RAIO-0618-60531

June 19, 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
4. NuScale Power, LLC Supplemental Response to "NRC Request for Additional Information No. 83 (eRAI No. 8899)" dated May 18, 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:

- 19.01-3
- 19.01-5

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 Paul Infanger at 541-452-7351 or at pinfanger@nuscalepower.com.

Sincerely,

Zackary 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.: 19.01-3

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. In SECY 93-087, the Commission approved use of the seismic margin approach (SMA) for DCAs in lieu of a seismic PRA. As specified in ISG-20, a PRA-based SMA for a DCA provides results that include all identified seismically initiated accident sequences, the Seismic Equipment List with High Confidence of Low Probability of Failure (HCLPF) values and associated failure modes, and plant and sequence HCLPFs, as well as risk insights for seismic events.

a. The staff reviewed Table 19.1-38 and noted that approximately 20 SSCs have HCLPF values below 0.88g. Some of these are addressed in the text of the report, for instance, the reactor module corbel bearing failure HCLPF capacity. The staff requests that the applicant provide additional information in the FSAR to clarify that these SSCs do not contribute to the plant level HCLPF capacity or otherwise provide justification for HCLPF capacities below 0.88g. The staff additionally requests that the applicant include a column in Table 19.1-38 that includes the HCLPF capacities for the listed SSCs.
b. In FSAR Section 19.1.5.1.2, Subheading, “Significant Component Failure Modes,” the applicant states, “Moreover, component fragilities reported in Table 19.1-38 show a high degree of component seismic robustness.” The staff requests that the applicant quantify what is meant by seismic robustness. The applicant should also clarify whether this statement applies to PRA-critical SSCs only or all SSCs listed in Table 19.1-38.

NuScale Response:

NuScale is supplementing its response to RAI 8899 (Question 19.01-3) originally provided in letter RAIO-0917-55781 (dated September 01, 2017). This supplemental response results from email communication with the NRC on May 31, 2018.

The original response revised Table 19.1-38, which included a "Note 2"; Note 2 referred to Table 19.1-40. However, in FSAR Revision 1, Note 2 incorrectly refers to Table 19.1-39. Accordingly, FSAR Table 19.1-38, Note 2 has been revised to refer to Table 19.1-40, consistent with the original response.

Impact on DCA:

FSAR Table 19.1-38 has been revised as described in the response above and as shown in the markup provided in this response.

RAI 19.01-3, RAI 19.01-3S1, RAI 19.01-4, RAI 19.01-8S1, RAI 19.01-9, RAI 19.01-17

Table 19.1-38: Seismic Correlation Class Information

Seismic Transfer Event	Component ID	Elevation (ft)	Location	NuScale Component	Failure Mode Description	A_m (g)	β_r (g)	β_u (g)	HCLPF (g)[1]	Contributes to seismic margin?[2]	Fragility Method[3]
Seismically Induced Initiating Events											
SUPP-75-RXB-SHR-SEIS	SUPP	75	RXB	RXM Supports	Shear Failure of Multiple Shear Lugs	1.98	0.12	0.35	0.92	Yes	DS
HTX---50--RXB---HXF-SEIS[4]	HTX	50	RXB	CVCS Heat Exchanger	Heat Exchanger Failure	6.81	0.32	0.51	1.74	No	Generic
RRV2--50--RXM---FTC-SEIS	RRV2	50	RXM	All ECCS Reactor Recirculation Valves	Fails to Close	3.32	0.24	0.32	1.32	No	DS
					Fails to Remain Closed						
					Spuriously Open						
RSV---75--RXM---FTC-SEIS[4]	RSV	75	RXM	All Reactor Safety Valves	Fails to Close	3.37	0.24	0.32	1.34	No	DS
					Fails to Remain Closed						
					Fails to Reclose						
					Spuriously Open						
RVV3--75--RXM---FTC-SEIS	RVV3	75	RXM	All ECCS Reactor Vent Valves	Fails to Close	2.38	0.28	0.5	0.66	No	DS
					Fails to Remain Closed						
					Spuriously Open						
SGT---50--RXM---BRK-SEIS[4]	SGT	50	RXM	Steam Generators	Tube/Support Failure	2.53	0.28	0.36	0.88	No	DS
TFM---100-SITE--CIF-SEIS	TFM	100	SITE	Offsite Power Transformer	Ceramic Insulator Failure	0.3	0.29	0.47	0.09	No	Generic
Structural Failure Events											
BIOBN-125-RXB---BSF-SEIS	BIOBN	125	RXB	Bioshield Bay Wall Anchor Bolts	Bolt Shear Failure - Normal Operation	4.89	0.28	0.35	1.73	Yes	DS
BIOBR-125-RXB---BSF-SEIS	BIOBR	125	RXB	Bioshield Bay Wall Anchor Bolts	Bolt Shear Failure - Refueling Adjacent Module	2.73	0.28	0.35	0.97	Yes	DS
BION--125-RXB---OPB-SEIS	BION	125	RXB	Horizontal Bioshield	Out of Plane Bending - Normal Operation	11.62	0.28	0.37	3.99	Yes	DS
BIOPN-125-RXB---BTF-SEIS	BIOPN	125	RXB	Bioshield Pool Wall Anchor Bolts	Bolt Tension Failure - Normal Operation	5.37	0.28	0.35	1.91	Yes	DS

Table 19.1-38: Seismic Correlation Class Information (Continued)

Seismic Transfer Event	Component ID	Elevation (ft)	Location	NuScale Component	Failure Mode Description	A_m (g)	β_r (g)	β_u (g)	HCLPF (g)[1]	Contributes to seismic margin?[2]	Fragility Method[3]
RSV---75--RXM---FTC-SEIS[4]	RSV	75	RXM	All Reactor Safety Valves	Fails to Close	3.37	0.24	0.32	1.34	No	DS
					Fails to Remain Closed						
					Fails to Reclose						
					Spuriously Open						
RSV---75--RXM---FTO-SEIS	RSV	75	RXM	All Reactor Safety Valves	Fails to Open	3.37	0.24	0.32	1.34	Yes	DS
RTB---75--RXB---FOP-SEIS	RTB	75	RXB	Reactor Trip Circuit Breaker	Fails to Operate	3.69	0.24	0.39	1.31	No	Generic
SGT---50--RXM---BRK-SEIS[4]	SGT	50	RXM	Steam Generators	Tube/Support Failure	2.53	0.28	0.36	0.88	No	DS
SOV---50--RXM---FTO-SEIS	SOV	50	RXM	ECCS Reactor Recirculation Valve Trip Valve Solenoids	Fails to Open	3.32	0.24	0.41	1.14	No	DS
SOV---75--RXM---FTO-SEIS	SOV	75	RXM	ECCS Reactor Vent Valve Trip Valve Solenoids	Fails to Open	3.23	0.28	0.53	0.85	No	DS
TFM---100-HVSWG-FOP-SEIS	TFM	100	HVSWG	13KV High Voltage Main Power Transformer	Fails to Operate	2.1	0.24	0.39	0.75	No	Generic
TFM---100-LVPDC-FOP-SEIS	TFM	100	LVPDC	Low Voltage Transformer	Fails to Operate	2.1	0.24	0.39	0.75	No	Generic
TFM---100-MVSWG-FOP-SEIS	TFM	100	MVSWG	13KV/4KV Auxiliary Transformer	Fails to Operate	2.1	0.24	0.39	0.75	No	Generic

Notes:

[1] All HCLPF values are determined via 5% failure probability on the 95% probability of exceedance fragility curve, Reference 19.1-57.

[2] Contribution to the seismic margin is determined via a systematic methodology considering the MIN-MAX HCLPF determination and random CCDP product > 1% criterion described in ~~Table 19.1-39~~Table 19.1-40.

[3] The methods used to evaluate component fragilities are identified as either “DS” (design-specific) or “Generic”. Design-specific fragilities include an evaluation of both the equipment capacity and demand relative to a specific structure or piece of equipment. Generic fragilities constitute fragilities determined via a library/database search of similar equipment types. Such generic fragilities are augmented with ISRS information to include ground motion amplification specific to the NPM and the NuScale reactor building. All component failure modes identified as critical have design-specific fragilities.

[4] Three seismically-induced component failure modes are also identified as seismically induced initiating events (HTX---50--RXB---HXF-SEIS, RSV---75--RXM---FTC-SEIS, and SGT---50--RXM---BRK-SEIS). In accident sequences initiated by failure of this equipment, the equipment is not available for mitigation.

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

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

NRC Question No.: 19.01-5

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. In SECY 93-087, the Commission approved use of the SMA for DCAs in lieu of a seismic PRA.

The staff reviewed FSAR Tier 2, Section 19.1.5, and finds that the DCA lacks information on equipment qualified via tests. As described in Section 5.1.2 of ISG-20, a description of the procurement specifications (including the enhanced required response spectra (RRS)) should be provided in the DCA. The staff requests that the applicant address the RRS in the DCA or otherwise justify that the procured equipment qualified via tests will have adequate margin.

NuScale Response:

NuScale is supplementing its response to RAI 8899 (Question 19.01-5) originally provided in letter RAIO-0917-55781 (dated September 01, 2017) and supplemented in letters RAIO-1117-57364 (dated November 27, 2017) and RAIO-0518-60071 (dated May 18, 2018). This supplemental response results from email communication with the NRC on May 31, 2018.

A portion of the markup to FSAR Section 19.1.5.1.1.3 that was provided in letter RAIO-0518-60071 is being revised as follows:

The FSAR markup in Letter RAIO-0518-60071 states:

> "The CDFM method, described in Reference 19.1-21, uses conservative input parameters (e.g., seismic demands and material properties) to directly establish a conservative estimate of the HCLPF."

The FSAR markup is revised as indicated by the underlining:

> "The CDFM method, described in Reference 19.1-21, uses conservative input parameters (e.g., seismic demands and material properties) to <u>calculate the HCLPF directly</u>."

Impact on DCA:

FSAR Section 19.1.5.1.1.3 has been revised as described in the response above and as shown in the markup provided in this response.

Structure, system, and component fragility is referenced to the peak ground acceleration of the CSDRS, which is the SSE (0.5g).

19.1.5.1.1.3 Seismic Fragility Evaluation

RAI 19.01-1S1, RAI 19.01-2, RAI 19.01-2S1, RAI 19.01-8S1, RAI 19.01-17

A seismic fragility analysis is completed as part of an SMA. Fragility describes the probability of failure of a component under specific capacity and demand parameters and their uncertainties. It should be noted that all SSC modeled in the internal events PRA were included in fragility analysis, with the exception of basic events that are not subject to seismic-induced failure (e.g., phenomenological events, filters, control logic components). No pre-screening was performed to establish a seismic equipment list (SEL) or safe shutdown equipment list (SSEL). The terminology "PRA-critical" is used to denote SSC that contribute to the seismic margin. Contributing SSC are determined by applying the MIN-MAX method and the screening assumption described in Section 19.1.5.1.2 and Table 19.1-40.

RAI 19.01-2, RAI 19.01-5S2, RAI 19.01-5S3

~~Seismic capacities~~The HCLPF ground motion for PRA-critical structures and components modeled in the SMA are obtained by performing ~~detailed~~ fragility analysis using ~~either~~ the ~~hybrid method or the separation of variables method described in Reference 19.1-21, Reference 19.1-57, and Reference 19.1-58~~separation of variables and conservative deterministic failure margin (CDFM) methods, as endorsed by Reference 19.1-56. Separation of variables, described in Reference 19.1-57, is a best-estimate methodology to determine SSC fragility parameters (median capacity, randomness, and modeling uncertainty) as a combination of several independently determined factors (e.g., strength and ductility). The fragility parameters are then used to calculate the HCLPF. The CDFM method, described in Reference 19.1-21, uses conservative input parameters (e.g., seismic demands and material properties) to calculate the HCLPF directly. For non-critical components, fragilities are evaluated using generic capacity values and design-specific response spectra to calculate the demand.

RAI 19.01-5S1, RAI 19.01-8S1

The controlling failure mode of these structural events and their direct consequences are shown in Table 19.1-35. For components, seismic failures are either considered functional failures (all modes) or mapped to specific equivalent random failures (such as a valve failing to open on demand). The in-structure response spectra (ISRS) is produced at each SSC location using the CSDRS as input. Based on available component design information, ISRS is used in lieu of required response spectra for fragility calculations.

Seismic Structural Events

Structural events are modeled as basic events in the PRA model with median failure acceleration and uncertainty parameters. Structural events differ from