RAIO-0418-59519



April 11, 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. 83 (eRAI No. 8899) on the NuScale Design Certification Application
- **REFERENCES:** 1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 83 (eRAI No. 8899)," dated July 07, 2017
  - 2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 83 (eRAI No.8899)," dated September 01, 2017
  - 3 . NuScale Power, LLC Supplemental Response to "NRC Request for Additional Information No. 83 (eRAI No. 8899)" dated November 27, 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 Enclosure to this letter contains NuScale's supplemental response to the following RAI Questions from NRC eRAI No. 8899:

- 19.01-15
- 19.01-16

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,

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

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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8899



# Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8899



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

eRAI No.: 8899 Date of RAI Issue: 07/07/2017

### NRC Question No.: 19.01-15

10 CFR 52.47(a)(27) states that a DCA must contain an FSAR that includes a description of the design-specific PRA and its results. SECY 93-087 approves an alternative approach to seismic PRA for the DCA and ISG 20 provide guidance on the methods acceptable to the staff to demonstrate acceptably low seismic risk for a DC.

Based on the staff's review of NuScale FSAR Tier 2, Section 19.1.5, the staff needs additional information to confirm the validity of the applicant's HCLPF capacities. The staff expectation at the DC stage is that the design of structures within the scope of DC is essentially complete. To evaluate the application, the staff requests that the applicant demonstrate that the seismic margin of 1.67 times the CSDRS is met for the seismic Category I structures against seismic-induced sliding and overturning.

### **NuScale Response:**

NuScale is supplementing its response to RAI 8899 (Question 19.01-15) originally provided in letter RAIO-0917-55781 dated September 01, 2017 and later supplemented in letter RAIO-1117-57364, dated November 27, 2017. This supplemental response is provided in response to discussions with the NRC in a public meeting held on January 23, 2018.

The last paragraph of NuScale's response letter RAIO-1117-57364 with regard to Question 19.01-15 is modified with the underlined text. The revised text clarifies that the PRA performed for design certification assumes that Seismic Category I structures are not vulnerable to seismically-induced sliding or overturning due to a seismic demand of 1.67 times the certified seismic design response spectra (CSDRS).

### Response provided in RAIO-1117-57364

From the analysis results summarized in FSAR Tables 3.8.5-5, 3.8.5-12, and 3.8.5-13, it is judged that potential displacements associated with seismic loadings up to the plant-level high confidence of low probability of failure (HCLPF) would not challenge the structural integrity of



the Category I structures. FSAR Table 19.1-40 has been modified to add an assumption that Category I structures are not vulnerable to sliding and overturning.

### Supplemental response

From the analysis results summarized in FSAR Tables 3.8.5-5, 3.8.5-12, and 3.8.5-13, it is judged that potential displacements associated with seismic loadings up to the plant-level high confidence of low probability of failure (HCLPF) would not challenge the structural integrity of the <u>Seismic</u> Category I structures. FSAR Table 19.1-40 has been modified to add an assumption that <u>Seismic</u> Category I structures <u>meet the seismic margin requirement of 1.67\*CSDRS for site-specific seismic hazards (e.g., sliding, overturning).</u>

### Impact on DCA:

FSAR Table 19.1-40 has been revised as described in the response above and as shown in the markup provided in this response.



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

eRAI No.: 8899 Date of RAI Issue: 07/07/2017

### NRC Question No.: 19.01-16

10 CFR 52.47(a)(27) states that a DCA must contain an FSAR that includes a description of the design-specific PRA and its results.

SECY 93-087 approves an alternative approach to seismic PRA for the DCA, and ISG 20 provides guidance on the methods acceptable to the staff to demonstrate acceptably low seismic risk for a DC. In accordance with ISG 20, the operating modes to be considered include at power, low power, and shutdown.

The staff reviewed FSAR Tier 2 Section 19.1.6.3, "Safety Insights from the External Events Probabilistic Risk Assessment for Low Power and Shutdown Operation" and noted that the Containment Vessel Flange Tool (CFT) and the Reactor Vessel Flange Tool (RFT) are not included in the SMA even though in FSAR Section 9.1.5 (1) the RFT and the Module Lifting Adapter are classified as Seismic Category I and (2) the CFT is classified as Seismic Category II. The RFT, the CFT, and the Module Lifting Adapter are not listed in FSAR Table 3.3-2. The staff requests that the applicant include the RFT, the Module Lifting Adapter, and the CFT in the SMA and in FSAR Table 3.3-2 or justify why these components are not listed in the table.

### NuScale Response:

NuScale is supplementing its response to RAI 8899 (Question 19.01-16) originally provided in letter RAIO-0917-55781 dated September 01, 2017 and later supplemented in letter RAIO-1117-57364, dated November 27, 2017. This supplemental response is provided in response to discussions with the NRC in a public meeting held on February 13, 2018.

This supplemental response supersedes the supplemental response provided in letter RAIO-1117-57364. Accordingly, the third paragraph of NuScale's original response letter RAIO-0917-55781 with regard to Question 19.01-16 is replaced in its entirety:

### Original response

Fragilities for the CFT and RFT do not appear in the seismic margin assessment (SMA)



because of the limited consequences of their seismic failure. After the module is placed in the CFT and the CNV flange bolts are de-tensioned, the inventory of the ultimate heat sink (UHS) is available for cooling the core through the open emergency core cooling system (ECCS) valves. Therefore, core cooling is assured by natural circulation even if the CFT were to fail seismically. When the module is in the RFT, the RPV head is removed, core cooling is provided by the UHS, irrespective of a seismically-induced RFT failure. As such, the CFT and RFT do not contribute to the seismic margin.

### Supplemental response

Fragilities for the CFT and RFT do not appear in the seismic margin assessment (SMA) because seismic failure of the CFT or RFT does not lead to core damage. As discussed in Section 9.1.5.2.3, the NuScale Power Module (NPM) remains connected to the Seismic Category I reactor building crane (RBC) when in the CFT. Because the NPM is connected to the RBC when in the CFT, failure of the CFT does not contribute to the seismic margin. When the upper CNV and RPV are in the RFT, the RBC remains connected until the upper CNV and upper RPV are removed. When the upper CNV and upper RPV are removed, the lower RPV, which contains the reactor core, remains in the RFT, open to the ultimate heat sink (UHS). If the RFT were to fail structurally after the RBC is disconnected, the CFT and RFT do not contribute to the seismic margin.

### Impact on DCA:

FSAR Table 19.1-40 has been revised as described in the response above and as shown in the markup provided in this response.

RAI 19.01-2, RAI 19.01-5, RAI 19.01-7, RAI 19.01-8, RAI 19.01-8S1, RAI 19.01-11, RAI 19.01-14, RAI 19.01-15S1, RAI 19.01-15S2, RAI 19.01-16, 19.01-16S2

### Table 19.1-40: Key Assumptions for the Seismic Margin Assessment

	Assumption	Basis
	Structures are screened out if they are not directly in contact with the NPM and do not have the potential to collapse on top of it.	Engineering judgment
	Systems and components are screened if they are not included in the internal events PRA models (full power and low power and shutdown).	Common engineering practice
	Seismic sequences are mapped to those in the internal events PRA but augmented with seismically induced SSC initiating events and seismically induced SSC failures.	Common engineering practice and consistent with the ASME/ANS PRA Standard.
	Intra-module component groups have 100 percent correlation provided all components share the same elevation class, general component type and same failure mode. Components not meeting these shared criteria are treated as independent.	Common engineering practice, consistent with the ASME/ANS PRA Standard, and bounding assumption.
	Different component failure modes (for the same component or different components of the same type) are not modelled as correlated when the specific seismic failure mode is identified, i.e. "seismic failure to open". When the event is labeled as a functional failure, all failure modes are included and considered correlated.	Common engineering practice, consistent with the ASME/ANS PRA Standard, and bounding assumption.
	Seismic component failures are not modelled for fail-safe signal logic, which includes sensors, transmitters, relays, equipment interface modules, safety function modules, actuation priority logic modules, hard-wired modules, scheduling and bypass modules, and scheduling and voting modules. As such, seismically-induced signal logic failures of the MPS are not considered credible.	Common engineering practice
	Design-specific fragilities are used for failures that contribute to the seismic margin, including valves located inside the NuScale Power Module and structural events.	Common engineering practice, consistent with the ASME/ANS PRA Standard, and engineering judgment.
	For SSC that do not contribute significantly to the seismic margin, design-specific response factors combined with generic capacity values are used.	Engineering judgment and common engineering practice.
1	Fragility parameters acquired from generic sources, including capacity, randomness, and uncertainty values, are assumed valid and relevant to the NuScale design.	Common engineering practice
	Systems are assumed to fail at the ground motion in which they have an 84 percent probability of failure. For ground motions with lower failure probabilities, the success logic is treated as a probability of 1.0.	Simplifying conservative assumption to avoid duplication of success logic in SAPHIRE.
	Structural events (e.g., RXB wall), are postulated to directly lead to core damage and large release. The term "structural event" is used in lieu of "structural failure".	Bounding simplification
	Control room failure is not included in the SMA because a control room collapse is bounded by the effects of a LOOP that occurs at lower ground motions with higher frequencies. A LOOP results in ECCS valve actuation; a control room collapse results in a signal loss and subsequent ECCS valve actuation.	Bounding assumption
	The controlling failure mode of the RBC, which is designed with seismic restraints, is the yielding of the bridge seismic restraint weldments. The bounding consequence of crane failure during low power operations is a collapse of the crane structure on top of the module, leading to core damage and large release.	Bounding assumption
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Tier 2

# Probabilistic Risk Assessment

## Table 19.1-40: Key Assumptions for the Seismic Margin Assessment (Continued)

Tie	Table 19.1-40: Key Assumptions for the Seismic Margin Assessment (Continued)		
r 2	Assumption	Basis	
	During low power and shutdown conditions, the state-specific risk to the module is during the transport phase before and after refueling, when the crane is bearing the load of the module. Other events involving the crane can be screened because the likelihood of the crane being over the module (and not bearing the load of the module) is bounded by the full-power assessment.	Engineering judgment	
	Failure of the bridge seismic restraints, rather than the bridge girders, is expected to be the controlling failure mode of the crane bridge.	Engineering judgement	
	In the MIN-MAX method, cutsets containing both seismic and random failures are screened if the product of all random failure probabilities is below 1E-2 because the HCLPF is defined as a 1percent failure probability on the mean fragility curve. Thus, it is reasonable to use this value as a screening criterion for the probability of non-seismic failures in the same cutset.	Common engineering practice and consistent with ISG- 020.	
	In a cutset containing multiple seismic failures, the highest HCLPF value determines the cutset HCLPF.	Common engineering practice, application of the MIN- MAX method.	
	Because the dominant structural events are assumed to lead core damage and a large release, the plant-level core damage HCLPF is the same as the large release HCLPF.	Bounding assumption	
	Recovery, including the recovery of offsite power, is not credited in the SMA.	Bounding assumption	
_	Extreme stress was considered for operator actions following a seismic event.	Engineering judgment	
9.1-213	Fragilities developed via the separation of variables methodology are assumed to be representative of fragilities determined via qualification testing. The separation of variables methodology is based on the same SSC design information, specifications, and analysis as would be used to develop testing information during procurement.	Engineering judgment	
	The CFT and RFT do not contribute to the seismic margin because the core geometry remains coolable after the CNV top is removed, even if the CFT or the RFT were to become damaged by an earthquake.Failure of the CFT does not contribute to the seismic margin because the NPM remains connected to the RBC when in the CFT. In the RFT, the RBC remains connected to the upper CNV and RPV until the upper CNV and upper RPV are removed, after which the lower RPV, which contains the reactor core, remains in the RFT, open to the UHS. Thus, failure of the RFT does not contribute to the seismic margin.	Engineering judgment	
	The MLA is modeled as part of the RBC structure, and design safety margins preclude it from being the controlling seismic failure.	Engineering judgment	
	The control rod guide tubes are assumed to be the controlling seismically induced failure associated with the reactor internals. Therefore, seismically induced damage to reactor internals is not considered in the seismic margin.	Engineering judgment	
Dra	Seismic Category I structures (i.e., the RXB and the CRB) are not vulnerable to seismically induced meet the seismic margin requirement of 1.67 * CSDRS for site-specific seismic hazards (e.g., sliding, overturning) sliding or overturning (FSAR 3.8.5).	Engineering judgment	