November 06, 2017

Docket: PROJ0769

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 8985 (eRAI No. 8985) 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. 8985 (eRAI No. 8985)," dated September 06, 2017
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. 8985:

- 15.06.06-1

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 8985 (eRAI No. 8985). 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
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8985, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 8985, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-1117-57046

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8985, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 8985, nonproprietary

Response to Request for Additional Information
Docket: PROJ0769

eRAI No.: 8985
Date of RAI Issue: 09/06/2017

NRC Question No.: 15.06.06-1

Title 10 of the Code of Federal Regulations (10 CFR) Part 52, Section 47 (a)(2) states, "A description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished." Likewise, 10 CFR Part 50, Appendix K, II.4 – Required Documentation, requires that, "To the extent practicable, predictions of the evaluation model, or portions thereof, shall be compared with applicable experimental information."

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 accessing evaluation models 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 evaluation model (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

(3) All other information needed to specify the calculational procedure.

The entirety of an EM ultimately demonstrates whether the results are in compliance with applicable regulations. Therefore, the development, assessment, and review processes must consider the entire EM. FSAR Chapter 15, Section 15.6.6.1, states that inadvertent operation of emergency core cooling system (ECCS) is defined as an accidental reactor vessel depressurization and decrease of reactor vessel coolant inventory that could be caused by a spurious electrical signal, hardware malfunction, or operator error. The spurious opening analysis in FSAR chapter 15.6.6 assumes a mechanical failure of either a Reactor Recirculation

Valve (RRV) or Reactor Vent Valve (RVV) with the resulting loss of reactor pressure vessel (RPV) coolant. To evaluate the system response to a spurious opening, the loss of coolant accident (LOCA) TR EM model is used. Therefore, to accurately predict the system response to either a spurious full or partial opening or a RRV/RVV LOCA, which was previously raised in RAI 8776 (Question 4) and RAI 8785, the LOCA EM must be adequately validated for high-ranked phenomena, especially those with high or medium levels of uncertainty. According to the LOCA TR Table 4-4, High-ranked Phenomena, NuScale states that both {{ }}[2(a),(c)] indicating there can be large uncertainty associated with this flow and hence uncertainty in important figures of merit, including minimum RPV water level. In its review of ER-T080-5201, which summarizes the NIST-1 tests performed, NRC staff noted tests that address inadvertent opening of a RVV, but no similar test(s) for a RRV opening. It is the staff's opinion that {{ }}[2(a),(c)] than that of a RVV because of two-phase flow conditions will exist upon RRV activation and with single phase flow during the recirculation phase.

The inclusion of tests with a single failure would better represent design basis scenarios that challenge modeling limitations or uncertainties, which affect meeting the acceptance criteria. Examples of tests in which a single failure was not considered include: (1) full or partial openings of a RRV with the failure of the other RRV to open or (2) opening of two RVVs caused by the failure of an Inadvertent Actuation Block (IAB) valve as discussed in RAI 8815. Explain how the single failure criterion is applied to both a full and partial opening of an RRV or RVV including the technical basis (e.g., valve design features) which support the single failure assumptions.

Based on the staff's current understanding of the LOCA EM Phenomena Identification Ranking Table (PIRT) and associated validation tests, the staff is requesting the applicant:

1. Provide justification as to why high-ranked phenomena with high- or medium-ranked uncertainty specific to a RRV opening or break are adequately validated by test or experiments for the NuScale design. The justification should also discuss how the validation tests or experiments address {{ }}[2(a),(c)] Furthermore, state whether any NIST-1 test or experiment of a RRV opening was performed or attempted, and if so, provide a summary of any data collected, including the data which demonstrates that NRELAP5 adequately predicts important system parameters.

2. Provide justification for omitting NIST-1 integral tests taking a single failure of a RRV, in particular the scenario of either a break at, or a spurious opening of, a RRV with a single failure of the other RRV.

3. Provide {{ }}[2(a),(c)] if a small RRV break or valve opening results in core uncovery and heat-up.

NuScale Response:

FSAR Section 15.6.6 describes the inadvertent operation of the emergency core cooling system (ECCS) event for the NuScale power module (NPM). FSAR Section 15.6.6.3.2 describes the single failure scenarios analyzed to find the limiting inadvertent operation of the ECCS, which include: failure of a single reactor vent valve (RVV) to open, failure of a single reactor recirculation valve (RRV) to open, and failure of one ECCS division (one RVV and one RRV) to open. A more in-depth discussion of how the single failure criterion is applied to the ECCS valves is provided in the NuScale response to eRAI 8815, Question 15-2.

The initiating events described in FSAR Section 15.6.6 are inadvertent full openings of ECCS valves. NuScale does not consider a partial opening of an RVV or RRV as a credible failure that would initiate an event. The ECCS failure modes and effects analysis (FMEA) is summarized in FSAR Table 6.3-3. As described in the NuScale response to eRAI 8820, Question 03.09.06-1(e), a subcomponent level FMEA for the ECCS valves is forthcoming. The subcomponent level FMEA will identify failure modes and related effects for each subcomponent of the valve assembly. The FMEA will consider plausibility of ECCS valve partial opening to confirm partial openings are not credible initiating events.

The NuScale loss-of-coolant accident (LOCA) Phenomena Identification and Ranking Table (PIRT) summarized in Section 4.0 of the LOCA evaluation model (EM) topical report (Reference 1) is a general PIRT that is applicable for typical transients initiated by {{

}}2(a),(c)

Furthermore, the EM adequacy assessment documented in Section 8 of the LOCA EM topical report (Reference 1) is also applicable to the inadvertent ECCS valve opening scenarios. This evaluation is performed following the guidance provided in Element 4 of the Evaluation Model Development and Assessment Process (EMDAP) of Regulatory Guide 1.203 and includes bottom-up and top-down assessments of the EM. The bottom-up assessments of the code models and correlations are performed in order to determine their adequacy for the prediction of all high-ranked phenomena identified in the NuScale LOCA PIRT. The phenomenological domain or the applicability ranges where these models and correlation are used is determined (such as pressure range, temperature range, void fraction range, etc.) to perform the adequacy evaluations. Table 8-1 of Reference 1 identifies the dominant code models and correlations that

are essential to model the high-ranked PIRT phenomena and the associated key model parameters. Table 8-2 of Reference 1 provides estimated range of key parameters over which the dominant models or correlations must be demonstrated to be applicable. As described below, this range of key parameters is estimated based on {{

.}}2(a),(c)

The range of parameters in Table 8-2 of Reference 1 is determined by {{

}}2(a),(c)

The {{ }}2(a),(c) that support the determination of key parameter ranges in Table 8-2 of Reference 1 were performed by {{

}}2(a),(c) As shown in Table 8-2 of Reference 1, the {{

}}2(a),(c)

Section 8.2.2 of Reference 1 assesses the adequacy of the LOCA EM to cover {{

}}2(a),(c) It is noted that as with the LOCA break scenario, the inadvertent opening of an ECCS valve event is evaluated by conservatively applying {{

}}2(a),(c)

{{

}}2(a),(c)

The adequacy of the LOCA EM to cover {{

}}2(a),(c)

The LOCA EM is shown to adequately cover the range of phenomena encountered during a inadvertent ECCS valve opening event with uncertainty addressed by the conservative biasing of valve performance characteristics. The integral effects tests (IET) performed at the NIST-1 facility assess the ability of the LOCA EM to predict the integral module response to loss of inventory scenarios. Two tests evaluate the integral module response to a steam space discharge: the HP-07 test which evaluates a pressurizer spray line break (Section 7.5.7 of Reference 1) and the HP-09 test which evaluates a spurious RVV opening (Section 7.5.8 of Reference 1). It is noted that due to the significantly larger size of the RVV seat diameter relative to the pressurizer spray line diameter, the HP-09 test also provides a bounding depressurization rate for a LOCA initiated from the steam space (Section 7.5.8 of Reference 1). A single test evaluates the integral module response to a liquid space discharge: the HP-06 test which evaluates a chemical volume and control system (CVCS) discharge line break. The HP-06 test is adequate to evaluate the integral module response to both a CVCS discharge line break and a spurious opening of an RRV. As previously discussed, both events feature identical phenomena, both locations connect the downcomer side of the RPV to the CNV, and the 100% CVCS discharge line break and RRV seat area diameters, based on final valve drawings, are of comparable size (1.69 in compared to 2 in). Calculation results show that a 100% CVCS discharge line break and a inadvertent RRV opening event feature similar event progression, with the RRV event timings generally occurring sooner as the maximum specified seat area is conservatively applied to the analysis. For these reasons it is determined that the HP-06 is adequate to assess the ability of NRELAP5 to predict the integral module response to a spurious RRV opening event. Additionally, it is determined that the HP-06, HP-07, and HP-09 tests are adequate to assess the LOCA EM without the need to consider single failures during testing. As previously mentioned, the range of parameters presented in Table 8-2 of Reference 1 includes consideration for single failures for both the LOCA spectrum and inadvertent ECCS valve opening events; therefore the LOCA EM phenomena applicability range is already shown to cover inadvertent ECCS valve events with single failures. Additionally, single failures do not

introduce any new transient phenomena that would require additional testing. As discussed in FSAR Section 15.6.6.3.2, sensitivity calculation results show that single failures do not have an impact on the acceptance criteria evaluated in the analysis.

In summary, the PIRT, the assessment base, and the applicability evaluation presented in LOCA LTR are applicable for the scenarios initiated by inadvertent opening of an RRV or an RVV. As previously mentioned, the LOCA PIRT identifies a {{

}}2(a),(c)

This is uncertainty further discussed in detail below.

The allowable flow characteristics of the ECCS valves are specified as design requirements through the establishment of upper and lower bounds on performance characteristics that address uncertainties related to the performance of the actual component. Demonstration of these characteristics will be performed through qualification testing of the components after they are built and prior to installation. For the ECCS valves, both the minimum and maximum flow capacity is important for different aspects of the NPM safety determination. The single phase flow performance analytical range, inclusive of uncertainty, is specified for the valves in terms of a {{

}}2(a),(c) characteristics of the valves is being conservatively addressed.

Generally, the {{

}}2(a),(c)

For the limiting liquid space LOCA cases, or in the case of the inadvertent RRV, the period of {{

}}2(a),(c)

{{

}}2(a),(c)

FSAR Section 15.6.6.1 classifies the inadvertent operation of the ECCS as an anticipated operational occurrence. A break at the reactor vessel attachment location of an ECCS valve (RVV or RRV) is not considered credible as described in the NuScale responses to eRAI 8785, Question 15.06.05-1 and eRAI 8786, Question 15.06.05-5. As described above, an inadvertent partial opening of an RRV is not considered credible as an intiating event. Therefore, no modifications to the phenomena identification and ranking table associated with these two non-credible events are provided.

References

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

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-1117-57046

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 methods by which NuScale develops its loss-of-coolant accident analysis.

    NuScale has performed significant research and evaluation to develop a basis for these methods 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. 8985, eRAI No. 8985. 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 11/6/2017.

Zackary W. Rad