NUSCALE POWER™

RAIO-0817-55698

August 28, 2017

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 82 (eRAI No. 8879) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 82 (eRAI No. 8879)," dated July 07, 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 Questions from NRC eRAI No. 8879:

- 17.04-1
- 17.04-2

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 Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8879

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NuScale Response to NRC Request for Additional Information eRAI No. 8879

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

eRAI No.: 8879
Date of RAI Issue: 07/07/2017

NRC Question No.: 17.04-1

Section II.A.3 of Standard Review Plan Section 17.4, "Reliability Assurance Program" lists the following acceptance criterion for an application:

"If the applicant excludes certain types of risk-significant SSCs [structures, systems and components] *from the RAP* [reliability assurance program] *(e.g., passive SSCs such as pipes, ducts, electrical cables), then the application should provide a rationale for excluding these SSCs and address how other programs and requirements ensure that these SSCs do not degrade to an unacceptable level of reliability, availability, or condition during plant operations and will function reliably when challenged."*

The following statements regarding the reliability of reactivity control systems are provided in Section 4.31 of the FSAR:

"The control rods and soluble boron system are capable of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained consistent with Principal Design Criteria (PDC) 27. CRAs [control rod actuation]*, with all rods inserted, are capable of holding the reactor subcritical under postulated accident conditions in accordance with PDC 27."*

The following statement in Section 9.3.4.1 of the FSAR identifies the CVCS as in integral part of one of the reactivity control systems.

"Consistent with GDC [General Design Criteria] *26, the CVCS and BAS* [boron addition system] *operate together to control reactor coolant boron concentrations thereby providing a second means for reliably controlling the rate of reactivity changes resulting from planned, normal power changes, including xenon burnout, to assure acceptable fuel design limits are not exceeded. The CVCS also provides a secondary means of holding the reactor core subcritical under cold conditions."*

The following statement in section 19.1.7.2 of the FSAR acknowledges that the CVCS is considered risk significant under some conditions.

"The operator action for CVCS injection shows as risk significant in the MM [multi-module]

PRA [probabilistic risk assessment] *but not in the single module PRA."*

The applicant's process for determining risk significance of SSCs, as depicted in Figure 17.4-1 in the FSAR, indicates that insights from the PRA and the importance of an SSC as a provision for defense-in- depth are factors considered in selection of SSCs for the reliability assurance program.

The staff notes the following insights it has determined from its review of the application:

1. Information provided in Figures 19.1-2 through 19.1-11 in the FSAR indicate core damage in approximately one-half of the event sequences from the internal events, at-power PRA that do go to core damage could be avoided if injection to the reactor coolant system with the CVCS is successful.
2. The CVCS system provides an alternative means of reactor coolant make-up under accident conditions which is diverse [active] from the passive ECCS system, and therefore serves as an important contributor to defense-in-depth in the design.

The staff has reviewed list of risk signifiacnt SSCs provided in Section 17.4 of the final safety analysis report (FSAR) and determined that the applicant has not included the Chemical and Volume Control System (CVCS) functions for reactivity control and reactor coolant system make-up in the scope of the RAP. Based on statements and other information from the FSAR and described below, the staff questions the expert panel decision on CVCS and requests that the applicant provide a summary of the expert panel's deliberations regarding the CVCS and their rationale for not including it in the RAP.

NuScale Response:

The expert panel established as part of NuScale's Design Reliability Assurance Program (D-RAP) discussed the chemical and volume control system (CVCS) at three meetings prior to submittal of the NuScale Design Certification Application. At these meetings, the expert panel confirmed the classification of risk-significant structures, systems, and components (SSCs) for each system or structure. The results are summarized in FSAR Table 3.2-1. The following provides the rationale for not including the CVCS in the D-RAP for the functions of reactivity control and reactor coolant system makeup.

<u>CVCS Performs the Function of Reactivity Control</u>

The design of the NuScale small modular reactor fundamentally protects the health and safety of the public by preventing reactor core damage during an accident by isolating the containment around each reactor and allowing natural circulation to provide heat removal from the reactor to the large pool of water in the ultimate heat sink. The probabilistic risk assessment (PRA) described in FSAR Section 19.1 evaluates the risk associated with operation of the plant and FSAR Section 19.1.4.1.2 describes that a large negative moderator temperature coefficient is an important phenomenological characteristic of the design for reactivity control.

The CVCS adds borated water received from the boron addition system (BAS) to a reactor for reactivity control. But, the reactivity control function in general has been shown to not be important to risk because of the large negative moderator temperature coefficient. This has been demonstrated through the many thermal-hydraulic simulations that indicate the PRA success criteria are virtually identical regardless of whether or not a neutron poison (i.e., control rods or borated water) has been successfully inserted. This is also illustrated in the Chapter 19 event trees which show many event sequences progress similarly independent of a reactor trip. In FSAR Section 19.1.9.1, the ATWS contribution to CDF of 2.2E-11 is more than an order of magnitude less than the Level 1 CDF of 3.0E-10, indicating the reactivity control function is not a significant contributor to risk. So, although the CVCS is an integral part of one of the reactivity control systems, this function performed by the CVCS is not risk significant.

CVCS Performs the Function of Adding Reactor Coolant System Makeup

The CVCS can also add borated water to the reactor coolant system (RCS) for makeup following a beyond design basis accident if an operator takes the action to open the containment system isolation valves, which would have closed early in the accident sequence. The CVCS equipment is explicitly modeled in the PRA and found not to be risk significant under these circumstances. This is because the redundancy of active components in the CVCS ensures unavailability is reduced. Even though the operator action for CVCS injection is a candidate for risk significance consideration (as the action is modeled explicitly in the PRA), it is covered by the treatment of important human actions. Given that the CVCS hardware is not risk significant and important human actions are addressed in a separate process, NuScale believes the CVCS is treated appropriately. The NuScale design also has the means of adding inventory to the RCS via the containment flooding and drain system further adding redundancy and reducing functional unavailability.

Risk Significant Systems Do Not Include CVCS

In addition to the above information describing why the CVCS is not risk significant, the following summarizes the FSAR information that identifies the risk-significant systems and shows that the CVCS was considered but did not meet the criteria.

FSAR Table 19.1-4 lists the systems modeled in the PRA, which includes CVCS. FSAR Section 19.1.4.1.1.4, Accident Sequence Determination, describes the following event trees that model the CVCS in the PRA:

- CVCS--ALOCA-COC: CVCS Charging Line Pipe Break Outside Containment
- CVCS--ALOCA-LOC: CVCS Letdown Line Pipe Break Outside Containment
- CVCS--ALOCA-CIC: CVCS Charging Line LOCA Inside Containment

FSAR Sections 19.1.4.1.1.5 through 19.1.4.1.1.8 describe how the systems modeled in the PRA are evaluated for risk significance. FSAR Section 19.1.4.1.1.9, Risk-Significance Determination, describes how systems are identified as a candidate for a risk significant system based on the results of the PRA evaluations.

CVCS is not identified as risk significant in any NuScale PRA model (e.g., full power internal

events, low power and shutdown, internal fire, or internal flood). The FSAR tables identifying candidate risk significant components include FSAR Table 19.1-20 for the Level 1 PRA, FSAR Table 19.1-27 for the Level 2 PRA, FSAR Table 19.1-64 for the external event PRAs, and FSAR Table 19.1-70 for low power and shutdown. While other systems modeled in the PRA are identified as candidates for risk significance, CVCS is not.

Expert Panel Decision on CVCS

In deciding the risk classification for the CVCS, the expert panel followed the programmatic approach described in FSAR Section 17.4 and took the above considerations into account, along with the results of deterministic analysis and industry operating experience. The expert panel concluded that the CVCS equipment was not risk-significant consistent with the acceptance criteria in Standard Review Plan Section 17.4, Section II.A.3: Methodology for Identifying Systems, Structures, and Components within the Scope of the Reliability Assurance Program.

Impact on DCA:

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

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

eRAI No.: 8879
Date of RAI Issue: 07/07/2017

NRC Question No.: 17.04-2

Standard Review Plan section 17.4, "Reliability Assurance Program states that:

"The application should describe the roles and responsibilities of any expert panels used because they play an important role in reviewing the information associated with risk-significance determinations and could compensate for the limitations of the PRA [probabilistic risk assessment]*."*

The staff has reviewed the description of expert panel roles and responsibilities in determining risk significant structures, systems and components(SSCs) in the Final Safety Evaluation Report (FSAR) which states that: *"Concurrence by the expert panel constitutes the final classification of the SSC."* In light of this important role the staff requires the following additional information--not provided in the FSAR--in order to complete its evaluation.

1. Describe the process used by the expert panel to weigh the eight different considerations (as depicted in Figure 17.4-1 of the FSAR) to arrive at a final decision regarding risk significance. For example: Were numerical weights given to the various considerations; Were any specific decision criteria applied?; Were the bases for decisions documented or just the results?
2. Explain why the process of re-evaluation by the expert panel following non-agreement with the proposed category and classification, as depicted in Figure 17.4-1 of the FSAR, only includes some of the eight considerations, and appears to exclude consideration of operating experience, probabilistic risk assessment (PRA) and severe accident insights and assumptions, defense-in-depth and systems interactions.
3. Clarify whether the consideration of PRA and severe accident insights and assumptions includes insights from the seismic margin analysis. If insights from the seismic margins analysis are being excluded, please explain why.

NuScale Response:

1) The SSC classification process is used to document the safety and risk classification of system level functions and the classification of each system level function is applied to the SSCs that perform the function. The results are documented as A for safety-related and B for

nonsafety-related, and 1 for risk-significant and 2 for not risk-significant. The expert panel is trained on the SSC classification process including topics such as, regulatory treatment of nonsafety systems (RTNSS) and lessons learned from Fukushima. Operating experience (OE) is available to the system engineers/subject matter experts during the classification process based on input developed by the Human Factors Engineering/Operating Experience Review team. The expert panel members also bring their own unique operating experience as part of the basis for their membership. Numerical weights are not given to the different considerations noted in FSAR Figure 17.4-1. Some considerations (safety analysis, PRA, and RTNSS) have specific decision criteria that are part of the SSC classification analysis process. The methods for applying these criteria are documented within their own programs. Other considerations (Fukushima, OE, defense-in-depth) are qualitative in the expert's panel application. The results of the SSC classification process are documented in detail based on the components included in a system or structure. However, individual deliberations and panel discussions are not documented, other than concurrence with the SSC classifications recommended by the system engineers/subject matter experts.

2) During the expert panel review, concurrence with an SSC classification that did not get the requisite votes is required to go back through the process, resolve the disparity, and be returned to the expert panel for subsequent review. All eight considerations are again used to classify an SSC for which concurrence wasn't initially obtained. FSAR Figure 17.4-1 shows that the system engineers/subject matter experts return to the initial step in the process when agreement is not reached during an expert panel evaluation. That is, if the expert panel does not confirm the SSC risk categorization determined by the system engineers/subject matter experts, then the system engineers/subject matter experts return to the step identified as "System Functions" on FSAR Figure 17.4-1. This is the first step in the SSC risk classification process and entire process is repeated with the system engineers/subject matter experts gathering more information to resolve the non-agreement before returning for a subsequent meeting with the expert panel. The arrow showing the action after a non-agreement represents starting over. At the subsequent expert panel meeting, the appropriate information on operating experience, PRA, severe accident insights and assumptions, defense-in-depth, and systems interactions is again considered during the expert panel's evaluation of SSC classification.

3) Insights from the results of the seismic margin assessment (SMA) are included in the overall consideration of PRA inputs by the expert panel. During the panel meetings, the subject matter expert for the PRA provides the SMA results when appropriate as part of the PRA insights on the risk significance of SSCs; the SMA is summarized in FSAR Section 19.1.5.1. The contribution of the PRA subject matter expert is reflected in FSAR Section 17.4 which identifies that risk significance is determined in part, by the NuScale PRA, including the SMA.

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