Wall Temperatures (Mid Region)

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}}2(a),(b),(c),ECI

Figure 29: HP-06b Mid-term CNV Wall Temperatures (Upper Region)

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}}2(a),(b),(c),ECI

Figure 30: HP-06b Mid-Term HTP Temperatures (Lower Region)

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}}2(a),(b),(c),ECI

Figure 31: HP-06b Mid-Term HTP Temperatures (Mid Region)

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}}2(a),(b),(c),ECI

Figure 32: HP-06b Mid-Term HTP Temperatures (Upper Region)

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}}2(a),(b),(c),ECI

Figure 33: HP-06b Mid-Term CPV Fluid Temperatures (Lower Region)

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}}2(a),(b),(c),ECI

Figure 34: HP-06b Mid-Term CPV Fluid Temperatures (Mid Region)

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}}2(a),(b),(c),ECI

Figure 35: HP-06b Mid-Term CPV Fluid Temperatures (Upper Region)

The HP-43 test is intended to provide a better understanding of phenomena {{

}}2(a),(c) Figure 36 through Figure 50 provide the requested plots from the assessment between HP-43 data (both short-term and mid-term) and the NRELAP5 HP-43 model. Code-to-data comparisons for identified key figures of merit (RPV pressure, PRV level, CNV pressure, and CNV level) were {{

}}2(a),(b),(c),ECI

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}}2(a),(b),(c),ECI

Figure 36: HP-43 Pre-RVV Opening CNV Wall Temperatures

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}}2(a),(b),(c),ECI

Figure 37: HP-43 Pre-RVV Opening HTP Wall Temperatures

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}}2(a),(b),(c),ECI

Figure 38: HP-43 Pressurizer Pressure (Short-Term)

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}}2(a),(b),(c),ECI

Figure 39: HP-43 Pressurizer Level (Short-Term)

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}}2(a),(b),(c),ECI

Figure 40: HP-43 RPV Level (Short-Term)

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}}2(a),(b),(c),ECI

Figure 41: HP-43 Secondary Side Pressure (Short-Term)

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}}2(a),(b),(c),ECI

Figure 42: HP-43 Spurious RVV Orifice Mass Flow (Short-Term)

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}}2(a),(b),(c),ECI

Figure 43: HP-43 Spurious RVV Orifice Differential Pressure (Short-Term)

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}}2(a),(b),(c),ECI

Figure 44: HP-43 CNV Pressure (Short-Term)

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}}2(a),(b),(c),ECI

Figure 45: HP-43 CNV Level (Short-Term)

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}}2(a),(b),(c),ECI

Figure 46: HP-43 Pressurizer Pressure (Mid-Term)

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}}2(a),(b),(c),ECI

Figure 47: HP-43 RPV Level (Mid-Term)

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}}2(a),(b),(c),ECI

Figure 48: HP-43 CNV Pressure (Mid-Term)

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}}2(a),(b),(c),ECI

Figure 49: HP-43 CNV Level (Mid-Term)

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}}2(a),(b),(c),ECI

Figure 50: HP-43 Spurious RVV Orifice Mass Flow Rate (Short-Term "Cd cases")

References:

1. Idelchik, I.E., “Handbook of Hydraulic Resistance,” Hemisphere Publishing, New York, NY, 3rd Edition.

Impact on Topical Report:

There are no impacts to the Topical Report TR-0516-49422, Loss-of-Coolant Accident Evaluation Model, as a result of this response.

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0918-61794

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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.

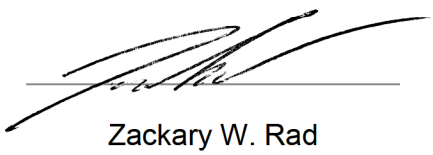
    NuScale has performed significant research and evaluation to develop a basis for this method and has invested significant resources, including the expenditure of a considerable sum of money.

    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. 9492, eRAI No. 9492. 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 17, 2018.



Zackary W. Rad