NuScale Power

RAIO-0717-55094

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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. 60 (eRAI No. 8861) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 60 (eRAI No. 8861)," dated June 09, 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 Enclosure to this letter contains NuScale's response to the following RAI Question from NRC eRAI No. 8861:

- 19-6

This letter and the enclosed response 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: Gregory Cranston, NRC, TWFN-6E55
Samuel Lee, NRC, TWFN-6C20
Rani Franovich, NRC, TWFN-6E55

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8861

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8861

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

eRAI No.: 8861
Date of RAI Issue: 06/09/2017

NRC Question No.: 19-6

Review procedure III.6 in Standard Revie Plan (SRP) Section 19.3, "Regulatory Treatment of Nonsafety Systems in Passive Advanced Light Water Reactor Designs", Revision 0, states that:

"The Staff responsible for review of the applicant's PRA reviews the applicant's evaluation of potential uncertainties associated with assumptions made in the PRA regarding passive systems and verifies that the applicant has included nonsafety-related SSCs in the scope of the RTNSS program to compensate for the uncertainties in the PRA and in the modeling of severe accident phenomenology, or provided a reasonable justification for not doing so (RTNSS "C")".

The staff has reviewed section 19.3 of the Final Safety Analysis Report (FSAR) and could not find an evaluation of potential uncertainties associated with assumptions made in the PRA regarding passive systems. Passive system thermal-hydraulic uncertainties manifest themselves in the PRA model within failure probabilities and success criteria. Some passive functions in the NuScale design are based on new engineering design, with limited operating experience to establish confidence in the failure rate estimates. Therefore, please describe in Section 19.3 of the FSAR:

1. Those non-safety active systems that have been included in the scope of the RTNSS program to compensate for the uncertainties in the PRA and in the modeling of severe accident phenomenology, or a reasonable justification for not including such systems in the scope of the RTNSS program. Such systems could include, for example, those which can perform the same key safety function a passive safety system performs, such as core cooling or reactor coolant inventory control.
2. The reliability and availability missions as defined in SRP Section 19.3 for those systems described in item 1 above, and the proposed regulatory treatment of those systems that provide assurance the RTNSS reliability and availability missions can be accomplished.

NuScale Response:

1. NuScale evaluated potential uncertainties associated with assumptions made in the probabilistic risk assessment (PRA) regarding passive systems. Nonsafety-related active systems were considered for including in the scope of the Regulatory Treatment of Nonsafety Systems (RTNSS) Program to compensate for the uncertainties in the NuScale PRA and in the modeling of severe accident phenomenology. However, none are included in the RTNSS Program because the PRA explicitly assessed the thermal-hydraulic uncertainties in the modeling and performance of passive safety systems and found that nonsafety-related active systems are not needed to compensate for such uncertainties, as described below.

   The first step was to assess the likelihood that the passive safety systems in a NuScale plant might be operating outside of the conditions in which core heat removal would be effective. This analysis was performed in the passive safety system reliability assessment, which was a very comprehensive assessment of the performance of two safety-related passive heat removal systems incorporated in the NuScale design, the decay heat removal system (DHRS) and the emergency core cooling system (ECCS). FSAR Section 19.1.4.1.1.5, Data Sources and Analysis, has a section, Thermal-Hydraulic Uncertainty, which summarizes the assessment.

   The results of the analyses performed for the assessment provide the bases for probabilistic characterizations of the effectiveness and likelihood of failure of these two passive heat removal processes. That is, this assessment explicitly characterizes the uncertainties associated with the operating regimes for each of these two passive processes to be effective. The assessment generated the probabilities that each of these passive processes would fail to operate effectively. FSAR Table 19.1-10 provides calculated probabilities for the failure of passive heat transfer for each system. FSAR Tables 19.1-11 and 19.1-12 identify the phenomena impacting passive reliability for each system. In addition, FSAR Tables 19.1-22 and 19.1-31 include the results of sensitivity studies that increased the failure probability of passive heat removal for each system by an order of magnitude to provide additional insights on modelling uncertainties and establish confidence in the failure rate estimates.

   The failure probabilities and associated uncertainty estimate provided in FSAR Table 19.1-10 for failure of the two passive heat removal systems to operate effectively are explicitly included in the NuScale PRA model that is used to generate core damage frequency (CDF) and large release frequency (LRF) results. These failure probabilities are likewise explicitly included in the RTNSS evaluation for the RTNSS C Acceptance Criterion. As described in FSAR Section 19.3.2.3, the focused PRA demonstrated that reliance on nonsafety-related active systems is not needed to achieve this RTNSS C Criterion.

FSAR Section 19.3.2.3 has been revised as shown in the attached markup to summarize the assessment of the uncertainty of the effectiveness of the highly reliable passive DHRS and ECCS heat removal systems. This assessment justifies not including nonsafety-related active systems in the scope of the RTNSS Program for the RTNSS C Criterion.

2. No systems are identified in item 1 above and so system reliability and availability missions as defined in SRP Section 19.3 are not needed to be described in FSAR Section 19.3.

Impact on DCA:

FSAR Section 19.3.2.3 has been revised as described in the response above and as shown in the markup provided in this response.

during the normal coping strategy, the SBO analysis described in Section 8.4 also demonstrates that core cooling and containment integrity are successfully maintained with only safety-related systems and no reliance on DC power systems. As such, there are no SSC for mitigating SBO that meet RTNSS criteria.

Since the issuance of SECY-95-132 that revised portions of SECY-94-084, the NRC has not identified any additional beyond design basis deterministic requirements within the scope of RTNSS A SSC (in addition to those for ATWS and SBO discussed above).

Based on the consideration of beyond design basis deterministic NRC performance requirements for ATWS and SBO, there are no SSC that meet the RTNSS A criteria.

19.3.2.2 RTNSS B

Nonsafety-related SSC functions identified through the D-RAP process in Section 17.4 are evaluated to determine whether they are relied upon to:

- provide a long term nonsafety-related back-up to passive system functional capability and for a period after 72 hours up to 7 days following an accident.
- meet the acceptance criteria for the seismic margins analysis (SMA).

The safety analyses, PRA insights (including SMA), and expert panel considerations (discussed in Chapter 15, Section 19.1, and Section 17.4, respectively) did not identify any nonsafety- related SSC relied on to perform a backup to passive safety functions (i.e., ensure long term safety) in the period of 72 hours to 7 days, nor credited for SMA. Therefore, no nonsafety-related SSC meet the RTNSS B criteria.

19.3.2.3 RTNSS C

Nonsafety-related SSC functions were evaluated to determine whether they are relied upon under power operating and shutdown conditions to meet the NRC core damage frequency goal of less than 1.0E-4 each reactor year and large release frequency goal of less than 1.0E-6 each reactor year.

A focused PRA, described in Section 19.1.9.3, evaluated CDF by assuming that only safety-related SSC function and all nonsafety-related SSC fail. The results of the focused PRA determined that the CDF and LRF goals are met by relying on only safety-related SSC (i.e., without crediting nonsafety-related SSC).

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Also, nonsafety-related active systems were considered for including in the scope of the RTNSS Program to compensate for the uncertainties in the PRA and in the modeling of severe accident phenomenology. The PRA explicitly assessed the uncertainties in the modeling and performance of passive safety systems including assessing the likelihood that the passive safety systems in a NuScale plant might be operating outside of the conditions in which core heat removal would be effective.

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The section titled, Thermal-Hydraulic Uncertainty, in Section 19.1.4.1.1.5 summarizes the comprehensive assessment of the performance of the DHRS and ECCS, which are safety-related passive heat removal systems incorporated in the NuScale design.

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The results of the analyses performed for the assessment provide the bases for probabilistic characterizations of the effectiveness and likelihood of failure of these two passive heat removal processes. That is, this assessment explicitly characterizes the uncertainties associated with the operating regimes for each of these two passive processes to be effective. The assessment generated the probabilities that each of these passive processes would fail to operate effectively. Table 19.1-10 provides calculated probabilities for the failure of passive heat transfer for each system. Tables 19.1-11 and 19.1-12 identify the phenomena impacting passive reliability for each system. In addition, Tables 19.1-22 and 19.1-31 include the results of sensitivity studies that increased the failure probability of passive heat removal for each system by an order of magnitude to provide additional insights on modeling uncertainties and establish confidence in the failure rates.

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The failure probabilities and associated uncertainty estimates provided in Table 19.1-10 for failure of the two passive heat removal systems to operate effectively are explicitly included in the NuScale PRA model that is used to generate CDF and LRF results. These failure probabilities are likewise explicitly included in the RTNSS evaluation for the RTNSS C acceptance criterion. As described above, the focused PRA demonstrated that reliance on nonsafety-related systems is not needed to achieve this RTNSS C criterion. The assessment of the uncertainty of the effectiveness of the highly reliable passive DHRS and ECCS heat removal systems justifies not including nonsafety-related active systems in the scope of the RTNSS Program for the RTNSS C criterion.

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No nonsafety-related SSC are credited to meet the Commission safety goals, ~~or~~ to reduce the occurrence of initiating events, or to compensate for the uncertainties regarding passive systems in the PRA and in the modeling of severe accident phenomenology. Therefore, no nonsafety-related SSC meet the RTNSS C criteria.

19.3.2.4 RTNSS D

Nonsafety-related SSC functions identified through the D-RAP process in Section 17.4 were evaluated to determine whether they are needed to meet the containment performance goal, including containment bypass, during severe accidents. The severe accident evaluation used to identify these SSC functions is described in Section 19.2.

As discussed in Section 19.1, the containment design meets the containment performance goals. Accordingly, the containment provides a reliable, leak-tight barrier by ensuring that containment stresses do not exceed ASME service level C limits for a minimum period of 24 hours following the onset of core damage. Following this 24-