RAIO-0518-59877

May 09, 2018

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. 16 (eRAI No. 8783) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 16 (eRAI No. 8783)," dated May 03, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 16 (eRAI No.8783)," dated June 30, 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).

The Enclosures to this letter contain NuScale's supplemental response to the following RAI Question from NRC eRAI No. 8783:

- 06.02.01.01.A-1

Enclosure 1 is the proprietary version of the NuScale Supplemental Response to NRC RAI No. 16 (eRAI No. 8783). 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 Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

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

Distribution: Omid Tabatabai, 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. 8783, proprietary

Enclosure 2: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8783, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0518-59878

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Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8783, proprietary

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Enclosure 2:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8783, nonproprietary

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NuScale Power™

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

eRAI No.: 8783
Date of RAI Issue: 05/03/2017

NRC Question No.: 06.02.01.01.A-1

NPM CNV DBA Models and NIST-1 Test Data for Containment Peak Pressure/Temperature Analyses

Title 10 of the Code of Federal Regulations (10 CFR), Part 50, Appendix A, “General Design Criteria [GDC] for Nuclear Power Plants,” Criterion 50, “Containment design basis,” requires “the reactor containment structure, including access openings, penetrations, and the containment heat removal system shall be designed so that the containment structure and its internal compartments can accommodate, without exceeding the design leakage rate and with sufficient margin, the calculated pressure and temperature conditions resulting from any loss-of-coolant accident. This margin shall reflect (1) the effects of potential energy sources which have not been included in the determination of the peak conditions, such as energy in steam generators and as required by 10 CFR 50.44 energy from metal-water and other chemical reactions that may result from degradation but not total failure of emergency core cooling functioning, 2) the limited experience and experimental data available for defining accident phenomena and containment responses, and (3) the conservatism of the calculational model and input parameters.” In addition, 10 CFR, Part 50, Appendix A, Criterion 16, “Containment design,” requires “Reactor containment and associated systems shall be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require.” 10 CFR, Part 50, Appendix A, Criterion 38, “Containment heat removal,” requires “A system to remove heat from the reactor containment shall be provided. The system safety function shall be to reduce rapidly, consistent with the functioning of other associated systems, the containment pressure and temperature following any loss-of-coolant accident (LOCA) and maintain them at acceptably low levels.”

Further, 10 CFR Part 52.47, Contents of Applications; Technical Information, (a)(2) also requires “A description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefore, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished,” and 52.47(c)(2) “An application for certification of a nuclear power reactor design that differs significantly from the light-water reactor designs described in paragraph (c)(1) of this section or uses simplified, inherent,

passive, or other innovative means to accomplish its safety functions must provide an essentially complete nuclear power reactor design except for site-specific elements such as the service water intake structure and the ultimate heat sink, and must meet the requirements of 10 CFR 50.43(e).” Further, from 50.43(e) “Applications for a design certification, combined license, manufacturing license, or operating license that propose nuclear reactor designs which differ significantly from light-water reactor designs that were licensed before 1997, or use simplified, inherent, passive, or other innovative means to accomplish their safety functions, will be approved only if: (1)(i) The performance of each safety feature of the design has been demonstrated through either analysis, appropriate test programs, experience, or a combination thereof; (ii) Interdependent effects among the safety features of the design are acceptable, as demonstrated by analysis, appropriate test programs, experience, or a combination thereof; and (iii) Sufficient data exist on the safety features of the design to assess the analytical tools used for safety analyses over a sufficient range of normal operating conditions, transient conditions, and specified accident sequences, including equilibrium core conditions”

The staff needs to assess the ability of the applicant’s analytical tools used in the safety analyses to meet the aspects of GDCs 16, 38, and 50; Part 52.47 and Part 50.43(e) relevant to the containment design basis. Specifically, the staff needs to assess the ability of the applicant’s NRELAP5 model to predict the safety-significant phenomena in order for the staff to conclude that the code results are valid over the applicable range of accident conditions. The thermal-hydraulic phenomena pertinent to NuScale design certification document (DCD) Section 6.2 containment design basis accident (DBA) analyses are the heat transfer from the containment vessel (CNV) to reactor pool (including condensation on the inner surface of the CNV), conduction through CNV wall (represented by the heat transfer plate (HTP) in NIST-1), and the convection to the reactor pool (CPV in NIST-1). The staff needs to review and understand the conservatism of the licensing-basis models, constitutive correlations, and input parameters for the applicant’s NPM DBA containment response analyses and the experimental data used to validate the accident phenomenology. Therefore, NuScale is requested to submit the following information:

1. Four NRELAP5 *NuScale Power Module* (NPM) input model decks nodalized and biased for DCD Chapter 6 peak containment pressure/temperature analyses are requested. They include decks for the limiting containment peak pressure case, and the limiting LOCA, main steam line break (MSLB), and main feedwater line break (MFLB) cases for the respective containment design basis accident (DBA). Provide the corresponding base, steady-state, and transient model decks.
2. NRELAP5 NIST-1 input model deck for HP-02 test case. Provide both steady-state and transient model decks.
3. Energy balances on the HP-02 test data as documented in the first three close-out observations made in the June 27-30, 2016, ECCS-Containment Performance Audit Summary Report (ML16168A277), specifically,
    a. Core electrical power-to-primary SG side heat balance,
    b. Primary-to-secondary SG side heat balance, and
    c. Containment-to-cooling-pool heat balance based on the measurements made by the thermocouple grid embedded in the HTP and the condensate drainage.

NuScale Response:

NuScale Letter RAIO-0617-54735, dated June 30, 2017 transmitted the responses to eRAI 8783, Question 06.02.01.01.A-1, Items 1 through 3. Subsequently, NuScale discovered an error in the HP-02 test data heat balance provided in response to Question 06.02.01.01.A-1, Item 3, and NuScale was notified of additional test data nonconformances that affected the heat balance calculation. Accordingly, this supplementary response supersedes the response to eRAI 8783, Question 06.02.01.01.A-1 Item 3 transmitted by NuScale letter RAIO-0617-54735, in its entirety. The responses to eRAI, Question 06.02.01.01.A, Items 1 and 2, transmitted by NuScale letter RAIO-0617-54735 are unaffected by this supplement. Specific changes to the Item 3 response are as follows:

- Table 1 "Summary of Heat Balance Results" is updated with revised values. The revised values are highlighted by bold text.
- Table 2 is added to summarize the magnitude of the change in Table 1 values and the reason for each change.

Response to Item (3):

The HP-02 condensation test is a separate effects test performed at Oregon State University (OSU) at the NIST-1 facility. The HP-02 condensation test was designed to measure the containment vessel response to a controlled in-flow of steam. The test involved injecting steam at known conditions into the containment vessel (CNV) to capture the CNV pressure, temperature, and condensate water level response. Condensation occurred at the inner surfaces of the containment walls, mainly on the heat transfer plate (HTP), which is in direct contact with the cooling pool on the cold (non-condensing) side. The facility was instrumented to measure the HTP wall temperatures and the cooling pool water temperatures, thus allowing for a derivation of heat transfer from the containment to the pool during the test.

During the HP-02 condensation test, the NIST-1 facility was operated to inject a controlled amount of steam into the CNV via the NIST-1 steam generator. The steam generator (SG) was powered by heating the reactor pressure vessel (RPV) with the core heaters. The steam generated in the SG was directed to the CNV, rather than exhausted out to ambient as in the normal configuration. Test runs were performed to obtain data to analyze steady-state condensation at varying CNV pressures. For each test run, the CNV was initialized at vacuum conditions. First, superheated steam was discharged into the CNV until the CNV target pressure was reached. After the target pressure was reached, the inlet steam flow was ramped down in an effort to achieve steady state conditions at the target pressure within the CNV; this is referred to as the steady-state phase of each test run.

During the HP-02 condensation test, the function of the primary side was thus to provide a constant heat rate to the secondary steam. The core power, SG feedwater flowrate, and steam

exit pressure were controlled to obtain the desired conditions for steam injection into the CNV.

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}}2(a),(c)

In the LOCA evaluation model topical report (Reference 1) Section 7.5.4, results from three HP-02 test runs are presented. Energy balances from these three HP-02 test runs are summarized in Table 1. {{

}}2(a),(c) A brief description of how the data are used for the purpose of performing the energy balance calculations is given in the following paragraphs.

The core power is measured by the NIST-1 data acquisition and control system.

The energy balance over the primary side of the steam generator is calculated using the measured lower plenum pressure and pressurizer pressure, reactor coolant system (RCS) flow rate, fluid temperature at the upper riser exit, and fluid temperature in the downcomer near the steam generator exit. The heat transfer from fluid in the riser to fluid in the primary side of the steam generator through the riser wall is accounted for using the lower plenum and pressurizer pressure, and the fluid temperature in the hot leg riser and at the riser exit.

The energy balance over the secondary side of the steam generator is calculated using measured secondary side feedwater temperature, feedwater flow rate, feedwater pressure, steam generator outlet pressure, and steam temperatures at the steam generator tube exit.

The rate of energy transfer to the cooling pool fluid is calculated using atmospheric pressure, the pool liquid volume, and pool fluid temperatures. The cooling pool fluid energy is calculated {{

}}2(a),(c)

The containment to cooling pool heat transfer is also calculated from the conduction heat transfer through the HTP, based on temperature measurements made by the thermocouple grid embedded in the HTP.

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}}2(a),(c)

Table 1. Summary of Heat Balance Results

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

Table 2. Explanation of Changes in Heat Balance Results

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}}2(a),(c)

References:

1. TR- 0516-49422, Revision 0, “Loss-of-Coolant Accident Evaluation Model,” December 2016.

Impact on DCA:

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

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0518-59878

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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 methodology by which NuScale develops its containment response analysis.

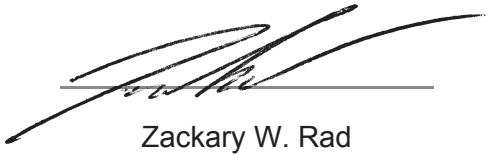
    NuScale has performed significant research and evaluation to develop a basis for this methodology and has invested significant resources, including the expenditure of a considerable sum of money.

    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 Supplemental RAI No. 16, eRAI No. 8783. 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 5/9/2018.



Zackary W. Rad