

September 25, 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. 186 (eRAI No. 9009) on the NuScale Design Certification Application

**REFERENCE:** U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 186 (eRAI No. 9009)," dated August 18, 2017

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

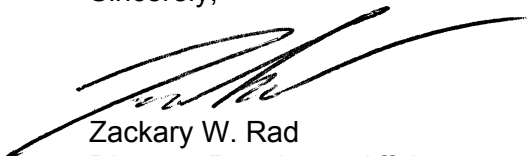
The Enclosure to this letter contains NuScale's response to the following RAI Questions from NRC eRAI No. 9009:

- 06.02.02-3
- 06.02.02-4
- 06.02.02-5
- 06.02.02-6
- 06.02.02-7

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 Marty Bryan at 541-452-7172 or at [mbryan@nuscalepower.com](mailto:mbryan@nuscalepower.com).

Sincerely,



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



RAIO-0917-56144

Distribution: Gregory Cranston, NRC, OWFN-8G9A  
Omid Tabatabai, NRC, OWFN-8G9A  
Samuel Lee, NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9009

**Enclosure 1:**

NuScale Response to NRC Request for Additional Information eRAI No. 9009

---

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

**eRAI No.:** 9009

**Date of RAI Issue:** 08/18/2017

---

**NRC Question No.:** 06.02.02-3

10 CFR 50.46(b)(5) regarding long-term cooling and the effects of LOCA-generated debris, latent debris, and chemical products on component performance.

DSRS Section 6.2.2 is staff guidance for an acceptable method of meeting the regulations in 10 CFR 50.46(b)(5) and it lists acceptance criteria for the capability of components credited for long-term cooling as follows: Evaluate the effects of LOCA-generated debris, latent debris, chemical products, and associated effects on component performance. Potential effects include blockage at narrow flow passages (e.g., tight clearance valves), and wear and abrasion of components.

NuScale FSAR Tier 2, Section 6.2.2.2, "System Design," states that Tier 2, Section 6.3.2.5 describes conformance with RG 1.82 and the approach used to address Generic Safety Issue 191 (GSI-191), "Assessment of Debris Accumulation on Pressurized Water Reactor Sump Performance." The NuScale FSAR states that blockage is not a concern for valves but does not provide a basis for the potential effects of LOCA-generated debris, latent debris, chemical products, and associated effects on component performance due to blockage, wear and abrasion.

To support a finding under 10 CFR 50.46(b)(5), the staff is requesting NuScale to address the following question regarding effects of LOCA-generated debris, latent debris, chemical products, and associated effects on component performance due to blockage, wear and abrasion. Revise the DCD as applicable.

Identify the type, quantity, and maximum size of LOCA-generated debris, latent debris, and chemical products.

---

**NuScale Response:**

Component performance is not degraded as a result of blockage, wear or abrasion due to LOCA-generated debris, latent debris or chemical products.

No LOCA debris is generated in the NuScale plant containment vessel. By design, all

---



components within the containment are qualified to LOCA conditions so as not to generate debris.

Latent debris in the NuScale containment consists of fibers and particulates that remain in containment after maintenance or testing. This debris is minimized by controls in following the foreign material exclusion program. All materials are controlled going into and out of the containment during an outage. As the containment is closed up, cleanup of the area will remove any large latent debris in the form of tools, plastics, scraps of paper or cloth, and any other items not designated to remain in containment. Cleanup of the area will include removal of surface dirt and dust that may have accumulated during the time containment was open.

Chemical products in the NuScale containment are minimal. The NuScale design permits no coatings to be used within the containment, including components installed in containment. Some chemicals may be generated in the LOCA and post LOCA environments. However, since there are no coatings or additional chemicals added to the post ECCS actuation containment water environment, leaching of component materials present in containment would be the only source. Chemicals and precipitants that may form are typically soft, non-abrasive, low-shear and readily stay in solution due to the flow conditions present within the system and can be treated like a particulate. Therefore the chemical mass is included in the total particulate mass.

Latent particulates have a diameter of 10 microns, density of 100 lbm/ft<sup>3</sup>, with a limit of 30 lbm combined [particulate (2.7 lbm) and chemical (27.3 lbm)]. Latent fibrous debris is characterized as 7 micron fiber diameter, density of 62.4 lbm/ft<sup>3</sup>, with a limit of 0.61 lbm.

**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.:** 9009

**Date of RAI Issue:** 08/18/2017

---

**NRC Question No.:** 06.02.02-4

10 CFR 50.46(b)(5) regarding long-term cooling and the effects of LOCA-generated debris, latent debris, and chemical products on component performance.

To support a finding under 10 CFR 50.46(b)(5), the staff is requesting NuScale to address the following question regarding effects of LOCA-generated debris, latent debris, chemical products, and associated effects on component performance due to blockage, wear and abrasion: Revise the DCD as applicable.

Blockage due to debris is a concern for tight-clearance valves. The applicant does not address potential blockage due to valves that are not in the fully open position. Address the potential of blockage or reduced flow due to the effects of LOCA-generated debris, latent debris, and chemical products on tight-clearance valves (such as RVVs, RRVs and any throttle valves or check valves in the flowpath during long-term cooling) that may not be in the fully open position during post-LOCA operation.

---

**NuScale Response:**

The ECCS valves are pilot operated globe valves that are not designed to be throttled. Fluid passages in the valves are large compared to the debris size (10 micron diameter) and will provide ample room for the latent debris to pass through without clogging. Chemicals that may be generated in the RCS water during an event will remain in solution and will not block valve passages. The ECCS valves are open/closed valves that do not have any throttling requirements during their operation and therefore will not be in a partially open position. There are no other valves in the recirculation pathway. Given the open/closed operation of the valves and the relatively small debris size in the NuScale design, the only potential for wear or abrasion during operation would be to the seating surfaces of valves, which would not affect their ability to remain open .

**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.:** 9009

**Date of RAI Issue:** 08/18/2017

---

**NRC Question No.:** 06.02.02-5

10 CFR 50.46(b)(5) regarding long-term cooling and the effects of LOCA-generated debris, latent debris, and chemical products on component performance.

To support a finding under 10 CFR 50.46(b)(5), the staff is requesting NuScale to address the following question regarding effects of LOCA-generated debris, latent debris, chemical products, and associated effects on component performance due to blockage, wear and abrasion. Revise the DCD as applicable.

Debris settling in low flow areas is a concern during post-LOCA operation. The applicant does not address the effect of debris settling during post-LOCA operation on component performance. Provide additional information to address settling of LOCA-generated debris, latent debris, and chemical products in low flow areas and its effect on system/component operation. For example, the applicant is requested to address the quantity and type of material that will settle, locations where it will settle, and its impact on the performance of components in the applicable systems.

---

**NuScale Response:**

Latent debris is the only source of debris in the NuScale plant. Latent debris in the system is characterized as debris with a diameter of 10 microns, density of 100 lbm/ft<sup>3</sup>, and a limit of 30 lbm combined [particulate (2.7 lbm) and chemical (27.3 lbm)]. Latent Fibrous debris is characterized as 7 micron fiber diameter, density of 62.4 lbm/ft<sup>3</sup>, with a limit of 0.61 lbm. These properties are consistent with the recommended value for latent debris as described in NEI 04-07 R0.

The ECCS does not have any piping. ECCS valves are attached directly to the vessel and discharge from the valve bodies into the containment and reactor spaces. There is no open instrument tubing which would be capable of plugging and impacting ECCS performance.

Debris velocity within containment has been calculated to be 0.0020 ft/s, which is capable of maintaining particulate debris with a diameter of 22 microns in solution and moving in the

---



system. Debris velocity within the reactor vessel has been calculated to be 0.0061 ft/s, which is capable of maintaining particulate debris with a diameter of 38.6 microns in solution and moving in the system. Therefore, the 10 micron debris in the NuScale containment and reactor vessel will be maintained in solution. Settling of debris in low flow areas such as the lower containment or reactor vessel region would have a negligible impact on overall ECCS performance given the small potential debris load.

**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.:** 9009

**Date of RAI Issue:** 08/18/2017

---

**NRC Question No.:** 06.02.02-6

10 CFR 50.46(b)(5) regarding long-term cooling and the effects of LOCA-generated debris, latent debris, and chemical products on component performance.

To support a finding under 10 CFR 50.46(b)(5), the staff is requesting NuScale to address the following question regarding effects of LOCA-generated debris, latent debris, chemical products, and associated effects on component performance due to blockage, wear and abrasion. Revise the DCD as applicable.

Potential blockage of small diameter tubing/piping is a concern during post-LOCA operation. The applicant does not address the potential blockage of small diameter tubing/piping during post-LOCA operation. Identify all small diameter tubing/piping such as instrument lines, sensing lines, inadvertent actuation block (IAB) pressure sensing lines in the ECCS system and long-term cooling flowpath and evaluate the effects of LOCA-generated debris, latent debris, and chemical products for potential blockage that could affect component function.

---

**NuScale Response:**

There is no small diameter tubing subject to blockage in the path of the ECCS during post-LOCA recirculation operation. No instrument tubing is utilized in the CNV to monitor conditions in the CNV and RPV. During recirculation, the IAB pressure sensing passage is a dead end with a vertical orientation, preventing LOCA-generated debris, latent debris, and chemical products from accumulating in the IAB. Therefore, there is no potential for blockages that could affect component function during post-LOCA operation.

The ECCS long term cooling flow path does not rely on small bore lines or instrument tubing. Once the ECCS valves have been opened, no sensing lines are needed to maintain the flow path open. All the instrument and sensing lines are designed to survive accident conditions; therefore no debris is generated due to damage to these lines in a LOCA

---



**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.:** 9009

**Date of RAI Issue:** 08/18/2017

---

**NRC Question No.:** 06.02.02-7

10 CFR 50.46(b)(5) regarding long-term cooling and the effects of LOCA-generated debris, latent debris, and chemical products on component performance.

To support a finding under 10 CFR 50.46(b)(5), the staff is requesting NuScale to address the following question regarding effects of LOCA-generated debris, latent debris, chemical products, and associated effects on component performance due to blockage, wear and abrasion. Revise the DCD as applicable.

Wear and abrasion of components and piping is potential concern during post-LOCA operation. The applicant does not address the potential effects of wear and abrasion of components during post-LOCA operation. Address the potential effects of wear and abrasion of components due to LOCA-generated debris, latent debris, and chemical products during post-LOCA operation.

---

**NuScale Response:**

The RRVs and RVVs are the only components of the ECCS. The valves are attached to the reactor vessel, and no piping is included. During normal plant operation, there is no flow through the RRVs or RVVs, and no wear occurs. These valves open in response to LOCA events, and are not required to close or throttle.

Due to the minimal amount of debris, minimal to no wear or abrasion of components is expected. Latent particulates (10 microns diameter, density of 100 lbm/ft<sup>3</sup>) are limited to 30 lbm [combined particulate (2.7 lbm) and chemical (27.3 lbm)]. Latent fibrous debris (7 micron fiber diameter, density of 62.4 lbm/ft<sup>3</sup>) is limited to 0.061 lbm. Any valve wear or abrasion that might occur from the passage of latent debris in the water entering or exiting the RPV would not impact the ability of valves to perform their safety function.

**Impact on DCA:**

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

---