RAIO-0218-58569

February 12, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 304 (eRAI No. 9189) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 304 (eRAI No. 9189)," dated December 19, 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. 9189:

- 09.03.04-5
- 09.03.04-6
- 09.03.04-7

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
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9189

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9189

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

eRAI No.: 9189
Date of RAI Issue: 12/19/2017

NRC Question No.: 09.03.04-5

In accordance with GDC 1, quality standards and records, Structures, systems, and components important to safety shall be designed, fabricated, erected, and tested to quality standards commensurate with the importance of the safety functions to be performed.

In FSAR Tier 2, Table 3.2-1, "Classification of Structures, Systems, and Components," the applicant designates "piping from (CES, CFDS, CVCS, FWS, MSS, and RCCWS) CIVs to disconnect flange (outside containment)" as Quality Group D. Furthermore, in this table, the applicant designates the CVCS Discharge Spoolpiece Drain Valve, Discharge Spoolpiece Isolation Valve, Injection Check Valve, Injection Spoolpiece Drain Valve, Pressurizer Spoolpiece Drain Valve, Reactor Module Removable Spoolpieces, RPV High Point Degasification Isolation Valve, RPV High Point Degasification Spoolpiece Drain Valve, and Spray Check Valve, as Quality Group C. Also, FSAR Tier 2, Figure 9.3.4-1, "Chemical and Volume Control System Diagram," shows the piping between the CIVs and the respective CVCS isolation valves (i.e. injection check valve, discharge isolation valve, pressurizer spray check valve, and the high point degasification isolation valve) is Quality Group C, which is inconsistent with FSAR Tier 2, Table 3.2-1. Lastly, FSAR Tier 1, Table 2.2-1, “Chemical and Volume Control System Piping,” identifies this piping as ASME Code Section III Class 3 piping, which is inconsistent with FSAR Tier 2, Table 3.2-1’s quality classification of Quality Group D because Regulatory Guide 1.26 indicates that ASME Code Section III Class 3 piping is Quality Group C.

From the information provided in the FSAR, the staff is unable to determine the appropriate Quality classification of this piping between the CIVs and the removable spoolpieces. The staff asks the applicant to clarify what this piping's Quality classification is and if this piping is Quality Group D, the staff asks the applicant to justify why its Quality Group D when the removable spoolpieces, their respective drain valves, and the associated isolation valves are Quality Group C, and update FSAR Tier 1, Table 2.2-1 and FSAR Tier 2, Figure 9.3.4-1 to be consistent with FSAR Tier 2, Table 3.2-1. If this piping's Quality classification is actually Quality Group C, the staff asks the applicant to update Table 3.2-1 appropriately.

NuScale Response:

The chemical and volume control system piping and components between the containment isolation valves and the removable spoolpieces are Quality Group C (ASME Code Class 3) components. The Containment System (CNTS) equipment in FSAR Table 3.2-1 has been corrected to identify that the CVCS piping from the containment isolation valves to the disconnect flange (outside containment) are Quality Group C.

Impact on DCA:

FSAR Table 3.2-1 has been revised as described in the response above and as shown in the markup provided in this response.

RAI 03.02.01-2, RAI 03.02.01-3, RAI 03.02.02-2, RAI 03.02.02-6, RAI 06.02.04-2, RAI 09.02.02-1, RAI 09.02.04-1, RAI 09.02.05-1, RAI 09.02.06-1, RAI 09.02.07-4, RAI 09.02.07-5, RAI 09.02.09-2, RAI 09.03.04-5, RAI 09.04.02-1, RAI 10.04.07-2, RAI 11.02-1, RAI 19-14

Table 3.2-1: Classification of Structures, Systems, and Components

SSC (Note 1)	Location	SSC Classification (A1, A2, B1, B2)	RTNSS Category (A,B,C,D,E)	QA Program Applicability (Note 2)	Augmented Design Requirements (Note 3)	Quality Group / Safety Classification (Ref RG 1.26 or RG 1.143) (Note 4)	Seismic Classification (Ref. ~~RG 1.189 or~~ RG 1.29 or RG 1.143) (Note 5)
CNTS, Containment System							
All components (except as listed below)	RXB	A1	N/A	Q	None	A	I
• RXM Lifting Lugs • Top Auxiliary Mechanical Access Structure • Top Auxiliary Mechanical Access Structure Diagonal Lifting Braces	RXB	B1	None	AQ-S	• ANSI/ANS 57.1-1992 • ASME NOG-1 • NUREG-0554	N/A	I
CFDS Piping in containment	RXB	B2	None	AQ-S	None	B	II
Piping from (CES, CFDS, ~~CVCS,~~ FWS, MSS, and RCCWS) CIVs to disconnect flange (outside containment)	RXB	B2	None	AQ-S	None	D	I
CVCS Piping from CIVs to disconnect flange (outside containment)	RXB	B2	None	AQ-S	None	C	I
~~Hydraulic Skid for valve reset~~	~~RXB~~	~~B2~~	~~None~~	~~None~~	~~None~~	~~D~~	~~III~~
CIV Close and Open Position Sensors: • CES, Inboard and Outboard • CFDS, Inboard and Outboard • CVCS, Inboard and Outboard PZR Spray Line • CVCS, Inboard and Outboard RCS Discharge • CVCS, Inboard and Outboard RCS Injection • CVCS, Inboard and Outboard RPV High-Point Degasification • FWS, Supply to SGs and DHR HXs FWIV • RCCWS, Inboard and Outboard Return and Supply • SGS, Steam Supply CIV/MSIVs and CIV/MSIV Bypasses	RXB	B2	None	AQ-S	IEEE 497-2002 with CORR 1	N/A	I
Containment Pressure Transducer (Wide Range)	RXB	B2	None	AQ-S	IEEE 497-2002 with CORR 1	N/A	~~II~~I
• Containment Air Temperature (RTDs) • FW Temperature Transducers	RXB	B2	None	AQ-S	None	N/A	II
SGS, Steam Generator System							
• SG tubes • Feedwater plenums • Steam plenums • ~~SG tube supports~~	RXB	A1	N/A	Q	None	A	I
• SG tube supports	RXB	A1	N/A	Q	None	N/A	I
• Steam piping inside containment • Feedwater piping inside containment • Feedwater supply nozzles • Main steam supply nozzles • Thermal relief valves	RXB	A2	N/A	Q	None	B	I
Flow restrictors	RXB	A2	N/A	Q	None	N/A	I
RXC, Reactor Core System							
Fuel assembly (RXF)	RXB	A1	N/A	Q	None	N/A	I
Fuel Assembly Guide Tube	RXB	A2	N/A	Q	None	N/A	I
Incore Instrument Tube	RXB	B2	None	AQ-S	None	N/A	I
CRDS, Control Rod Drive System							
• Control Rod Drive Shafts • Control Rod Drive Latch Mechanism	RXB	A1	N/A	Q	None	N/A	I
CRDM Pressure Boundary (Latch Housing, Rod Travel Housing, Rod Travel Housing Plug)	RXB	A2	N/A	Q	None	A	I
CRDS Cooling Water Piping and Pressure Relief Valve	RXB	B2	None	AQ-S	None	B	II
Rod Position Indication (RPI) Coils	RXB	B2	None	AQ-S	None	N/A	I
• Control Rod Drive Coils • CRDM power cables from EDN breaker to MPS breaker • CRDM power cables from MPS breaker to CRDM Cabinets	RXB	B2	None	AQ-S	None	N/A	II

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

eRAI No.: 9189
Date of RAI Issue: 12/19/2017

NRC Question No.: 09.03.04-6

In accordance with 10 CFR 52.47(b)(1), the DC application shall contain the proposed inspections, tests, analyses, and acceptance criteria that are necessary and sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a facility that incorporates the design certification has been constructed and will be operated in conformity with the design certification, the provisions of the Act, and the Commission's rules and regulations.

As part of the ASME Code Class 3 components in the CVCS, the applicant identified the RPV high point degasification isolation valve in FSAR Tier 1, Table 2.2-2, as an air operated valve. However, the staff noted that this valve is identified as a solenoid operated valve in FSAR Tier 2, Figure 9.3.4-1.

The staff asks the applicant to clarify if the RPV high point degasification isolation valve is an air operated valve or a solenoid operated valve. The staff also asks the applicant to update the FSAR as necessary to maintain consistency between Tier 1 and Tier 2 information.

NuScale Response:

FSAR Tier 1, Table 2.2-2 has been revised to indicate that the reactor pressure vessel high point degasification isolation valve is a solenoid operated valve.

Impact on DCA:

FSAR Tier 1, Table 2.2-2 has been revised as described in the response above and as shown in the markup provided in this response.

RAI 09.03.04-6

Table 2.2-2: Chemical and Volume Control System Mechanical Equipment

Equipment Name	Equipment Identifier	ASME Code Section III Class	Loss of Motive Power Position
Demineralized water system supply isolation valve	CVC-AOV-0101	3	Closed
Demineralized water system supply isolation valve	CVC-AOV-0119	3	Closed
RPV discharge isolation valve	CVC-AOV-0339	3	Closed
RPV high point degasification isolation valve	CVC-~~AOV~~SV-0406	3	Closed
Injection check valve	CVC-CKV-0352	3	N/A
Pressurizer spray check valve	CVC-CKV-0353	3	N/A

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

eRAI No.: 9189
Date of RAI Issue: 12/19/2017

NRC Question No.: 09.03.04-7

In accordance with 10 CFR 50 Appendix A GDC 14, “Reactor coolant pressure boundary,” the reactor coolant pressure boundary shall be designed, fabricated, erected, and tested so as to have an extremely low probability of abnormal leakage, of rapidly propagating failure, and of gross rupture.

To meet the requirements of GDC 14, as it relates to the RCPB having an extremely low probability of abnormal leakage, rapidly propagating failure, and gross rupture, the CVCS should be designed to maintain acceptable purity levels in the reactor coolant through the removal of insoluble corrosion products and dissolved ionic material by filtration and ion exchange. Furthermore, the CVCS should be designed to maintain proper RCS chemistry by controlling total dissolved solids, pH, oxygen concentration, and halide concentrations within the acceptable ranges. Lastly, the CVCS should be designed such that the probability of corrosion-induced failure of the RCPB will be minimized, thereby maintaining the integrity of the RCPB. As DSRS Section 9.3.4 specifies, the application should contain the necessary drawings, descriptions, schematics, and P&IDs so that the staff can review the CVCS in order to ascertain that the RCPB has an extremely low probability of abnormal leakage, rapidly propagating failure, and gross rupture.

Part 1.) In FSAR Tier 2, Figure 5.1-2, the applicant shows a single branch off of the CVCS RCS Injection line that goes to the ECCS Actuator Valves. In FSAR Tier 2, Figure 6.3-1, the applicant shows two branches from the RCS that go to the ECCS valves. The staff cannot determine how a single branch, from one drawing connects to two branches on a different drawing, and thus cannot ascertain whether or not the system has been designed to minimize abnormal leakage. The staff requests the applicant to update the FSAR with the appropriate connection between Figure 5.1-2 and Figure 6.3-1 so that the staff can logically verify the line's adequacy.

Part 2.) In FSAR Tier 2, Figure 6.3-1, the applicant shows the CVCS/ECCS reset lines going to both RRV trip valves, and shows the RRV reset valves discharging into containment. This display of the RRV reset/trip lines and valves is directly opposite of how it is displayed for the RVVs on the same figure. The staff cannot determine if the reset/trip lines and valves are configured correctly for the RRVs showed in Figure 6.3-1. The staff requests the applicant to update the FSAR with the appropriate reset/trip line and valve configuration in Figure 6.3-1.

Part 3.) In FSAR Tier 2, Figure 6.3-1, the staff notes that the ECCS line between the reset valve, trip valve, and associated ECCS valve is normally isolated from the CVCS during normal operation. The staff notes that the CVCS is used to reset the ECCS valve by providing pressurized CVCS water to this ECCS line. After this line becomes isolated from the CVCS, the CVCS no longer maintains chemistry of this water. The staff notes that contaminants could accumulate in this line due to stagnation and may affect ECCS valve operation. The staff cannot determine if this line, which contains stagnate CVCS water, maintains appropriate chemistry throughout the operation of the plant. The staff requests the applicant to provide the chemistry requirements of these lines and valves (i.e. reset line/valve, trip line/valve, and ECCS line/valve) and justify how the CVCS meets those requirements when the CVCS water has stagnated within those lines and valves. The staff requests the applicant to update FSAR Tier 2, Section 9.3.4 with this explanation justifying how the CVCS adequately maintains the water chemistry used to reset the ECCS valves over the operation of the plant.

NuScale Response:

Response to Part 1

There are two branches from the chemical volume control system (CVCS) reactor coolant system (RCS) injection line to the emergency core cooling system (ECCS). FSAR Tier 2, Figure 5.1-2 has been updated to show both branches.

Response to Part 2

FSAR Tier 2, Figure 6.3-1 was in error and has been updated to indicate the correct relative locations of the trip valves and reset valves.

Response to Part 3

NuScale has reviewed EPRI reports “Materials Reliability Program: Investigation of Likely Local Primary Circuit Chemistries in PWR Plants (MRP-387)” and “Pressurized Water Reactor Primary Water Chemistry Guidelines, Appendix H, Maintaining and Monitoring the Chemistry Environment in Stagnant Attached RCS Lines and Components.” In addition, NuScale has reviewed “NRC Information Notice 2011-04: Contaminants and Stagnant Conditions Affecting Stress Corrosion Cracking in Stainless Steel Piping in Pressurized Water Reactors.”

These documents describe a collection of known instances of SCC in stagnant stainless steel lines or components of operating PWRs. These failures have largely been attributed to deleterious water chemistry conditions in the stagnant lines. A few failures in IN 2011-04 are attributed to externally initiated SCC from chloride attack in condensate, which is not applicable to the ECCS lines due to the external vacuum operating environment. Stress corrosion cracking of the stainless steel lines is attributed to the presence of dissolved oxygen and dissolved anions (i.e. chloride, fluoride, or sulfate impurities). When oxygen is maintained less than 100 ppb and anion impurities less than 150 ppb each, in accordance with the PWR Primary Water Chemistry Guidelines, the risk of SCC of stainless steels is low. As discussed in the two EPRI documents (MRP-387 and Appendix H of the Guidelines), high oxygen concentrations can be attributed to high initial oxygen concentrations or trapped pockets of air. Chlorides (the most prominent deleterious anion in PWR chemistry) are typically attributed to leaching from chloride containing materials, such as valve packing or adhesives.

The recommendations of Appendix H of the Guidelines focus on establishing low oxygen and low anion chemistry in the stagnant lines. The primary mechanisms for controlling chemistry are startup procedures and flushing or recirculation of lines.

Startup and chemistry control of a NuScale power module (NPM) are the responsibility of a COL applicant, however, the NPM, ECCS, and chemical volume control system (CVCS) designs described in the FSAR provide the necessary capabilities for chemistry control of the RCS and the ECCS stagnant lines. The NuScale RCS has no local high points for trapping pockets of air and the NPM is equipped with permanently installed vacuum pumps in the containment evacuation system. NPM startup procedures include an initial vacuum degasification phase to remove air in the NPM and to reduce the dissolved oxygen of the RCS water, as described in FSAR Tier 2, Section 9.3.6.2.3. The ECCS valve hydraulic lines are filled with water from the RCS CVCS injection line before hydrazine addition. This water is expected to have dissolved oxygen above 150 ppb. However, the reset valves can be subsequently opened during startup or normal operation to flush the ECCS hydraulic system with filtered and purified CVCS injection flow. The ECCS system remains operable when the reset valve is open because the hydraulic line to the reset valve is much smaller than the trip valve line, preserving the valve safety function despite additional flow from the reset line. This ECCS flushing operation has negligible effect on the operation of the module, and can be performed anytime CVCS injection is occurring (which is continuous during normal operation). Therefore, at any point during normal operation or startup, the ECCS hydraulic lines can be flushed by opening the ECCS reset valves (as shown in FSAR Tier 2, Figure 6.3-1).

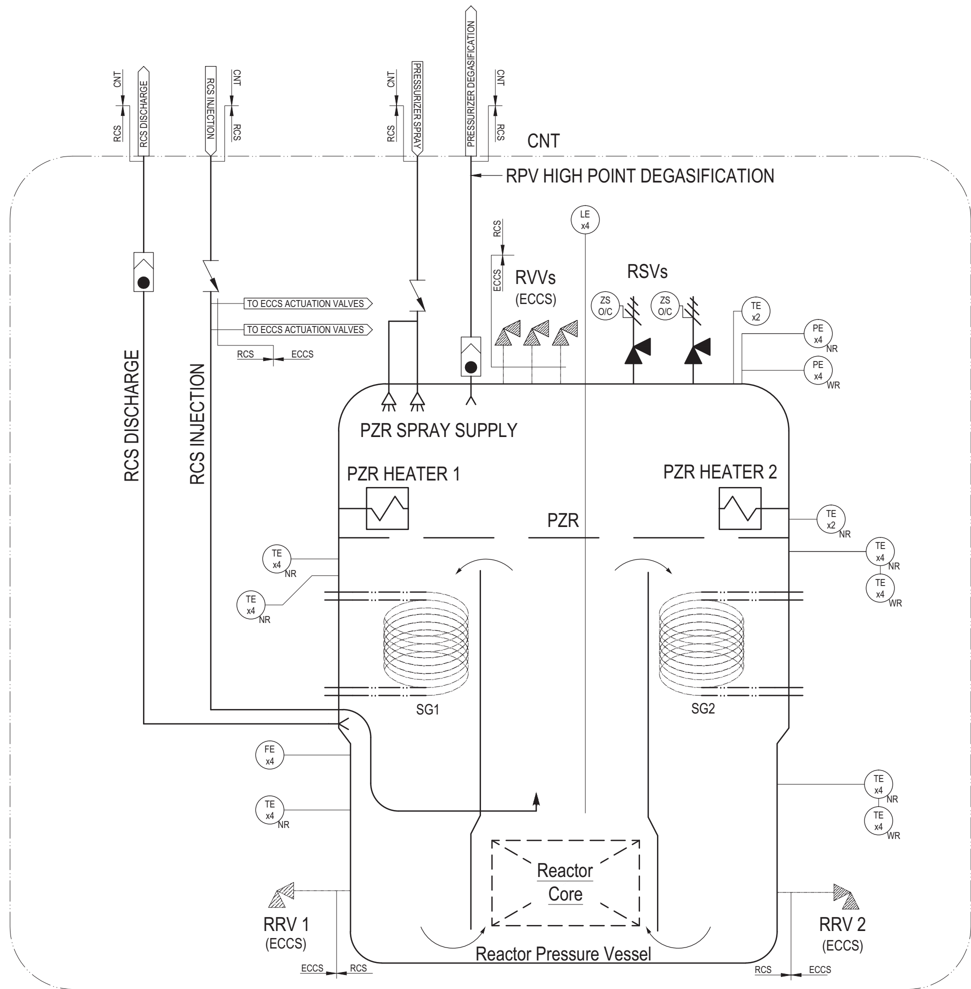
Once the ECCS hydraulic system is flushed with low oxygen and low anion impurity water, there is no source for anion impurities (the valves do not have packing, or other materials with the potential for leaching anionic impurities). The frequency of flushing the ECCS hydraulic lines is the responsibility of the COL application for a NuScale plant (COL Items 13.5-1 and 13.5-4). Note that COL Item 13.5-4 did not exist in DCA Revision 0, but has since been added to FSAR Section 13.5 as part of the response to eRAI 8827.

Impact on DCA:

FSAR Figures 5.1-2 and 6.3-1 have been revised as described in the response above and as shown in the markup provided in this response.

RAI 09.03.04-7

Figure 5.1-2: Reactor Coolant System Simplified Diagram



RAI 09.03.04-7

Figure 6.3-1: Emergency Core Cooling System