RAIO-0519-65801

May 31, 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. 377 (eRAI No. 9380) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 377 (eRAI No. 9380)," dated March 02, 2018
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 377 (eRAI No.9380)," dated September 13, 2018

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. 9380:

- 06.02.01.01.A-6

Enclosure 1 is the proprietary version of the NuScale Supplemental Response to NRC RAI No. 377 (eRAI No. 9380). 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 Rebecca Norris at 541-602-1260 or at rnorris@nuscalepower.com.

Sincerely,

Michael Melton
Manager, Licensing
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8H12
Omid Tabatabai, NRC, OWFN-8H12
Samuel Lee, NRC, OWFN-8H12

Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9380, proprietary

Enclosure 2: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9380, nonproprietary

Enclosure 3: Affidavit of Thomas A. Bergman, AF-0519-65802

NuScale Power, LLC
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Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9380, proprietary

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Enclosure 2:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9380, nonproprietary

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

eRAI No.: 9380
Date of RAI Issue: 03/02/2018

NRC Question No.: 06.02.01.01.A-6

NIST-1 HP-02 is a separate effects, high pressure steam condensation test. During the HP-02 test, steam is introduced into the NIST-1 containment vessel (CNV) resulting in a slowly increasing steam pressure. The steam condenses to liquid on the NIST-1 CNV wall at a temperature approximately equal to the saturation temperature at the time of condensation. Thus, the condensate temperature increases with time during the test as the NIST-1 CNV pressure increases. The staff's review of the HP-02 test data shows that this process {{

}}2(a),(c)

a. While Staff recognizes that the temperature stratification in the NIST-1 HP-02 tests did not result from the same mechanism as discussed for the NPM, the staff requests to audit the NRELAP5 computer code calculations in order to gain better understanding of how NRELAP5 calculates the temperature stratification. Specifically, the applicant is requested to provide technical justification that the NRELAP5 code is capable of adequately representing thermal stratification in the CNV and justify the nodalization used in the model. For example, the applicant may use the standard NRELAP5 model for NIST-1 HP-02 tests to compute liquid temperature versus time at the same elevations as the temperature measurements made for HP-02 Runs 1, 2, and 3. If additional NRELAP5

analysis is performed, the applicant should consider modifying the standard NRELAP5 model with sufficiently fine hydrodynamic noding below the final liquid level occurring at the end of the HP-02 test runs to capture the thermally stratified distribution of subcooled water in the containment vessel. The applicant is requested to provide comparison plots to show the impact of node size on the computed temperature stratification of the liquid and CNV pressure vs. the HP-02 test data for any additional analyses performed. Provide an evaluation showing whether NRELAP5 correctly calculates the temperature stratification observed in the HP-02 tests and demonstrate that NRELAP5 does not allow the cooler stratified water to act as a heat sink and reduce the temperature and pressure of the steam.

b. Staff noticed that there was no pre-heating of NIST-1 containment wall in HP-02 test that suggests that condensation also took place on the containment wall besides the heat transfer plate (HTP). This would lead to a heat loss to the ambient air through the containment wall, in addition to the heat transfer across the HTP to the reactor cooling pool. Since the objective of the experiment is to validate the condensation heat transfer in a pressurized environment, failure to model the heat loss and the pool heat transfer will distort the pressure response inside the containment. {{

}}2(a),(c)

NuScale Response:

During an April 16, 2019 conference call with the staff, the NRC requested a supplementary response to eRAI 9380, Question 06.02.01.01.A-6. Specifically, the NRC requested additional information regarding the results of the NIST-1 HP-49 test nodalization sensitivity analyses. The requested information is provided below.

Background

RAI 9380 - 06.02.01.01.A-6 part (a) requested additional information to gain a better understanding of how NRELAP5 calculates liquid temperature stratification. The RAI requested comparison plots showing the impact of node size on the calculated temperature stratification

and the containment vessel (CNV) pressure for the NIST-1 HP-02 test assessments, to demonstrate that NRELAP5 does not allow cooler stratified water to act as a heat sink and reduce the temperature and pressure of the steam. In response to this RAI, results from the NIST-1 HP-02 test nodalization sensitivity calculations were provided, discussing the impact of the nodalization on the predicted thermal stratification and CNV pressure. RAI 9380 - 06.02.01.01.A-5 requested similar information about the impact of the NPM plant nodalization in the peak containment pressure calculations and effect of predicted liquid thermal stratification on the calculated CNV peak pressure.

The NRC staff observed that the finer nodalization in the HP02 assessment sensitivity calculation resulted in a larger change in CNV pressure compared to the results of the NPM plant renodalizaiton sensitivity calculations. This RAI response supplement provides additional information discussing how the NIST-1 HP-02 test was conducted, discussion of the phenomena governing the CNV pressurization in the NPM, and additional NRELAP5 nodalization sensitivity calculations based on the NIST-1 HP-49 test assessment. The NIST-1 HP-49 test simulated an inadvertent reactor recirculation valve (RRV) opening, thus the thermal-hydraulic phenomena governing CNV pressurization for this test are consistent with the phenomena governing the NPM CNV pressurization. Therefore, the NRELAP5 nodalization sensitivity calculations based on the NIST-1 HP-49 test are more relevant for evaluation of the NRELAP5 models, to confirm that no important phenomena were missed in the NPM NRELAP5 model, compared to the assessment of the HP-02 test. The HP-49 nodalization study is used to examine the impact of the CNV nodalization on high ranked phenomena such as the CNV heat removal rate, and on the CNV peak pressure and level figures of merit.

Conduct of the NIST-1 HP-02 Test

The NIST-1 HP-02 test is a separate effects test performed at the NIST-1 facility to collect experimental data on high pressure steam condensation. During the test, steam at known conditions was injected into the CNV and the CNV pressure, level, and temperature response were measured. During the test, the NIST-1 facility was initially operated in its normal mode, heating the RPV with core heaters with heat rejection through the steam generator to the stack (i.e., rejected to the environment). The steam generator feedwater flow rate, steam exit pressure, and core power were established to obtain the desired steam conditions. Once the desired conditions were established, steam was diverted from the stack to the CNV. For each test point, superheated steam was discharged into the CNV until the CNV target pressure was reached, after which the inlet steam flow was ramped down in an effort to achieve steady-state conditions in the CNV at the target pressure. After steam was injected into the CNV,

condensation occurred on the heat transfer plate (HTP). Condensation energy was then thermally conducted through the HTP and convected into the cooling pool.

This test was used to validate the NRELAP5 calculation of {{

}}2(a),(c)

Phenomena Governing CNV Pressurization in the NPM and NIST-1 LOCA-Type Tests

As discussed in response to RAI 9208 - 15.06.05-14 part (c) (NuScale letter dated February 27, 2019, ML19058A864) and in response to RAI 9494 - 06.02.01.01.A-16 part (e)(5) (NuScale letter dated March 8, 2019, ML19067A287), the high-ranked phenomena governing the CNV pressurization in the NPM for primary side release events are:

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}}2(a),(c)

As discussed in response to RAI 9494 - 06.02.01.01.A-16 part (e)(5) (NuScale letter dated March 8, 2019, ML19067A287), comparisons of RPV and CNV energy balance non-dimensional similarity groups (PI groups) between the NPM and NIST-1 for the NIST-1 tests HP-06b, HP-07, and HP-09 show that the same high-ranked phenomena dominate the NIST-1 and NPM CNV pressure behavior and indicate that the NIST-1 facility is capable of predicting the overall trends in CNV pressure. The HP-49 test modeled a spurious RRV opening into containment. This is a liquid space break similar to the HP-06b test modeling a CVCS discharge line break into

containment; the RRV area is larger than the CVCS discharge and is located at a lower elevation.

As summarized in response to RAI 8985 - 15.06.06-1 (NuScale letter dated November 6, 2017, ML17310B505), the NuScale LOCA phenomena identification and ranking table (PIRT) is a general PIRT that is applicable for typical transients initiated by {{

}}[2(a),(c)] Therefore, it is concluded that the same high-ranked phenomena dominate the NIST-1 CNV pressure behavior in the HP-49 test. NRELAP5 CNV nodalization sensitivity calculations for an NIST-1 RRV opening scenario, based on the HP-49 assessment calculation, were performed to examine the effect on the CNV pressurization.

NRELAP5 CNV Nodalization Sensitivity Calculations for NIST-1 RRV Opening Type Transient

The NRELAP5 model for the NIST-1 HP-49 assessment was used as the starting point for NIST-1 model CNV nodalization sensitivity calculations. {{

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

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}}2(a),(c)

Table 1 summarizes the total number of nodes in the CNV for each model and Table 2 summarizes the calculated peak CNV pressure. Figure 1 compares the calculated CNV pressure and Figure 2 compares the calculated CNV level response. Due to the initial condition simplifications made for the nodalization sensitivity calculations, the calculated values are not directly comparable to the measured peak pressure data and therefore, the measured data is not included in the tables or figures. However, the phenomena that govern the peak CNV pressure are not affected by the simplifications in the initial conditions. The predicted CNV pressure and level response in the nodalization sensitivity calculations are characteristic of a liquid space blowdown at NIST-1.

In conclusion, the phenomena of {{

}}2(a),(c) This supports the conclusion that the base NIST-1 model nodalization of the CNV is sufficient to resolve high ranked phenomena governing CNV pressurization for liquid space primary system release events such as an inadvertent RRV opening event.

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

Figure 1: NIST-1 RRV opening CNV nodalization study containment pressure comparison

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}}2(a),(c)

Figure 2: NIST-1 RRV opening CNV nodalization study collapsed liquid level

Table 1: CNV and HTP axial nodalization

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

Table 2: CNV pressure response from CNV axial nodalization sensitivity

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

Impact on DCA:

There are no impacts to the DCA as a result of this response.

Enclosure 3:

Affidavit of Thomas A. Bergman, AF-0519-65802

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NuScale Power, LLC

AFFIDAVIT of Thomas A. Bergman

I, Thomas A. Bergman, state as follows:

1. I am the Vice President, 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 containment vessel condensation modeling.

    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. 377, eRAI 9380. 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 May 31, 2019.

Thomas A. Bergman