RAIO-1117-57282

November 20, 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. 236 (eRAI No. 9103) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 236 (eRAI No. 9103)," dated September 25, 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. 9103:

- 05.02.04-1
- 05.02.04-2
- 05.02.04-3
- 05.02.04-4
- 05.02.04-5
- 05.02.04-6

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 Carrie Fosaaen at 541-452-7126 or at cfosaaen@nuscalepower.com.

Sincerely,

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

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
Bruce Bavol, NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9103

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9103

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

eRAI No.: 9103
Date of RAI Issue: 09/25/2017

NRC Question No.: 05.02.04-1

10 CFR 52.47, “Contents of Applications,” specifies the level of design information needed to be submitted to support design certification. 10 CFR 52.47(a)(3)(i) requires that the this design information include the principle design criteria for the facility and notes that Appendix A to 10 CFR Part 50, General Design Criteria, establishes minimum requirements for the principal design criteria for water-cooled nuclear power plants. Appendix A to 10 CFR Part 50 specifies, in part, the following:

- 10 CFR Part 50, Appendix A, General Design Criterion 14, requires that, “The reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, or rapidly propagating failure, and of gross rupture.”
- 10 CFR 50.55a(b) requires that systems and components of boiling and pressurized water-cooled nuclear power reactors must meet the requirements of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code), with conditions on the use of ASME Code Section XI described in 10 CFR 50.55a(b)(2).
- 10 CFR 50.55a(g)(3)(i) requires for design certifications under Part 52 issued on or after July 1, 1974 that ASME Code Class 1 components (including supports) must be designed and be provided with access to enable the performance of inservice examination of these components.

In order for the staff to determine whether the NuScale design meets these criteria with regard to the inservice inspections of Class 1 components, the staff is requesting the following information.

While ASME Code Section XI (as conditioned by 10CFR50.55a) provides reasonable assurance of leak tightness and structural integrity, several adjustments have been made to ASME Code Section XI and to 10CFR50.55a in response to operating experience. When evaluating a new reactor design, the NRC staff therefore examines areas where any new reactor designs significantly differ from the reactors for which the NRC and ASME have a large body of experience. One area of concern the NRC staff has for applying ASME Code Section XI to the NuScale design is the inspection requirements for smaller pipe sizes, such as NPS 4 or NPS 1.

The NRC staff request additional information on the use of the inspection requirements for NPS

4 and smaller piping and components exempted by ASME BPVC Section XI, Paragraph IWB-1220 for piping in the NuScale DCD to ensure that, in accordance with 10 CFR Part 50, Appendix A, General Design Criterion 14, “The reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, or rapidly propagating failure, and of gross rupture.” If the ISI requirements for NPS 4 and smaller piping cannot be justified, revise the DCD to propose augmented inspection requirements beyond those required by ASME Code, Section XI.

NuScale Response:

NuScale will follow the ASME BPVC verbatim as required by 10 CFR 50 to ensure compliance with the GDC requirements specified in 10 CFR 50 Appendix A. Compliance with the ASME BPVC, 10 CFR 50.55a and 10 CFR 50 Appendix A assures a high degree of quality and integrity for the structures, systems and components designed to these standards. A more detailed response to this RAI was included in eRAI 9109, 06.06-1. See the response to RAI 06.06-1 for additional information, including the basis for the NuScale position.

Impact on DCA:

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

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

eRAI No.: 9103
Date of RAI Issue: 09/25/2017

NRC Question No.: 05.02.04-2

A typical boiling water or pressurized water reactor has over 400 ASME Code Class 1 piping welds, meaning that a 25% sample of welds includes over 100 of welds in an ASME Code Section XI ISI program. If 100 welds are examined and none are found to have flaws, we could conclude with 95 percent confidence that no more than 3 percent of the remaining welds have flaws, which is reasonable assurance of leak tightness and structural integrity. The NuScale DCD describes a system with many fewer Class 1 welds, resulting in a greatly reduced number of inspections. If only 10 Class 1 welds out of 40 are examined and no flaws were found, we could only conclude with a 95 percent confidence that no more than 26 percent of the remaining welds would have flaws, which would not provide an equivalent assurance of leak tightness or structural integrity for the other welds.

Based on an assessment of the significance of the piping systems of the NuScale design, determine how many Class 1 piping welds in the reactor coolant pressure boundary would need to be inspected to achieve the same level of assurance of leak tightness and structural integrity as the 25% sample described in ASME Code, Section XI, Table IWB-2500, Examination Category B-J, Note 2(d) to ensure that, in accordance with 10 CFR Part 50, Appendix A, General Design Criterion 14, “The reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, or rapidly propagating failure, and of gross rupture.”

NuScale Response:

NuScale will follow the ASME BPVC verbatim as required by 10 CFR 50 to ensure compliance with the GDC requirements specified in 10 CFR 50 Appendix A. Compliance with the ASME BPVC, 10 CFR 50.55a and 10 CFR 50 Appendix A assures a high degree of quality and integrity for the structures, systems and components designed to these standards. A more detailed response to this RAI was included in eRAI 9109, 06.06-1. See the response to RAI 06.06-1 for additional information, including the basis for the NuScale position.

Impact on DCA:

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

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

eRAI No.: 9103
Date of RAI Issue: 09/25/2017

NRC Question No.: 05.02.04-3

In the DCD, the drawings showing the penetrations through the reactor pressure vessel shell and head appear to show that the nozzles are integral to the shell and head materials (e.g., Figure 5.4-4) and no nozzle-to-shell or nozzle-to-head welds are shown in these figures. Table 5.2-6 describes the nozzle-to-vessel and nozzle-to-head welds as Examination Category B-D, "Full Penetration Welded Nozzles in Vessels." This is an inconsistency in the two sections of the DCD.

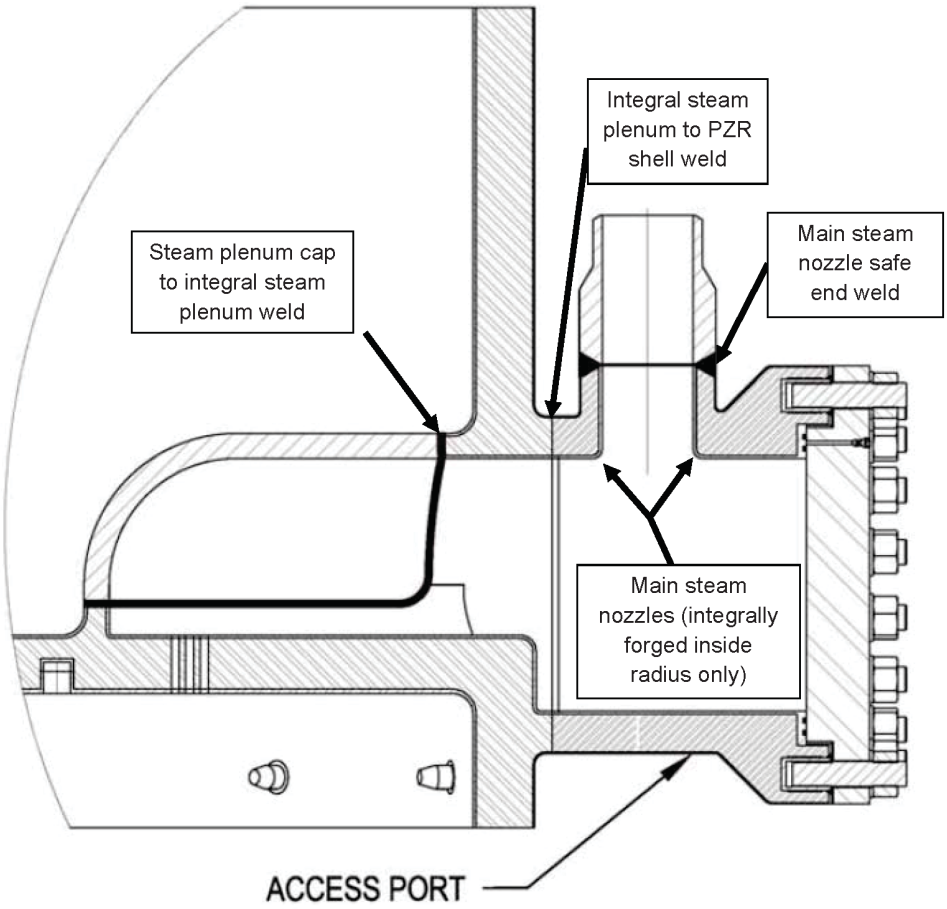
Revise the DCD to resolve this inconsistency, describe how the nozzles are attached to the vessel and head, and provide the proposed ISI requirements for the nozzles so that the staff can confirm that the locations will meet the accessibility for inspection requirements of 10 CFR 50.55a (3)(i).

NuScale Response:

Reactor pressure vessel head nozzles are integrally forged into the head material. There are no welded nozzles on the reactor vessel head. Examination Category B-D is specified to ensure the inside radii of the forged nozzles are examined as per Figure IWB-2500-7(d) in the ASME BPVC. Nozzles within the reactor vessel shell are welded.

Tier 2, FSAR Table 5.2-6 has been revised (See response to eRAI 9109, RAI 06.06-3) to add the applicable ASME Boiler and Pressure Vessel Code (BPVC) examination requirements. Figure IWB-2500-7(a) through Figure IWB-2500-7(d) in the ASME BPVC identifies the applicable method of nozzle attachment for each nozzle. The appropriate IWB-2500-7(x) figure is added for each nozzle attachment weld in the tables so the appropriate in-service inspection requirements are applied.

For clarity FSAR Figure 5.4-4 has been reproduced below and enhanced to identify the welds by name. Each weld is included in Table 5.2-6 along with the required examination method.



INTEGRAL STEAM PLENUM
(SIDE VIEW - CUTAWAY)

Impact on DCA:

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

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

eRAI No.: 9103
Date of RAI Issue: 09/25/2017

NRC Question No.: 05.02.04-4

Section 5.2.4.2 of the DCD states:

> If it is determined that conformance with an ASME Code ISI requirement is impractical following the performance of an ISI, request for relief from the applicable ASME Code requirement is submitted to the NRC for approval in accordance with 10 CFR 50.55a(g)(5)(iii). The relief requests include appropriate justifications and proposed alternative inspection or testing methods.

This statement, as it anticipates the submittal of alternatives to the ASME Code requirements, may be interpreted to be contrary to the requirements of 10 CFR 50.55a(g)(3)(i). Revise the DCD to eliminate this statement.

NuScale Response:

The NRC requested change to FSAR section 5.2.4.2 has been made. See the markup to FSAR section 5.2.4.2 attached to this response.

Impact on DCA:

FSAR section 5.2.4.2 has been revised as described in the response above and as shown in the markup provided in this response.

RAI 05.02.04-4

5.2.4.2 ~~CFR 50.55a Relief Requests~~

~~If it is determined that conformance with an ASME Code ISI requirement is impractical following the performance of an ISI, request for relief from the applicable ASME Code requirement is submitted to the NRC for approval in accordance with 10 CFR 50.55a(g)(5)(iii). The relief requests include appropriate justifications and proposed alternative inspection or testing methods.~~

5.2.4.3 Preservice Inspection and Testing Program

Preservice examinations required by the design specification and preservice documentation are in accordance with ASME BPVC, Section III, Paragraph NB-5281. Volumetric and surface examinations are performed as specified in ASME BPVC, Section III, Paragraph NB-5282. Components described in ASME BPVC, Section III, Paragraph NB-5283 are exempt from preservice examination.

Surfaces of the RPV are designed to be suitable for examinations and conform to the applicable requirements of ASME BPVC Sections III and XI. For welds requiring an ultrasonic preservice examination, the surface finish meets the requirements of ASME BPVC Section III, Subsubparagraph NB-4424.2(a) except that the surface finish for Class 1 piping welds are 125 in Ra or better and the surface flatness is less than 0.03125 inches for a minimum distance of two times the thickness of the part from the weld centerline.

The containment is a Class MC containment in accordance with ASME BPVC, Section III, Subsection NE; however, it is designed, fabricated, and stamped as a Class 1 pressure vessel in accordance with BPVC, Section III, Subsection NB, with overpressure protection in accordance with ASME BPVC, Section III, Article NE-7000. Refer to Sections 3.8.2 and 6.2 for additional description of the containment compliance with the ASME BPVC, including preservice inspection and ISI and testing.

Preservice examinations for ASME Code Class 1 pressure boundary and attachment welds conform with ASME BPVC, Section III, Paragraph NB-5280 and ASME BPVC, Section XI, Subarticle IWB-2200. Examination methods are in accordance with ASME BPVC Section V except as modified by ASME BPVC, Section III, Paragraph NB-5111. These preservice examinations include 100 percent of the pressure boundary welds.

Preservice eddy current examinations for the SG tubing are in accordance with the applicable requirements of the EPRI Steam Generator Management Program guidelines (Reference 5.2-8) and ASME BPVC Section XI.

COL Item 5.2-6: A COL applicant that references the NuScale Power Plant design certification will develop site-specific preservice examination, inservice inspection, and inservice testing program plans in accordance with Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code and will establish implementation milestones. If applicable, a COL applicant that references the NuScale Power Plant design certification will identify the implementation

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

eRAI No.: 9103
Date of RAI Issue: 09/25/2017

NRC Question No.: 05.02.04-5

The NuScale design drawings show several pipe-to-valve welds. Pipe-to-valve welds are a frequent area requiring relief requests for insufficient volumetric coverage as this geometry is challenging to inspect from both sides of the weld. Describe how the pipe-to-valve configuration will allow inspections to be conducted to obtain “essentially 100 percent” inspection coverage in accordance with the requirements of 10 CFR 50.55a(g)(3)(i).

NuScale Response:

ASME Section III Class 1 valves are designed to meet the requirements of NB-3125. The design of the Class 1 valve bodies are provided with additional length to allow for volumetric inspection of the pipe to valve weld from both sides of the weld.

Impact on DCA:

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

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

eRAI No.: 9103
Date of RAI Issue: 09/25/2017

NRC Question No.: 05.02.04-6

Section 5.2.4 of the DCD states:

> The initial ISI Program incorporates the latest edition and addenda of the ASME BPVC approved in 10 CFR 50.55a(b) on the date 12 months before initial fuel load. Inservice examination of components and system pressure tests conducted during successive 120-month inspection intervals must comply with the requirements of the latest edition and addenda of the Code incorporated by reference in 10 CFR 50.55a(b) 12 months before the start of the 120-month inspection interval (or the optional ASME code cases listed in RG 1.147, Revision 17, that are incorporated by reference in 10 CFR 50.55a(b)), subject to the conditions listed in 10 CFR 50.55a(b).

The language of the DCD omits the use of code cases listed Regulatory Guide 1.147 “Inservice Inspection Code Case Acceptability, ASME Section XI, Division 1” and the conditions listed in 10 CFR 50.55a(b) for the first 120 month inservice inspection interval.

Revise the DCD to, at a minimum, indicate that conditions listed in 10 CFR 50.55a(b) on the edition and addenda of the ASME Code being implemented for the first 120 month inspection interval will be met.

NuScale Response:

Per the NRC request, FSAR Section 5.2.4 has been revised to remove reference to optional ASME Code Cases in Regulatory Guide 1.147. Revision 17. The phrase "subject to the conditions listed in 10 CFR 50.55a(b)," has been added to the first sentence to clarify that future regulatory changes may alter implementation of ISI program requirements.

Impact on DCA:

FSAR section 5.2.4 has been revised as described in the response above and as shown in the markup provided in this response.

are selected for their compatibility with the borated water environment in the RCS and reactor pool water.

Section 3.13 provides further description of the design of threaded fasteners for the RPV and pressure retaining components including design requirements for the use of Alloy 718 for the mitigation of SCC.

5.2.4 Reactor Coolant Pressure Boundary Inservice Inspection and Testing

Preservice and inservice inspection and testing of ASME BPVC Class 1 pressure-retaining components (including vessels, pumps, valves, bolting, and supports) within the RCPB are performed in accordance with ASME BPVC, Section XI pursuant to 10 CFR 50.55a(g), including ASME BPVC Section XI mandatory appendices.

RAI 05.02.04-6

The initial ISI Program incorporates the latest edition and addenda of the ASME BPVC approved in 10 CFR 50.55a(b) ~~on the date 12 months before initial fuel load~~prior to initial fuel load as specified in 10 CFR 50.55a, subject to the conditions listed in 10 CFR 50.55a(b). Inservice examination of components and system pressure tests conducted during successive 120-month inspection intervals must comply with the requirements of the latest edition and addenda of the Code incorporated by reference in 10 CFR 50.55a(b) ~~12 months before the start of the 120-month inspection interval (or the optional ASME code cases listed in RG 1.147, Revision 17, that are incorporated by reference in 10 CFR 50.55a(b))~~, subject to the conditions listed in 10 CFR 50.55a(b).

The specific edition and addenda of the Code used to determine the requirements for the inspection and testing plan for the initial and subsequent inspection intervals is to be delineated in the inspection program. The Code includes requirements for system pressure tests and functional tests for active components. The requirements for system pressure tests are defined in ASME BPVC, Section XI, Articles IWA-5000 and IWB-5000. These tests verify the pressure boundary integrity in conjunction with ISI. Section 6.6 discusses Class 2 and 3 component examinations.

5.2.4.1 Inservice Inspection and Testing Program

This section describes the process for assessing inspection and testing of the ASME BPVC Class 1components except for SG tubes. Section 5.4.1 describes the process for ISI requirements for the SG tubes.

The RCPB components are designed and provided with access to permit periodic inspection and testing of important areas and features to assess their structural and leak-tight integrity pursuant GDC 32. The design allows inspection, testing, and maintenance of the RSV, PZR heaters, SG primary and secondary sides, instruments, electrical connections, and other components located inside of the RCPB of the NPMs. Equipment that may require inspection or repair is placed in an accessible position to minimize time and radiation exposure during refueling and maintenance outages. Plant technicians access components without being placed at risk for excessive dose or situations where excessive plates, shields, covers, or piping must be moved or removed in order to access components.