



June 15, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission  
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**SUBJECT:** NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 282 (eRAI No. 9196) on the NuScale Design Certification Application

**REFERENCES:** 1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 282 (eRAI No. 9196)," dated November 14, 2017  
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 282 (eRAI No.9196)," dated January 12, 2018

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 Question from NRC eRAI No. 9196:

- 19-36

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](mailto:cfosaaen@nuscalepower.com).

Sincerely,

A handwritten signature in black ink, appearing to read "Zackary W. Rad".

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. 9196



**Enclosure 1:**

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9196

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

**eRAI No.:** 9196

**Date of RAI Issue:** 11/14/2017

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**NRC Question No.:** 19-36

### **Regulatory basis**

10 CFR 52.47(a)(23) requires a description and analysis of design features for the prevention and mitigation of severe accidents, e.g., challenges to containment integrity caused by core-concrete interaction, steam explosion, high-pressure core melt ejection, hydrogen combustion, and containment bypass. Standard Review Plan Chapter 19.0 refers to SECY-93-087 for guidance regarding intersystem loss-of-coolant accident (ISLOCA). SECY-93-087 provides the following guidance:

Designers should reduce the possibility of a loss-of-coolant accident outside containment by designing (to the extent practicable) all systems and subsystems connected to the reactor coolant system (RCS) to withstand the full RCS pressure. Systems that have not been designed to full RCS pressure should include the following:

- the capability for leak testing of the pressure isolation valves;
- valve position indication that is available in the control room when isolation valve operators are de-energized; and
- high-pressure alarms to warn control room operators when rising reactor coolant pressure approaches the design pressure of attached low pressure systems and both isolation valves are not closed.

The degree of isolation or number of barriers (for example, three isolation valves) is not sufficient justification for using low-pressure components that can practically be designed to the full RCS ultimate rupture strength criterion.

### **Request for additional information**

Final Safety Analysis Report (FSAR) Section 19.2.2.5 states that the chemical and volume control system (CVCS) is the only system connected to the RCS that has piping outside containment, the CVCS is designed to RCS pressure, and the CVCS has pressure isolation

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valves with the capability for leak testing.

The information in FSAR Section 9.3.4 indicates that CVCS subsystems may not meet the guidance in SECY-93-087. FSAR Table 9.3.4-1 lists 150 psig as the design pressure for the CVCS Chemical Mixing Tank and the CVCS Expansion Tank.

The information in FSAR Section 9.3.4 indicates that CVCS connecting systems (i.e., systems that are connected to the RCS via the CVCS) may not meet the guidance in SECY-93-087. CVCS connecting systems (e.g., liquid radioactive waste system, demineralized water system, process sampling system, boron addition system) are shown in Figure 9.3.4-1. FSAR Table 9.3.4-2 lists 125 psig and atmospheric pressure as the design pressure for two of the components in the boron addition system which is a CVCS connecting system.

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### **NuScale Response:**

NuScale is supplementing its original response to RAI 9196 (Question 19-36) provided in letter RAIO-0118-58141, dated January 12, 2018. This supplemental information is provided as a result of discussions with the NRC during a public phone call on May 8, 2018. Information provided in the original response remains valid.

As shown in FSAR Figure 6.2-4, the CVCS is the only system with connections to the RCS that has piping that runs outside containment. Therefore, the CVCS is the total scope for ISLOCA consideration in the NuScale design. Although ISLOCAs are prevented by the redundant CVCS containment isolation valves, the CVCS is designed to withstand RCS design pressure (i.e., "full" pressure) to the extent practicable. The makeup line and components upstream of the CVCS makeup pumps are the only portion of the CVCS that is not designed to withstand RCS design pressure. Although the CVCS isolation valves provide isolation of the CVCS from the RCS, there are additional barriers separating the RCS from the low pressure portion of the CVCS. The CVCS makeup pumps are positive displacement type with integral check valves; in addition a check valve is provided between the makeup pumps' discharge and the injection tee into the recirculation loop to minimize potential reactor coolant leak back to the low pressure portion of the CVCS makeup line. In the event of RCS leakage past the makeup pumps into the low pressure piping, a pressure indicating transmitter at the suction of the makeup pump provides a high pressure alarm in the main control room.

FSAR Figure 9.3.4-1 has been revised to include the pressure indicating transmitters on the suction of each of the CVCS makeup pumps. The figure has also been revised to show the check valve that is provided between the makeup pumps' discharge and the injection tee into the recirculation loop.

### **Impact on DCA:**

FSAR Section 9.3.4.3 and Figure 9.3.4-1 have been revised as described in the response



above and as shown in the markup provided in this response.

RCS piping. Shielding for the CVCS ion exchanger vessels and reactor coolant filters is provided by concrete cubicles. Primary coolant piping in CVCS equipment rooms is shielded to minimize surveillance and maintenance dose rates. The CVCS has several features to reduce radiation exposure to ALARA levels.

- Steel alloys with low cobalt content are specified for materials of construction for components containing reactor coolant to minimize the generation of Cobalt-60.
- CVCS equipment drains and pressure relief valves are routed to the RWDS.
- Area radiation monitors are provided for rooms containing CVCS equipment which are radiological sources (NRHX, RHX, recirculation pumps, ion exchangers, filters and resin traps).
- Sluicing of ion exchanger resin is done remotely (outside of the cubicles), to remove resins and flush the vessels.
- Control panels and valve stations for CVCS equipment are provided with permanent shielding to limit worker exposure and meet site ALARA goals.
- Manual valves on pipes filled with reactor coolant have valve operators extending outside of shielded barriers to minimize dose for manual actions.
- Components that are not radiological sources (hydrogen bottles, makeup pumps, and chemical addition tanks) which require periodic access are separated from radiological sources.

The CVCS is designed to maintain occupational radiation exposure to ALARA levels as discussed in Section 12.1 and Section 12.3.

The BAS does not normally contain radioactive material and check valves are provided to minimize the potential for cross contamination from connected systems. BAS discharge paths are to systems that are compatible with receiving contaminated water. The BAS is supplied by the DWS via a direct connection to the BAS batch tank and an indirect connection to the BAS storage tank that can be used to supply demineralized water for recirculation and flushing through any of the tanks and piping, and then discharged to the LWRS.

With respect to 10 CFR 50.34(f)(2)(xxvi) (Item III.D.1.1 in NUREG-0737), the CVCS is designed to be as leak free as practical. The system is in continuous use during normal operation and is provided with leakage detection instrumentation. During accident conditions, the CVCS is isolated from the RCS by the CIVs and is not needed to circulate primary coolant outside of containment. In addition, there are no safety systems that circulate reactor coolant outside of containment. However, in order to support post-accident sampling by the PSS as described in Section 9.3.2, the CVCS is capable of being unisolated from the RCS, when conditions permit, to establish the sample flow path from the CVCS discharge piping upstream of the RHX.

RAI 19-36, RAI 19-36S1

Consistent with SECY-93-087, Item I.F, the design of the CVCS reduces the possibility of a LOCA outside containment. As shown in FSAR Figure 6.2-4, the CVCS is the only system with connections to the RCS and piping that runs outside containment. Therefore, the CVCS is the total scope for intersystem LOCA consideration in the

NuScale design. The CVCS containment isolation valves meet the SECY-93-087 recommendations for pressure isolation valves; position indication is provided to the control room and they have the capability for leak testing and are periodically leak tested as part of the Inservice Testing Program (FSAR Section 3.9.6). ~~The~~ Although intersystem LOCAs are prevented by the CVCS containment isolation valves, the CVCS is designed to withstand full RCS design pressure to the extent practicable. The CVCS recirculation loop, including the purification bypass line, are designed to withstand RCS design pressure. The CVCS letdown line and CVCS reactor vessel high point degasification line connections to the liquid radwaste system are designed to withstand full RCS design pressure up to the degasifier tank where design pressure is reduced and overpressure protection is provided. The process sampling system lines connected to the CVCS are designed to withstand full RCS design pressure. The makeup line and components upstream of the CVCS makeup pumps are the only portion of the CVCS that is not designed to withstand RCS design pressure. However, the CVCS makeup pumps are positive displacement type with integral check valves; in addition, a check valve is provided between the makeup pumps' discharge and the injection tee into the recirculation loop to minimize potential reactor coolant leak back to the low pressure portion of the CVCS makeup line. The CVCS design incorporates pressure and level alarms that provide the control room with indication of adverse conditions. For example, in the event of reactor coolant leakage past the makeup pumps, the pressure indicating transmitter at the suction of the makeup pump provides a high pressure alarm in the MCR.

#### 9.3.4.4 Inspection and Testing

The in-service inspection (ISI) requirements of the American Society of Mechanical Engineers Boiler Pressure Vessel Code, 2013 Edition, Section XI, Reference 9.3.4-2, are applicable to the CVCS Quality Group C (per RG 1.26) equipment. This includes the Quality Group C equipment just outside of containment and the demineralized water supply isolation valves. Section 5.2 and Section 6.6 provide the requirements applicable to the CVCS regarding in-service nondestructive examination requirements for system components. The MHS and BAS are nonsafety-related, and have no safety functional requirements, and therefore have no in-service inspection requirements.

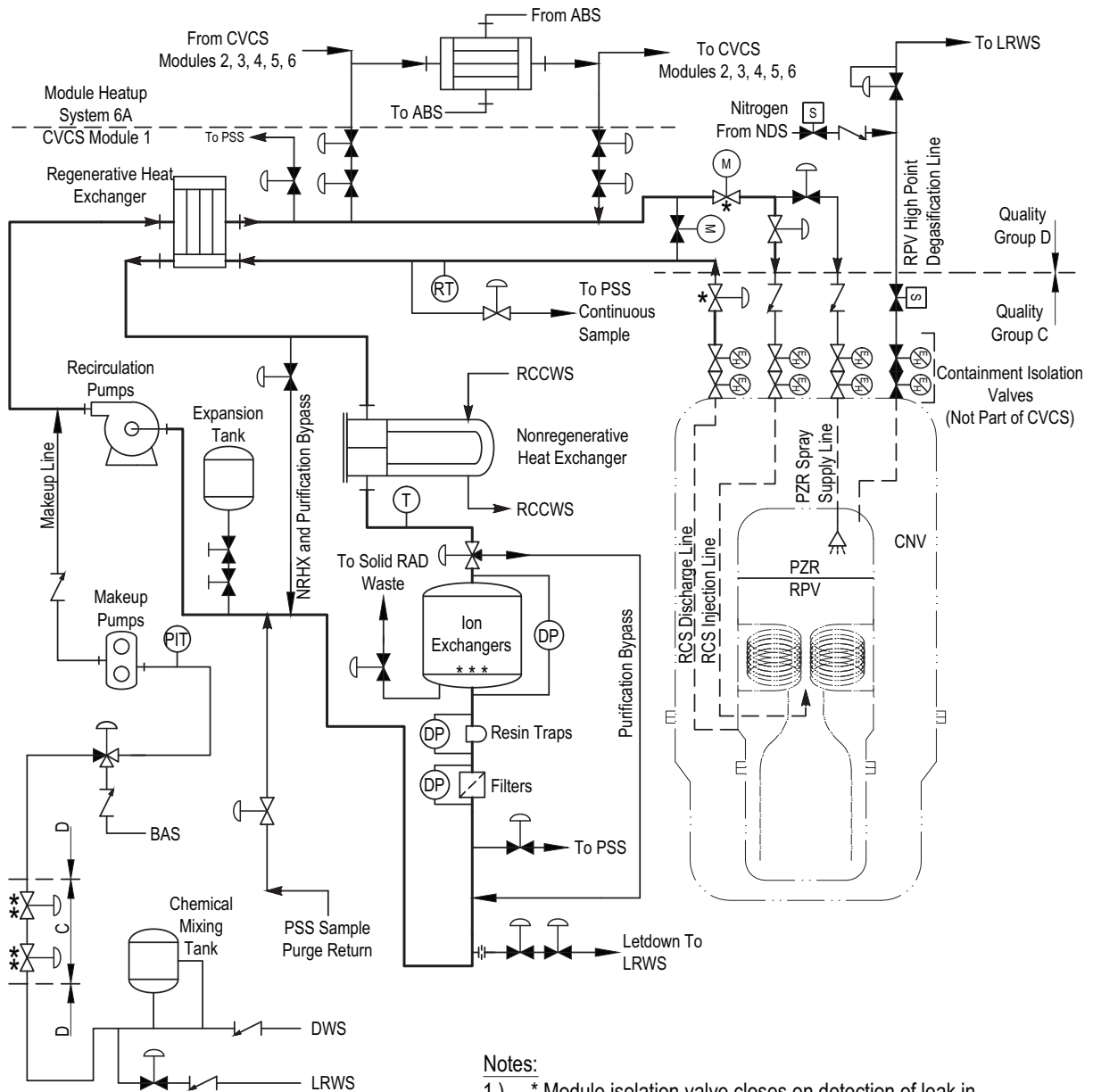
10 CFR 50.55a requires in-service testing (IST) for American Society of Mechanical Engineers Boiler and Pressure Vessel Code Section III, Class 1, 2 and 3 pumps and valves; therefore the CVCS American Society of Mechanical Engineers Section III, Class 1 and Class 3 components are subject to these requirements. 10 CFR 50.55a specifies the American Society of Mechanical Engineers Operation and Maintenance Code as the testing standard. See Section 3.9.6 for the inservice testing program plan.

The methodology associated with the development of Inspections, Tests, Analyses, and Acceptance Criteria is presented in Section 14.3.

RAI 09.03.02-3, RAI 09.03.02-4, RAI 09.03.02-5, RAI 09.03.02-6, RAI 09.03.02-8, RAI 9.3.4-4, RAI 19-36S1

**Figure 9.3.4-1: Chemical and Volume Control System Diagram**

(Chemical and Volume Control System Module 1 with Module Heatup System Subsystem 6A Shown)



**Notes:**

- 1.) \* Module isolation valve closes on detection of leak in CVCS/Process Sampling System (mass flow imbalance).
- 2.) \*\* Demineralized water isolation valve.
- 3.) Simplified diagram - not all equipment shown.
- 4.) \*\*\* Quantity four ion exchangers as follows: 2 mixed bed, 1 auxiliary, 1 cation