NUSCALE
Power for all humankind

RAIO-0119-64304

January 25, 2019

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. 42 (eRAI No. 8836) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 42 (eRAI No. 8836)," dated June 02, 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 Enclosures to this letter contain NuScale's response to the following RAI Question from NRC eRAI No. 8836:

- 03.06.02-2

The responses to the other questions in eRAI No. 8836 have previously been provided in multiple letters. This submittal completes all of the responses to eRAI No. 8836.

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 42 (eRAI No. 8836). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The enclosed affidavit (Enclosure 3) supports this request. Enclosure 2 is the nonproprietary version of the NuScale response.

This letter and the enclosed responses 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, OWFN-8H12
Samuel Lee, NRC, OWFN-8H12
Marieliz Vera, NRC, OWFN-8H12

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8836, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 8836, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0119-64305

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8836, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 8836, nonproprietary

NuScale Power, LLC
1100 NE Circle Blvd., Suite 200 Corvalis, Oregon 97330, Office: 541.360.0500, Fax: 541.207.3928
www.nuscalepower.com

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

eRAI No.: 8836

Date of RAI Issue: 06/02/2017

NRC Question No.: 03.06.02-2

To address its compliance with GDC 4 requirements, in NuScale FSAR Tier 2, Section 3.6, the applicant describes the criteria used in the NuScale design for determining the postulated rupture locations. In NuScale FSAR Tier 2, Sections 3.6.2.1.2 and 3.6.2.5, the applicant identifies at certain locations where some design and inspection criteria are employed to preclude the need for breaks to be postulated. Those locations as identified in the FSAR Section 3.6.2.1.2 include the welds between the valve and the safe-end for CVCS RCS injection, RCS discharge, pressurizer spray, high point vent line and two FW lines. The NuScale design provides two isolation valves in a single valve body outside of containment welded to a CNV nozzle safe-end. The applicant states that the benefits of this approach include eliminating piping between valves and between the vessel and the valve. The applicant also states that the piping and valves are designed to preclude a breach of containment integrity in conformance with SRP 3.6.2 and its associated BTP 3-4.

In FSAR Section 3.6.2.1.2, the applicant also states that breaks are not postulated in the ASME Class 1 piping (i.e., the four CVCS reactor coolant system lines) from the CNV head to the first isolation valve, and the ASME Class 2 FW piping from containment to the first isolation valve in accordance with the staff's guidelines delineated in BTP 3-4, Part B, Item A(ii). In the FSAR, the applicant describes its specific design and inspection provision for those piping segments. Similarly, in the FSAR Section 3.6.2.5, the applicant describes how the break exclusion criteria are applied to the segments of piping between the MS and FW lines from containment to the penetration at the reactor pool wall (including tees to the DHRS) and the DHRS piping outside containment.

It should be noted that the NRC staff guidance as delineated in BTP 3-4 is intended to present a means of compliance with the requirements of GDC 4 for the design of nuclear power plants SSCs. For the fluid system piping in containment penetration areas (i.e., those portions of

piping from containment wall to and including the inboard or outboard isolation valves), the NRC staff guidance as described in BTP 3-4, Part B, Item A(ii) provides certain design and inspection provisions to ensure an extremely low probability of pipe failure in these areas and allow breaks and cracks to be excluded from the design basis for those portions of piping.

Based on its review of the FSAR information described above, the NRC staff determined that the applicant has not provided adequate justification for its application of the break exclusion in the areas described above. In certain cases, the applicant expands the break exclusion area beyond those portions of piping in containment penetration areas as delineated in BTP 3-4, Part B, Item A(ii). It should be noted that FSAR Sections 3.6.2.1.2 and 3.6.2.5 primarily address the NuScale design and inspection requirement for system piping within the break exclusion area. To support the NRC staff's safety determination on the acceptability of the NuScale break exclusion areas identified in the above FSAR sections, the applicant should provide the following information to justify the departure from the pertinent BTP 3-4 staff guidance, particularly, how the FSAR break exclusion area design provisions are considered and applied to the results of the design of these portions of system piping including any associated welds:

a. For those portions of system piping in the break exclusion area, the applicant is to provide a figure for the detailed geometric configuration including the approximate length, any bends in the piping, welds, valves, and welded features and discuss how overall length is minimized to reduce the size of the break exclusion area and how piping bends and piping welds are utilized/minimized to reduce piping stress.

b. For those portions of system piping in the break exclusion area, the applicant is to provide a detailed piping analysis to demonstrate that for the piping and the associated welds, the design stress and the cumulative usage factor (for ASME Class 1 piping only) do not exceed the relevant stress and fatigue limit as delineated in FSAR Sections 3.6.2.1.2 and 3.6.2.5.

   NuScale FSAR Section 3.12 states that complete piping analyses have been performed for the class 1 RCS discharge line (NPS 2) and the class 2 FW (NPS 5) line up to the first 6-way rigid restraint beyond the containment isolation valve. FSAR 3.12 also implies that preliminary analyses have only been performed for the Class 1 RCS injection (NPS 2), the Class 2 MS (NPS 12) up to the first 6-way rigid restraint beyond the containment isolation valve and the DHRS lines. The applicant's preliminary analyses consider only deadweight, thermal expansion and seismic loads and does not consider the occasional loads including

plant system operating transient loads. It should be noted that one of the design criteria for piping in the break exclusion area as described in FSAR Sections 3.6.2.1.2 and 3.6.2.5 is that calculated stresses due to sustained, occasional load, and thermal expansion, including an OBE event (if applicable) should not exceed 80% of allowable value per ASME Section III, NC Eqs. (9) + (10) which is consistent with the pertinent staff guidance delineated in BTP 3-4. With respect to the seismic loads, for NuScale design, the OBE is 1/3 of the SSE and therefore, the OBE is not included as design loading in ASME Section III, NC Eq. 9. With the elimination of OBE load, the applicable loads in NC Eq. 9 are pressure, dead weight, and any applicable occasional loads including plant system operating transient loads while the applicable loads in NC Eq. 10 are due to thermal expansion. The applicant is to justify why performing only preliminary piping analysis with the consideration of dead weight and thermal expansion (i.e., not considering any applicable occasional loads) is consistent with the NuScale FSAR break exclusion criteria as delineated in FSAR Sections 3.6.2.1.2 and 3.6.2.5.

c. NuScale FSAR Section 3.6.2.1.2 Item 1(c) states that for ASME Class 1 piping, the maximum stress, as calculated by Eq. 9 in Section III of the ASME NB-3652 under the loading resulting from a postulated piping rupture beyond these portions of piping, does not exceed 2.25 Sm and 1.8 Sy. This is consistent with the pertinent staff guidance delineated in BTP 3-4, Part B.A(ii)(1)(c), except that the FSAR criteria do not address the potential impact on the valve . For those portions of system piping in the break exclusion area, the applicant is to perform a detailed piping analysis to demonstrate that the piping design meets FSAR Section 3.6.2.1.2 Item 1(c) and the applicable valve design requirement is met in accordance with the criteria specified in SRP Section 3.9.3. Similarly, the applicant is to provide a detailed piping analysis for ASME Class 2 system piping identified in FSAR Sections 3.6.2.1.2, and 3.6.2.5

d. NuScale FSAR Sections 3.6.2.1.2 and 3.6.2.5 Item 7 refer to the ISI program for the weld inspection in the break exclusion area. However, it is not clear whether access provisions are made in the NuScale design to permit a 100% volumetric inservice examination of all the welds in the break exclusion area conducted during each inspection interval as defined in ASME Section XI, IWA-2400 as delineated in BTP 3-4, Part B, Item A(ii)(7). The applicant is to describe and clarify the access provision for the applicable weld examination as described above.

e. The applicant is to provide a discussion to clarify whether the break exclusion only applies to the pertinent main piping (i.e., breaks are postulated for its associated branch piping, if any). If branch piping is included in the break exclusion area, then items (a) through (d) above should be addressed for these piping segments as well.

NuScale Response:

RAI 8836 Question 2 contains five sub-questions that are addressed individually below. The responses reference the NuScale Pipe Rupture Hazards Analysis Technical Report, TR-0818-61384, Revision 1, which was submitted to the NRC on December 20, 2018 by NuScale letter LO-1218-63871, hereafter referred to as the NuScale PRHA TR.

a) NuScale provided figures containing the detailed geometric configurations of piping within the containment penetration area (i.e., break exclusion zone) in the NuScale PRHA TR in Figures A-4 through Figure A-6. Section A.3 in the NuScale PRHA TR also provides discussion on overall length and use of piping bends and welds in the piping evaluation.

   Where piping connects to a containment vessel safe-end, only the weld between the piping and the safe-end is considered to be within the containment penetration area, while the weld between the safe-end and the containment vessel is part of the vessel (i.e., not piping) and therefore not considered within the scope of BTP 3-4. This is illustrated in Figures 1 through 4 below. Although the welds between the safe-ends and the vessel are not within the containment penetration area, these welds do comply with the ISI requirements of BTP 3-4 B.A.(ii)(7) in order to ensure a low probability of rupture. The extent of the containment penetration area is clarified in Appendix A of the NuScale PRHA TR. The ISI requirements are included in the FSAR Section 6.6, Inservice Inspection and Testing of Class 2 and 3 Systems and Components and in FSAR Section 6.2, Containment Systems.

{{

}}2(a),(c)

Figure 1 - CNTS Feedwater Line Containment Penetration Area

{{

}}[2(a),(c)]

Figure 2 - CNTS Main Steam Line Containment Penetration Area

{{

}}2(a),(c)

Figure 3 - CNTS Discharge Line Containment Penetration Area (representative of all CNTS CVCS lines).

{{

}}2(a),(c)

Figure 4 - DHRS Line connection to CNV

b) The ASME Class 2 and 3 portions of the piping system in the break exclusion area are evaluated to the relevant stress and fatigue limits as delineated in FSAR Section 3.6.2.1.2, as summarized in Attachment 1.

c) The ASME Class 1 portions of the piping system in the break exclusion area are evaluated to the relevant criteria listed in FSAR Section 3.6.2.1.2 Item 1(c) and summarized in Attachment 1. The potential effect on the valve is discussed in Section A.3 of the NuScale PRHA TR.

d) Information clarifying the access provisions for the applicable weld examinations is provided in the NuScale PRHA TR Section A.3 and Figure A-7.

e) The break exclusion criteria is applied to the pertinent main piping and associated branch piping, as applicable, as discussed in Section A.3 in the NuScale PRHA TR. Items (a) through (d) are addressed for a branch as for the piping, and are included in the listed responses for items (a) through (d).

NUSCALE
Power for all humankind

Attachment 1

The NUREG-0800 BTP 3-4 Section B.A.(ii)(1)(d) Service Level A and B combination of Equation (9a) and Equation (10a) comprises loads/stresses due to internal pressure, deadweight, thermal expansion and thermal anchor movements, and dynamic fluid loads caused by valve opening/closing or pump trip. The BTP 3-4 Section B.A.(ii)(1)(e) Level C primary stresses are checked through Eq. (9a) and include loads due to internal pressure, deadweight, and Level C dynamic fluid loads caused by pipe rupture beyond this portion of piping and coincident valve opening/closing transients occurring as a result of the pipe break event. OBE seismic loads are not included in the load combinations but are included in Class 1 fatigue analyses. Note that they are not required to be included explicitly in the Class 2 and Class 3 design analysis per Appendix S of 10 CFR 50.

The following summarizes results from the applicable analyses demonstrating that the stress criteria pertaining to BTP 3-4 Section B.A.(ii)(1) is met for the piping within the containment penetration area Break Exclusion Zone.

Stress Summaries

Notes on Stress Summaries

The summarized stress results are obtained from calculations using the computer programs AutoPIPE and ANSYS. Additional notes are as follows:

1. The highest stress location on each line is reported for each analysis.
2. Global Coordinate System Definition (NPM): The Y-axis is vertical and is coincident with the centerline of the CNV with the location of zero elevation at the base. The positive X-axis is horizontal and along the CNV 90 degree axis. The positive Z-axis (in accordance with the right-hand-rule) is orthogonal to the X-axis and is along the CNV 180 degree axis.
3. Stress Ratios less than 1.0 indicate that the criteria is met.
4. CIV = Containment Isolation Valve.
5. CNV = Containment Vessel.

CVCS Degasification Vent Line Piping Stress Analysis

The CVCS degasification vent line is ASME Class 3 piping and evaluated using the computer program AutoPIPE. The results are provided at the weld between the containment isolation valve and the 2-inch piping run (refer to Figure 5).

Table 1 - Degasification vent line (Break Exclusion Zone)

ASME Service Level	Acceptance criteria	Combination	Joint	Stress (ksi)	Allowable stress (ksi)	Ratio
A/B	BTP 3-4 B.A. (ii)(1)(d)	Eq.(9) + Eq. (10)	M01	{{		
C	BTP 3-4 B.A. (ii)(1)(e)	Eq. (9)	M01			}}2(a),(c)

Note(s):

1. The joint refers to the AutoPIPE node ID (refer to Figure 5).

{{

}}2(a),(c)

Figure 5 - Degasification vent line weld location - Outside CNV

CVCS Injection, Discharge, and PZR Spray Class 3 Piping Stress Analysis

The CVCS injection, discharge, and PZR spray lines are ASME Class 3 piping and evaluated using the computer program AutoPIPE. The results are provided for the locations shown in Figure 7, Figure 8, and Figure 9. Of the locations shown, the location of maximum stress is reported in Table 2.

Table 2 - CVCS injection, discharge, and PZR spray lines (Break Exclusion Zone)

ASME Service Level	Acceptance criteria	Combination	Joint	Stress (ksi)	Allowable stress (ksi)	Ratio
A	BTP 3-4 B.A. (ii)(1)(d)	Eq.(9) + Eq. (10)	B09	{{		
			A09			
			C09			
B	BTP 3-4 B.A. (ii)(1)(d)	Eq.(9) + Eq. (10)	B09			
			A09			
			C09			
C	BTP 3-4 B.A. (ii)(1)(e)	Eq. (9)	B09			
			A09			
			C09			}}[2(a),(c)]

Note(s):

1. The joint refers to the AutoPIPE node ID (refer to Figure 7, Figure 8, and Figure 9).

{{

}}2(a),(c)

Figure 6 - CVCS Injection, Discharge, and PZR Spray - Outside CNV (Entire Model)

{{

}}2(a),(c)

Figure 7 - Containment System Injection Line - Outside CNV

{{

}}2(a),(c)

Figure 8 - Containment System Pressurizer Spray Line - Outside CNV

{{

}}2(a),(c)

Figure 9 - Containment System Discharge Line - Outside CNV

Containment System Feedwater Piping ASME Class 2 Stress Analysis

The CNTS feedwater lines are ASME Class 2 piping and evaluated using the computer program AutoPIPE. The results are provided for the locations shown in Figure 10. Of the locations shown, the location of maximum stress is reported in Table 3.

Table 3 - CNTS feedwater lines (Break Exclusion Zone)

ASME Service Level	Acceptance criteria	Combination	Joint	Stress (ksi)	Allowable stress (ksi)	Ratio
A/B	BTP 3-4 B.A. (ii)(1)(d)	Eq.(9) + Eq. (10)	C01	{{		
C	BTP 3-4 B.A. (ii)(1)(e)	Eq. (9)	C01			}}2(a),(c)

Note(s):

1. The joint refers to the AutoPIPE node ID (refer to Figure 10).

{{

}}2(a),(c)

Figure 10 - Feedwater Line 1 and 2 (Entire Model) - Outside CNV

Piping Stress Analysis for DHR, CNT, and MS Piping Outside of Containment

The DHR, CNTS, and MS lines outside of containment are ASME Class 2 piping and evaluated using the computer program AutoPIPE, with the post-processing performed using Excel (DHRS_StressCalculations_ABC.xlsx, sheet StressSummary_SA312). The results are provided for the locations shown in Figures 12 and 13. Of the locations shown, the location of maximum stress is reported in Table 4.

Table 4 - DHR, CNT, and MS lines (Break Exclusion Zone)

ASME Service Level	Acceptance criteria	Combination	Joint	Stress (ksi)	Allowable stress (ksi)	Ratio
A	BTP 3-4 B.A.(ii)(1)(d)	Eq.(9) + Eq. (10)	CN05	{{		
B	BTP 3-4 B.A.(ii)(1)(d)	Eq.(9) + Eq. (10)	CN05			
C	BTP 3-4 B.A.(ii)(1)(e)	Eq. (9)	CM04			}}2(a),(c)

Note(s):

1. The joint refers to the AutoPIPE node ID (refer to Figure 12 and Figure 13).

{{

}}2(a),(c)

Figure 11 - DHRS and CNTS Piping Associated with the Main Steam Line (Entire Model) - Outside CNV

{{

}}2(a),(c)

Figure 12 - Weld at Main Steam Isolation Valve (Detail) - Outside CNV

{{

}}2(a),(c)

Figure 13 - Weld at DHRS Condensate Piping to CNV (Detail) - Outside CNV

CNV CVC Nozzle Weld Fatigue Analysis (CNV6, CNV7, CNV13, CNV14)

The CVCS lines at the interface of the nozzle safe-end and the containment isolation valves are ASME Class 1 piping and evaluated using the computer program ANSYS. The evaluation at these welds is limited to ASME Section III Division 1, Subsection NB-3200 (Fatigue). The piping criteria per ASME III-1 NB-3600 are not used for this analysis. As a result, the rules of BTP 3-4 B.A.(ii)(1)(a) and (c) are not evaluated.

The following tables show the evaluation of these locations to BTP 3-4 B.A.(ii)(1)(b), with a maximum cumulative usage factor less than the limit of 0.10. Including environmental effects (environmentally assisted fatigue (EAF) correction factor per NUREG/CR-6909), the cumulative usage is less than the limit of 0.40.

The RCS injection line results are summarized in Table 5, with the maximum of the Alloy 690 or stainless steel side of the weld shown.

Table 5 - CVCS weld at Nozzle Safe-end to Valve (CNV6)

ASME Service Level	Acceptance criteria	Environmental Condition	Location	CUF	Allowable CUF	Ratio
A/B	BTP 3-4 B.A.(ii)(1)(b)	Air	Wld.Nz3.o	{{		
A/B	BTP 3-4 B.A.(ii)(1)(b)	EAF	Wld.Nz3.o			}}[2(a),(c)]

Note(s):

1. The environmental condition refers to the in-air results or those modified per NUREG/CR-6909 (identified as EAF).
2. The location refers to the point on the nozzle safe-end to valve interface (refer to Figure 15). The naming is identical for each nozzle evaluated (CNV6, CNV7, CNV13, and CNV14).

The pressurizer spray line results are summarized in Table 6, with the maximum of the Alloy 690 or stainless steel side of the weld shown.

Table 6 - CVCS weld at Nozzle Safe-end to Valve (CNV7)

ASME Service Level	Acceptance criteria	Environmental Condition	Location	CUF	Allowable CUF	Ratio
A/B	BTP 3-4 B.A. (ii)(1)(b)	Air	Wld.Nz3.o	{{		
A/B	BTP 3-4 B.A. (ii)(1)(b)	EAF	Wld.Nz3.i			}}2(a),(c)

Note(s):

1. The environmental condition refers to the in-air results or those modified per NUREG/CR-6909 (identified as EAF).
2. The location refers to the point on the nozzle safe-end to valve interface (refer to Figure 15). The naming is identical for each nozzle evaluated (CNV6, CNV7, CNV13, and CNV14).

The RCS discharge line results are summarized in Table 7, with the maximum of the Alloy 690 or stainless steel side of the weld shown.

Table 7 - CVCS weld at Nozzle Safe-end to Valve (CNV13)

ASME Service Level	**Acceptance criteria**	**Environmental Condition**	**Location**	**CUF**	**Allowable CUF**	**Ratio**
A/B	BTP 3-4 B.A. (ii)(1)(b)	Air	Wld.Nz3.o	{{		
A/B	BTP 3-4 B.A. (ii)(1)(b)	EAF	Wld.Nz3.i			}}2(a),(c)

Note(s):

1. The environmental condition refers to the in-air results or those modified per NUREG/CR-6909 (identified as EAF).
2. The location refers to the point on the nozzle safe-end to valve interface (refer to Figure 15). The naming is identical for each nozzle evaluated (CNV6, CNV7, CNV13, and CNV14).

The high point degasification line results are summarized in Table 8, with the maximum of the Alloy 690 or stainless steel side of the weld shown.

Table 8 - CVCS weld at Nozzle Safe-end to Valve (CNV14)

ASME Service Level	Acceptance criteria	Environmental Condition	Location	CUF	Allowable CUF	Ratio
A/B	BTP 3-4 B.A.(ii)(1)(b)	Air	Wld.Nz3.o	{{		
A/B	BTP 3-4 B.A.(ii)(1)(b)	EAF	Wld.Nz3.i			}}2(a),(c)

Note(s):

1. The environmental condition refers to the in-air results or those modified per NUREG/CR-6909 (identified as EAF).
2. The location refers to the point on the nozzle safe-end to valve interface (refer to Figure 15). The naming is identical for each nozzle evaluated (CNV6, CNV7, CNV13, and CNV14).

{{

}}2(a),(c)

Figure 14 - CNV Nozzle Configuration (Entire Model)

{{

}}2(a),(c)

Figure 15 - CNV Nozzle Weld Detail at Safe-End to Valve Location

{{

}}2(a),(c)

Figure 16 - CNV Nozzle Weld Detail at Safe-End to Valve (Cross-section) - ANSYS Model Path Line Definitions

Impact on DCA:

The Tier 2 FSAR Section 6.2 and FSAR Section 6.6 and the PRHA Technical Report TR-0818-61384, Appendix A have been revised as described in the response above and as shown in the markup provided with this response.

RAI 03.06.02-2, RAI 03.08.02-14, RAI 05.02.04-3, RAI 06.02.01-3, RAI 06.02.02-2, RAI 06.02.06-17, RAI 06.02.06-18, RAI 06.06-3

Table 6.2-3: Containment Vessel Inspection Elements

Component Description	Examination Category	Examination Method	Notes
CNV Shell and Head Welds			
Bottom head to core region shell	B-A	Volumetric	
Core region shell to lower transition shell	B-A	Volumetric	
Lower transition shell to lower flange	B-A	Volumetric	
Upper flange to RPV support lug shell	B-A	Volumetric	
RPV support lug shell to steam plenum access shell	B-A	Volumetric	
Steam plenum access shell to upper shell	B-A	Volumetric	
Upper shell to top head	B-A	Volumetric	
Support Welds			
Support skirt ring to support skirt	F-A	Visual	
Support skirt to bottom head	B-K	Surface or volumetric	
CNV shipping/storage support lug	B-K	Surface	
CNV support lug	B-A	Volumetric	
Alignment pin to threaded insert	B-K	Surface	
Instrument enclosure base to CNV	None	None	Exempted by IWF-1230
CNV Nozzle to Shell and Head Welds			
Feedwater lines	B-D	Volumetric	Examination requirement IWB-2500-7(b)
Main steam lines	B-D	Volumetric	Examination requirement IWB-2500-7(b)
CRDS return line	B-D	Volumetric	Examination requirement IWB-2500-7(b)
CVCS makeup line	B-D	Volumetric	Examination requirement IWB-2500-7(b)
CVCS pressurizer spray line	B-D	Volumetric	Examination requirement IWB-2500-7(b)
I&C Divisions	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
Containment evacuation system line	B-D	Volumetric	Examination requirement IWB-2500-7(b)
Containment flood and drain system line	B-D	Volumetric	Examination requirement IWB-2500-7(b)
CRDS supply line	B-D	Volumetric	Examination requirement IWB-2500-7(b)
CVCS letdown line	B-D	Volumetric	Examination requirement IWB-2500-7(b)
RPV high point degasification line	B-D	Volumetric	Examination requirement IWB-2500-7(b)
Pressurizer heater power (Elect-1 and 2)	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
I&C channels A-D	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
Decay heat removal system lines	B-D	Volumetric	Single sided, shell side. Examination requirement IWB-2500-7(b)

Table 6.2-3: Containment Vessel Inspection Elements (Continued)

Component Description	Examination Category	Examination Method	Notes
Head manway	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
CRDM access opening	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
CNV manway	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
SG inspection ports	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
Pressurizer heater access ports	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
RRV and RVV trip/reset	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
CRDM power	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
RPI groups	B-D	Not required	See Table IWB-2500-1 (B-D) Note 1
Nozzle-to-Safe-end Dissimilar Metal Welds (SE)			
Feedwater lines SE (inner and outer)	B-F	Surface and Volumetric	
Main steam lines SE (inner and outer)	B-F	Surface and Volumetric	
CRDS return line SE (outer)	B-F	Surface and Volumetric	
CRDS return lines SE (inner)	B-F	Surface	
CVCS makeup line SE (outer)	B-F	Surface and Volumetric	
CVCS makeup line SE (inner)	B-F	Surface	
CVCS pressurizer spray line SE (outer)	B-F	Surface and Volumetric	
CVCS pressurizer spray line SE (inner)	B-F	Surface	
Containment evacuation system line SE	B-F	Surface	
Containment flood and drain system line SE (inner and outer)	B-F	Surface	
CRDS supply line SE (inner and outer)	B-F	Surface	
CVCS letdown line SE ~~(~~inner~~ and outer)~~	B-F	Surface	
CVCS letdown line SE outer	B-F	Surface and Volumetric	
RPV high point degasification line SE (inner and outer)	B-F	Surface	
Decay heat removal system lines SE (inner and outer)	B-F	Surface and Volumetric	Required surface exam augmented to surface and volumetric
RRV and RVV trip/reset SE	B-F	Surface and Volumetric	
Threaded Fastener Threaded Inserts and Threaded Insert Welds			
I&C Divisions	None	VT-1	No inspection requirement. Augmented to VT-1 when bolts are removed.
Pressurizer heater power (Elect - 1 and 2)	None	VT-1	No inspection requirement. Augmented to VT-1 when bolts are removed.
I&C channels A-D	None	VT-1	No inspection requirement. Augmented to VT-1 when bolts are removed.

RAI 03.06.02-2

Table 6.6-1: Examination Categories and Methods

Description	Examination Category	Methods
Decay Heat Removal Piping		
DHR INNER CNV SE TO PIPING	C-F-1	Surface and Volumetric
DHR CONDENSER FW OUTLET TO PIPING	C-F-1	Surface and Volumetric
DHR CONDENSER STEAM INLET TO PIPING	C-F-1	Surface and Volumetric
DHR HEADER TO FIT-UP PIPE	C-F-1	Surface and Volumetric
DHR HEADER TO TEE	C-F-1	Surface and Volumetric
DHR HEADER TO FIT-UP PIPE	C-F-1	Surface and Volumetric
PIPE TO SWAGELOK	None	Exempted by IWC- 1221(a)(1) NPS4 and smaller
DHR TEE TO PIPE	C-F-1	Surface and Volumetric
DHR PIPE TO ELBOW	C-F-1	Surface and Volumetric
DHR ELBOW TO VALVE	C-F-1	Surface and Volumetric
PIPE TO VALVE	C-F-1	Surface and Volumetric
PIPE TO FITTING LINE HEADER	None	Exempted by IWC-1221(a)(1) NPS4 and smaller
PIPE TO WELDOLET LINE	None	Exempted by IWC-1221(a)(1) NPS4 and smaller
FITTING TO FITTING	None	Exempted by IWC-1221(a)(1) NPS4 and smaller
PIPE TO CLAMP	F-A	VT-3
DHR OUTER CNV SE TO PIPING	C-F-1	Surface and Volumetric
Containment Evacuation Piping		
DUAL BODY ISOLATION VALVE TO SAFE-END (CNV10)	C-F-1	Surface
Containment Flooding and Drain Piping		
DUAL BODY ISOLATION VALVE TO SAFE-END (CNV11)	C-F-1	Surface and Volumetric
PIPE TO SAFE-END (CNV11)	None	Exempted by IWC 1221(a)(1) NPS4 and smaller
PIPE TO PIPE	None	Exempted by IWC 1221(a)(1) NPS4 and smaller
PIPE TO LUG	None	Exempted by IWF-1230
PIPE TO SUPPORT	F-A	VT-3
RCCWS Piping		
DUAL BODY ISOLATION VALVE TO SAFE-END (CNV5)	C-F-1	Surface
DUAL BODY ISOLATION VALVE TO SAFE-END (CNV12)	C-F-1	Surface
PIPE TO SAFE-END	C-F-1	Surface
PIPE TO CAP	C-F-1	Surface
PIPE TO NOZZLE TO BASE	None	Exempted by IWC 1221(a)(1) NPS4 and smaller
FITTING TO PIPE	None	Exempted by IWC 1221(a)(1) NPS4 and smaller
PIPE TO REDUCER	None	Exempted by IWC 1221(a)(1) NPS4 and smaller
REDUCER TO REDUCER	None	Exempted by IWC 1221(a)(1) NPS4 and smaller

Table 6.6-1: Examination Categories and Methods (Continued)

Description	Examination Category	Methods
REDUCER TO FLANGE	None	Exempted by IWC 1221(a)(1) NPS4 and smaller
U-BOLT TO SUPPORT BRACKET	None	Exempted by IWF-1230
Main Steam Piping		
CUSTOM TEE TO ELBOW	C-F-1	Surface and Volumetric
CUSTOM TEE TO SAFE-END	C-F-1	Surface and Volumetric
PIPE TO ELBOW	C-F-1	Surface and Volumetric
PIPE TO SAFE END	C-F-1	Surface and Volumetric
PIPE TO PIPE	C-F-1	Surface and Volumetric
PIPE TO CUSTOM TEE	C-F-1	Surface and Volumetric
PIPE TO VALVE	C-F-1	Surface and Volumetric
PIPE TO FLANGE	C-F-1	Surface and Volumetric
PIPE TO SOCKOLET	C-F-1	Exempted by IWC-1221(a)(1) NPS4 and smaller
PIPE TO THERMOWELL	C-F-1	Exempted by IWC-1221(a)(1) NPS4 and smaller
PIPE TO WELDOLET	None	Exempted by IWC-1221(a)(1) NPS4 and smaller
CUSTOM TEE TO VALVE	C-F-1	No description.
CUSTOM TEE TO DHR PIPE	C-F-1	Surface and Volumetric
CUSTOM TEE TO SAFE END	C-F-1	Surface and Volumetric
CUSTOM TEE TO CUSTOM TEE	C-F-1	Surface and Volumetric
Feedwater Piping		
PIPE TO PIPE	C-F-1	Surface and Volumetric
PIPE TO SAFE-END	C-F-1	Surface and Volumetric
PIPE TO CUSTOM TEE	C-F-1	Surface and Volumetric
VALVE TO PIPE	C-F-1	Surface and Volumetric
PIPE TO FLANGE	C-F-1	Surface and Volumetric
PIPE TO ELBOW	C-F-1	Surface and Volumetric
THERMOWELL TO PIPE	C-F-1	Exempted by IWC-1221(a)(1) NPS4 and smaller
VALVE TO SAFE END	C-F-1	Surface and Volumetric
FEEDWATER DHR TEE TO DHR INLET	None	Exempted by IWC-1221(a)(1) NPS4 and smaller
HSS TO HSS	F-A	VT-3
CVCS Piping		
CVCS DISCHARGE - PIPE TO DUAL BODY ISOLATION VALVE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS DISCHARGE – DUAL BODY ISOLATION VALVE TO CHECK VALVE	D-A	Augmented to Volumetric~~None - Exempted by IWD-1220 (a) NPS4 and smaller~~
CVCS DISCHARGE - PIPE TO CHECK VALVE	D-A	Augmented to Volumetric
CVCS DISCHARGE - PIPE TO TEE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS DISCHARGE - FLANGE TO TEE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS DISCHARGE - TEE TO REDUCER	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller

Table 6.6-1: Examination Categories and Methods (Continued)

Description	Examination Category	Methods
CVCS DISCHARGE - REDUCER TO FLANGE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS INJECTION - PIPE TO DUAL BODY ISOLATION VALVE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS INJECTION - PIPE TO CHECK VALVE	D-A	Augmented to Volumetric
CVCS INJECTION - DUAL BODY ISOLATION VALVE TO CHECK VALVE	D-A	Augmented to VolumetricNone - Exempted by IWD-1220(a) NPS4 and smaller
CVCS INJECTION - PIPE TO TEE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS INJECTION - FLANGE TO TEE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS INJECTION - TEE TO REDUCER	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS INJECTION - REDUCER TO FLANGE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS PRESSURIZER - PIPE TO DUAL BODY ISOLATION VALVE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS PRESSURIZER - PIPE TO CHECK VALVE	D-A	Augmented to Volumetric
CVCS PRESSURIZER - DUAL BODY ISOLATION VALVE TO CHECK VALVE	D-A	Augmented to VolumetricNone - Exempted by IWD-1220(a) NPS4 and smaller
CVCS PRESSURIZER - PIPE TO TEE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS PRESSURIZER - FLANGE TO TEE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS PRESSURIZER - TEE TO REDUCER	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS PRESSURIZER - REDUCER TO FLANGE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS HIGH POINT VENT -PIPE TO DUAL BODY ISOLATION VALVE	D-A	Augmented to VolumetricNone - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS HIGH POINT VENT - PIPE TO TEE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS HIGH POINT VENT - FLANGE TO TEE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS HIGH POINT VENT - TEE TO REDUCER	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
CVCS HIGH POINT VENT - REDUCER TO FLANGE	D-A	None - Exempted by IWD-1220 (a) NPS4 and smaller
Support Welds		
NPM TOP SUPPORT WELDS	F-A	VT-3
CVCS DISCHARGE - SUPPORT TO PLATFORM	None	Exempted by IWF-1230
CVCS INJECTION - SUPPORT TO PLATFORM	None	Exempted by IWF-1230
CVCS PRESSURIZER - SUPPORT TO PLATFORM	None	Exempted by IWF-1230
CVCS HIGH POINT VENT - SUPPORT TO PLATFORM	None	Exempted by IWF-1230

General: The preservice examination includes the items selected for in-service examination in each examination category with the exception of Category C-H, in accordance with IWC-2200, and the VT-2 examination of pressure retaining surfaces in Categories D-A, D-B and D-C, in

Appendix A. Break Exclusion – Compliance with Regulatory Acceptance Criteria

A.1 Application of BTP 3-4 Criteria for the Determination of Postulated Break Locations

The criteria used to determine the location of postulated HELBs and to exclude the need to postulate HELBs are provided in BTP 3-4. BTP 3-4 contains two sets of criteria for determining break locations; one for piping located within containment penetration areas and the other for areas outside containment penetration areas. Both are described in Section 2.2.2.1. NuScale's application of the guidance of BTP 3-4 with respect to postulated HELB locations is described below. Separate discussions are provided for three distinct regions of the NuScale plant.

A.2 Inside the CNV

SGS (i.e., MSS and FWS) lines are qualified to LBB criteria (see FSAR Section 3.6.3). Other high energy piping located inside the CNV is designed to the break criteria of BTP 3-4 B.A.(iii). Also, the five bolted-flange connections for the RVV and RRV are designed to break exclusion criteria (see FSAR Section 3.6.2.7).

Per the criteria in BTP 3-4 B.A.(iii)(1), breaks are postulated at piping system terminal ends and at intermediate locations. Additional intermediate break locations may be selected by one of two criteria: (i) at every fitting, weld, and valve and additionally at the extremities of protective structures, or (ii) through application of conservative stress criteria based on ASME code equation stresses. For the NuScale design the second option was used, and stress analysis performed to determine the location of postulated break locations. The break locations determined using this approach are listed in FSAR Table 3.6-2.

A.3 Outside the CNV under the Bioshield

The region outside the CNV under the bioshield contains high-energy piping both within and outside the containment penetration area. High-energy piping within the containment penetration area is identified in Figure 1 for the CNTS and Figure 2 for the DHRS and is presented in red. Where the portion of piping being identified is limited to a single weld, a red dot is shown rather than a line. The remainder of the high-energy piping, beginning immediately outboard of the containment penetration area welds (indicated with red dots) and continuing beyond the reactor pool wall, is outside the containment penetration area. Where piping connects to a containment vessel safe-end, only the weld between the piping and the safe-end is considered to be within the containment penetration area, while the weld between the safe-end and the containment vessel is considered part of the vessel (i.e., not piping), and therefore not within the scope of BTP 3-4. Although the welds between the safe-ends and the vessel are not within the containment penetration area, these welds do comply with the ISI requirements of BTP 3-4 B.A.(ii)(7) in order to ensure a low probability of rupture. These ISI requirements are included in FSAR Section 6.6, Inservice Inspection and Testing of Class 2 and 3 Systems and Components and in FSAR Section 6.2, Containment Systems.

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0119-64305

NuScale Power, LLC
AFFIDAVIT of Zackary W. Rad

I, Zackary W. Rad, state as follows:

1. I am the Director, Regulatory Affairs of NuScale Power, LLC (NuScale), and as such, I have been specifically delegated the function of reviewing the information described in this Affidavit that NuScale seeks to have withheld from public disclosure, and am authorized to apply for its withholding on behalf of NuScale.
2. I am knowledgeable of the criteria and procedures used by NuScale in designating information as a trade secret, privileged, or as confidential commercial or financial information. This request to withhold information from public disclosure is driven by one or more of the following:
   a. The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by NuScale competitors, without a license from NuScale, would constitute a competitive economic disadvantage to NuScale.
   b. The information requested to be withheld consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage, as described more fully in paragraph 3 of this Affidavit.
   c. Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.
   d. The information requested to be withheld reveals cost or price information, production capabilities, budget levels, or commercial strategies of NuScale.
   e. The information requested to be withheld consists of patentable ideas.
3. Public disclosure of the information sought to be withheld is likely to cause substantial harm to NuScale's competitive position and foreclose or reduce the availability of profit-making opportunities. The accompanying Request for Additional Information response reveals distinguishing aspects about the method and results by which NuScale develops its piping analyses.

   NuScale has performed significant research and evaluation to develop a basis for this method and results and has invested significant resources, including the expenditure of a considerable sum of money.

   The precise financial value of the information is difficult to quantify, but it is a key element of the design basis for a NuScale plant and, therefore, has substantial value to NuScale.

   If the information were disclosed to the public, NuScale's competitors would have access to the information without purchasing the right to use it or having been required to undertake a similar expenditure of resources. Such disclosure would constitute a misappropriation of NuScale's intellectual property, and would deprive NuScale of the opportunity to exercise its competitive advantage to seek an adequate return on its investment.

4. The information sought to be withheld is in the enclosed response to NRC Request for Additional Information No. 42, eRAI No. 8836. The enclosure contains the designation "Proprietary" at the top of each page containing proprietary information. The information considered by NuScale to be proprietary is identified within double braces, "{{ }}" in the document.
5. The basis for proposing that the information be withheld is that NuScale treats the information as a trade secret, privileged, or as confidential commercial or financial information. NuScale relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC § 552(b)(4), as well as exemptions applicable to the NRC under 10 CFR §§ 2.390(a)(4) and 9.17(a)(4).
6. Pursuant to the provisions set forth in 10 CFR § 2.390(b)(4), the following is provided for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:
   a. The information sought to be withheld is owned and has been held in confidence by NuScale.
   b. The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, chief technology officer or other equivalent authority, or the manager of the cognizant marketing function (or his delegate), for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside NuScale are limited to regulatory bodies, customers and potential customers and their agents, suppliers, licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or contractual agreements to maintain confidentiality.
   c. The information is being transmitted to and received by the NRC in confidence.
   d. No public disclosure of the information has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or contractual agreements that provide for maintenance of the information in confidence.
   e. Public disclosure of the information is likely to cause substantial harm to the competitive position of NuScale, taking into account the value of the information to NuScale, the amount of effort and money expended by NuScale in developing the information, and the difficulty others would have in acquiring or duplicating the information. The information sought to be withheld is part of NuScale's technology that provides NuScale with a competitive advantage over other firms in the industry. NuScale has invested significant human and financial capital in developing this technology and NuScale believes it would be difficult for others to duplicate the technology without access to the information sought to be withheld.

I declare under penalty of perjury that the foregoing is true and correct. Executed on January 25, 2019.

Zackary W. Rad