December 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. 254 (eRAI No. 9181) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 254 (eRAI No. 9181)," dated October 13, 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. 9181:

- 03.09.04-10

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

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9181

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9181

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

eRAI No.: 9181
Date of RAI Issue: 10/13/2017

NRC Question No.: 03.09.04-10

The NRC regulations in Appendix A, “General Design Criteria for Nuclear Power Plants,” to 10 CFR Part 50 specify principal design criteria to establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components (SSCs) important to safety; that is, SSCs that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. The control rod drive shaft is one such SSC.

General Design Criterion (GDC) 1, “Quality standards and records”, in 10 CFR Part 50, Appendix A, (as further specified in 10 CFR 50.55a), requires that this SSC be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed

In response to RAI 8835, Question 03.09.04-8, the following information was provided:

> A major non-pressure retaining CRDM component is the long drive shaft. Since this is a seismic category 1 component and it meets the definition of a Subsection NG, internal structure, Subsection NG is applied. Application of Subsection NG includes design, material, fabrication and inspection. Other non-pressure boundary parts will meet the applicable ASME/ASTM standards. The CRDM ASME Design Specification has been updated to include this requirement.

While the ASME BPV Code, Subsection NG provides rules for materials, design, fabrication, examination and preparation of reports, these rules are primarily directed towards core support structures, which are those structures which are designed to provide direct support or restraint of the core (fuel and blanket assemblies) within the reactor pressure vessel. Another class of structures addressed by Subsection NG, internal structures, is defined as all structures within the reactor pressure vessel other than core support structures, fuel and blanket assemblies, control assemblies, and instrumentation. As delineated in NG-1122, NG-2121, NG-3311, and NG-4110, the rules of Subsection NG are only applied to internal structures when specifically stipulated by the Certificate Holder. Barring specific stipulation, the only requirement imposed on internal structures is that the Certificate Holder shall certify that the internal structure shall not adversely affect the integrity of the core support structure.

Considering this, NRC staff seeks additional assurance that adequate requirements will be imposed on the control rod drive shaft, commensurate with the importance of the safety functions to be performed. The control rod drive shaft is a safety-related, risk-significant (A1) SSC which reliably controls reactivity under conditions of normal operation, including AOOs, and under postulated accident conditions. The applicant is requested to describe the specific requirements, including but not limited to the specific portions of Subsection NG, which will be stipulated to the Certificate Holder in order to ensure the control rod drive shaft maintains integrity and functionality under the entire range of postulated conditions, including those atypical of other internal structures, such as loadings induced as the control rod drive shaft is accelerated into the core by gravity, or deformations that might adversely affect the motion of the control rod drive shaft, such as buckling.

NuScale Response:

The following design requirements will be stipulated to the Certificate Holder to ensure control rod drive shaft integrity and functionality over the full range of postulated conditions:

- CRD shaft scram loads and control rod drive shaft deflection limits will be established by testing. CRD shaft scram and SEE loads are added to FSAR Table 3.9-6 for Service Level A and D loading combinations for control rod drive shafts..
- The control rod drive shafts are evaluated against the limits of NG-3222.1 and NG-3222.2 for normal operating (Service Level A) conditions. Service Level A loads for the control rod drive shafts are the deadweight of the control rod assembly and scram loading.
- The control rod drive shafts are evaluated against 110% of the limits of NG-3222.1 and NG-3222.2 for Service Level D loads. Consideration of cyclic loading is not required.
- Martensitic stainless steel materials used in the control rod drive shafts shall be Cv tested in accordance with NG-2331.

Impact on DCA:

FSAR Table 3.9-6 has been revised as described in the response above and as shown in the markup provided in this response.

RAI 03.09.04-10

Table 3.9-6: Required Load Combinations for Control Rod Drive Mechanism American Society of Mechanical Engineers Stress Analysis

Plant Event [(1)]	Service Level	Load Combination [(2)(4)]	Allowable Limit [(6)]
Design	Design	P_{des} + DW + EXT	Design
Hydrotest	Test	H + DW	Test
~~Appendix J CILRT~~	~~Test~~	~~CILRT + DW~~	~~Test~~
Normal operations	A	P + DW + TH + EXT	Level A
SCRAM[(9)]	A	DW + SCRAM[(9)]	Level A
Transients	B	P + DW + EXT + TH	Level B
Transients + OBE[(3)]	B	P + DW + EXT + TH ± OBE	Level B
Inadvertent RSV opening	C	P + DW + RSV	Level C
Spurious ECCS valve opening	C	P + DW + ECCS	Level C
Design basis pipe break	C	P + DW + EXT + DBPB	Level C
SG tube rupture [(8)]	C	P + DW + EXT + R	Level C
Rod ejection accident	D	P + DW + EXT + REA	Level C[(7)]
Main steam and feedwater pipe breaks	D	P + DW + EXT + MSPB/FWPB	Level D
MSPB/FWPB/DBPB + SSE	D	P + DW + EXT ± SRSS(SSE + MSPB/FWPB/ DBPB)[(5)]	Level D
SCRAM + SSE[(9)]	D	DW + SCRAM + SSE[(9)]	Level D

Notes:

1. Fatigue analysis is evaluated in accordance with the ASME BPVC Section III and considering the effects of the PWR environment in accordance with RG 1.207 and NUREG/CR-6909.
2. Applicable loads are defined in Section 3.9.3.1.1 and Table 3.9-2. Handling, upending, lifting and transportation loads for all applicable components is evaluated in accordance with the design specification.
3. OBE loading is only applicable to the fatigue analyses.
4. P is the greatest or conservative pressure value during the applicable transient.
5. Dynamic loads are combined considering the time phasing of the events in accordance with RG 1.92 and NUREG-0484.
6. Stress limits are as defined in the applicable subsection of ASME BPVC Section III for the specified level.
7. In accordance with NUREG-0800 Section 15.4.8, Acceptance Criterion 2.
8. Dynamic load due to SG tube failure is negligible.
9. The SCRAM and SCRAM + SSE load combinations are applicable to the control rod drive shaft only.