RAIO-1017-56528

October 11, 2017

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 Response to NRC Request for Additional Information No. 180 (eRAI No. 9010) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 180 (eRAI No. 9010)," dated August 12, 2017

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 Questions from NRC eRAI No. 9010:

- 09.01.02-1
- 09.01.02-2

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 180 (eRAI No. 9010). 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 Carrie Fosaaen at 541-452-7126 or at cfosaaen@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. 9010, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9010, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-1017-56529

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9010, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9010, nonproprietary

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

eRAI No.: 9010
Date of RAI Issue: 08/12/2017

NRC Question No.: 09.01.02-1

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Section 9.1.2 and DSRS Section 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above. DSRS 3.8.4 specifically states that dynamic input data such as floor response spectra or ground response spectra are developed using the criteria described in DSRS Section 3.7.1, 3.7.2, 3.7.3, and SRP Section 3.7.4. It also states that the seismic input motion to the racks should consider the spectra at the rack base and the wall of the spent fuel pool. It is acceptable to envelope the seismic motion at these two locations for the input loading to the racks.

The staff reviewed the description of the time history development in TR-0816-49833-P, Section 3.1.2. The staff requests the applicant clarify the steps taken in the development of the time histories for the fuel storage rack analysis. Specifically, the applicant should clarify the purpose of developing a target low frequency (LF) and high frequency (HF) response spectra and describe the enveloping methodology that yields the frequency targeted spectra. The applicant should also describe the basis for selecting one set of time histories to envelop RS (TH1), four sets of time histories for the LF target RS, and two sets of time histories for the HF target RS.

With respect to the identification of the selected wall nodes, in the 1st paragraph of Section 3.1.2.4, the applicant describes the eight nodes selected for time history generation. The paragraph states that nodes represent locations in the SFP walls, up to an elevation of +50 ft-0 in, which is consistent with the Figures 3-3 and 3-4 which show node locations at multiple elevations above the basemat. Also in the same paragraph, the applicant states that the nodal ISRS are enveloped at two elevations, 24 ft. and 50 ft. consistent with Figures 3-6 through 3-14. The applicant should clarify whether nodes are enveloped up to +50 ft-0 in. or at +50 ft-0 in.

Additionally, the nodes located on the basemat (5237 and 5981) appear to be located at the corner and edge of the basemat. Because Figures 3-8, 3-11, and 3-14 show that at some frequencies the ISRS in the Z direction, the acceleration at 24 ft-0 in. exceeds the acceleration at 50 ft-0 in., the applicant should explain why there is no node selected at the center of the SFP at the basemat elevation. The applicant should address the possible amplification in the ISRS due to flexibility of the basemat at this location.

NuScale Response:

The purpose of developing target low frequency (LF) in-structure response spectra (ISRS) is to generate certified seismic design response spectra (CSDRS) consistent with the design ISRS applicable to the spent fuel pool (SFP) racks. The target LF ISRS maintain the dynamic characteristics of the CSDRS and associated ground motions selected for the Reactor Building soil-structure interaction (SSI) analysis. Target LF ISRS are developed by enveloping the nodal responses due to CSDRS motions only. Target high frequency (HF) ISRS are developed to preserve the characteristics of the high frequency certified seismic design response spectra (CSDRS-HF) and associated HF ground motions selected in a supplemental HF SSI analysis. Target HF ISRS are developed by enveloping the nodal responses due to CSDRS-HF motions only.

In accordance with the guidance in the NuScale SMR Design-Specific Review Standard (DSRS) 3.7.1 Subsection II.1.B.ii, an initial calculation was completed following Option 1: Single Set of Time Histories. The generation of this set (TH1) met the criteria outlined in the DSRS and the time history was used to support the whole pool analysis. It was later determined that completing a calculation using multiple time histories would help to remove potential uncertainties in the responses due to the variability of phase in the time series. The generation of multiple sets of time histories followed the DSRS 3.7.1 Subsection II.1.B.ii- Option 2: Multiple Sets of Time Histories. In addition to TH1, six more sets of time histories were generated which utilize both low frequency and high frequency response spectra for a total of seven independent sets of time histories. Since the pool fluid behavior is controlled by low frequency motions, fluid movements dominate the loads on the SFS racks. Therefore, emphasis is placed onto the low frequency region where four time history sets were generated. To capture the effects of the rack and the pool structure, that are in the HF region, two high frequency sets of time histories were generated.

All eight nodes that were used to compute the target response spectra were enveloped up to +50 ft-0 in. The nodes at the 24 ft-0 in and 50 ft-0 in elevations are enveloped separately and then the envelope of the two elevations is generated. The target response spectra for each analysis case are labeled “Envelope” in Figure 3-6 to 3-14.

The nodes enveloped for the 24 ft-0 in location contain two basemat nodes (5237 and 5981), while the 50 ft-0 in location contains only nodes in the SFP area. Therefore, the response spectra at the 24 ft-0 in location cover local effects near the basemat edge and may exceed responses shown for the 50 ft-0 in location outside the main amplified region. The Reactor Building basemat has a relatively large thickness of 10 ft compared to its span between SFP walls. The dimensions of the basemat at the location of the SFP are such that the local vertical response of the basemat (also considering fluid mass) is beyond the frequency of interest (50 Hz). While global Reactor Building basemat behavior in the SFP area exists, no additional local vertical amplifications occur in the frequency region of interest. However, global basemat

behavior is sufficiently sampled by the selected nodes in the SFP walls. Since there are no amplifications due to the flexibility of the basemat in the SFP area, the SFP basemat is considered rigid, with no need to select an additional node at the center of the SFP.

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

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

eRAI No.: 9010
Date of RAI Issue: 08/12/2017

NRC Question No.: 09.01.02-2

10 CFR Part 50, Appendix A, General Design Criteria (GDC) 1, 2, 4, 5, 63, and 10 CFR 52.80(a) provide the regulatory requirements for the design of the new and spent fuel storage facilities. SRP Sections 9.1.2 and DSRS Sections 3.8.4 Appendix D describe the specific SRP acceptance criteria for the review of the fuel racks to meet the requirements of the Commission's regulations identified above.

The applicant should confirm whether the methodology to develop the synthetic time histories, including the spectral matching process, is the same approach used in developing the seismic time histories for the seismic SSI analyses described in FSAR Section 3.7, and if not, identify any differences.

Also, on page 17, in Section 3.1.2.1 of TR-0816-49833-P, the applicant describes the methodology for developing the acceleration time histories. The staff requests the applicant clarify the statement that "damping is not used in the development of the time history."

Additionally, on page 18, in Section 3.1.2.1, the last paragraph references "DSRS 3.7.1 Subsection II.1.B.II-Approach 2 (ii)". The staff requests the applicant clarify why "(ii)" is specified after "Approach 2."

NuScale Response:

The methodology to develop the time histories for the SFP, including the spectral matching process, is the same approach used in developing the time histories for the seismic SSI analyses described in FSAR Section 3.7. One difference is that 100 uniformly spaced points per frequency decade are used to describe the matched response spectra in the SFP evaluation, whereas 200 points per decade were used in the SSI time history matching process. This difference is insignificant. Another difference is that power spectral densities (PSDs) for the SSI analysis time histories are scaled by the strong motion duration, whereas the entire motion duration was used to scale the SFP PSDs. Since this is an arbitrary scale factor with no impact on the ability to review potential gaps in the spectral density, this difference is acceptable.

The statement about no damping being used in the development of the time history is misleading and will be removed from the document. The time histories are matched to the target response spectra with 5% damping.

The reference to “DSRS 3.7.1 Subsection II.1.B.II-Approach 2 (ii)” is a typo and will be corrected. The correct reference is “DSRS 3.7.1 Subsection II.1.B.ii-Approach 2.”

Impact on DCA:
Technical Report TR-0816-49833, Fuel Storage Rack Analysis, Section 3.1.2.1 has been revised as described in the response above and as shown in the markup provided in this response.

Table 3-1 Fuel storage rack detailed and simplified model frequency comparison

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}}2(a),(c)

The mass of the fuel storage rack model as determined by ANSYS is validated against the mass from the design drawings as shown in Table 3-2.

Table 3-2 Fuel storage rack detailed and simplified mass comparison

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}}2(a),(c)

3.1.1.6 Implementation and Use

The simplified model of the fuel storage rack is used in the whole-pool analysis (see Sections 3.1.4 and 3.1.6) and the detailed model is used in the load-drop analysis (see Section 3.1.3) and detailed stress evaluation (see Section 3.1.5).

3.1.2 Time-History Development for Fuel Storage Rack Floor Response Spectra

3.1.2.1 Methodology

Acceleration-time histories are developed to be used for the SFP seismic analysis. The acceleration-time histories are matched to target response spectra (RS) representing the SFP rack area and are generated in accordance with DSRS 3.7.1 (Reference 8) and ASCE/SEI 43-05 (Reference 9) criteria. Those criteria are defined in DSRS 3.7.1, Subsection II.1.B.ii-Option 2 (Reference 8). ~~Damping is not used in the development of the time history.~~ One of the means used to measure the applicability of a time history is to compute the corresponding response spectrum and compare it with a target response spectrum. In order to compute a response spectrum, spectral damping needs to be specified. The DSRS specifies the use of 5 percent for the matching process.

Spectrally matched time histories are generated for the target RS. The acceleration-time histories are generated following the defined criteria in DSRS 3.7.1, Subsection II.1.B.ii-Approach 2 as:

a) Time histories should have a Nyquist frequency of at least 50 Hz and a total duration of at least 20 seconds.

b) Spectral acceleration should be computed at a minimum of 100 uniformly spaced points per frequency decade (log scale). The comparison of the response spectrum obtained from the design ground motion time history with the target response spectrum should be made at each frequency computed in the frequency range of interest.

c) The computed five-percent damped RS should not fall more than ten percent below the target RS at any one frequency. No more than nine adjacent frequency points defined in (b) should fall below the target response spectrum.

d) The computed five percent damped RS should not exceed the target RS by more than 30 percent in the frequency range of interest.

e) The power spectrum density (PSD) should not have significant gaps in energy at any frequency in the frequency range of interest.

f) The time histories should have strong motion with an Arias Intensity ranging from 5 percent to 75 percent for a minimum of six seconds. The uniformity of growth of the Arias Intensity should be reviewed.

g) The time histories should be statistically independent where the absolute value of their correlation coefficient does not exceed 0.16.

h) There should not be any significant drift introduced in the acceleration, velocity, or displacement time histories. The modified recorded RS should achieve approximately a mean-based fit to the target spectrum; thus, the average ratio of the spectral acceleration calculated to the target, where the ratio is calculated frequency by frequency, is only slightly greater than one.

The DSRS 3.7.1 Subsection II.1.B.ii-Option 2 follows the procedures described in DSRS 3.7.1 Subsection II.1.B.ii-Approach 2~~ (ii)~~. Option 2 allows criteria identified in Items 3 and 4 to be satisfied by using the results for averaging the suite of multiple time histories. The time histories generated individually met the respective target RS and, therefore, did not require averaging to meet the criteria in Items 3 and 4.

3.1.2.2 Major Assumptions

None.

3.1.2.3 Software Use and Qualification

The time history development uses the software RSPMatch09 on the Windows 7 OS. RSPMatch09 is a widely accepted computer program for time-history generation. RSPMatch09 performs time-domain spectral matching of an earthquake acceleration-

Enclosure 3:

Affidavit of Zackary W. Rad, AF-1017-56529

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 structure of the NuScale spent fuel racks.

   NuScale has invested significant resources to develop a design for this structure 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. 180, eRAI No. 9010. 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 10/10/2017.

Zackary W. Rad