RAIO-0218-58634

February 12, 2018

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. 299 (eRAI No. 9247) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 299 (eRAI No. 9247)," dated December 15, 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. 9247:

- 09.01.03-3
- 09.01.03-4
- 09.01.03-5
- 09.01.03-6

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

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9247

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9247

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

eRAI No.: 9247
Date of RAI Issue: 12/15/2017

NRC Question No.: 09.01.03-3

Regulatory basis: Title 10 of the Code of Federal Regulations (CFR) Part 50, Appendix A, General Design Criterion (GDC) 4 requires structures, systems, and components (SSCs) to be designed and fabricated to accommodate the effects of environmental conditions during normal, off normal, and accident conditions. In the NuScale Design Control Document (DCD) the spent fuel assemblies, spent fuel racks, and the NuScale containment modules sit within the Ultimate Heat Sink (UHS). These important to safety and safety-related components are designed for the normal, off normal, and accident environments by: (1) selecting materials that are resistant to degradation as practicable and (2) maintaining water chemistry. The staff seeks further information on the water chemistry controls to ensure that important to safety and safety-related components will perform their safety functions.

In DCD Tier 2, Final Safety Analysis Report (FSAR) Table 9.1.3-1c, "Equipment Parameters for the Pool Cleanup System," the applicant described the capacity of the Pool Cleanup System (PCUS).

Table 9.1.3-1c describes parallel trains of the PCUS and a flow capacity values for components in the system. For instance, "PCUS Resin Traps A, B, and C" have a flow capacity of 1450 gpm. In DCD Tier 2, FSAR Section 9.1.3.2.3, "Pool Cleanup System," the applicant states that normal operation of the PCUS utilizes one train of the demineralizer and resin trap. The staff is unclear if the 1450 gpm flow capacity applies to one train of the PCUS or is the entire capacity of the PCUS. Provide the staff with information on the capacity of a single train of the PCUS.

NuScale Response:

Each demineralizer (3 total) has a flow capacity of 1450 gpm per train. Under normal circumstances, a clean-up train consists of a coolant pump supplying 1250 gpm to a demineralizer. Use of up to three demineralizers simultaneously will allow for a higher system flow through the demineralizers.

Impact on DCA:

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

Response to Request for Additional Information
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eRAI No.: 9247
Date of RAI Issue: 12/15/2017

NRC Question No.: 09.01.03-4

Regulatory basis: 10 CFR Part 50, Appendix A, GDC 4 requires SSCs to be designed and fabricated to accommodate the effects of environmental conditions during normal, off normal, and accident conditions. As stated in the NuScale DCD, the spent fuel assemblies, spent fuel racks, and the NuScale containment modules sit within the UHS. The staff seeks further information on the water chemistry controls to ensure that important to safety and safety-related components within the UHS will perform their safety functions.

In DCD Tier 2, FSAR Table 9.1.3-1c, "Equipment Parameters for the Pool Cleanup System," the applicant described the capacity of the PCUS.

Table 9.1.3-1c describes parallel trains of the PCUS and a flow capacity values for components in the system. In DCD Tier 2, FSAR Section 9.1.3.2.3, "Pool Cleanup System," the applicant states that normal operation of the PCUS is "capable of cleanup of the combined volume of the UHS every two months."

The staff seeks additional information on the cleanup of the UHS.

1) The applicant states that the PCUS is "capable of cleanup of the combined volume of the UHS every two months." Provide the staff with the meaning of the phrase "capable of cleanup." In the context of what the phase is intended to mean, please explain:

    a. The number of PCUS trains in operation necessary to achieve UHS cleanup in two months.
    b. The assumed cleaning efficiency of a single train of the PCUS.
    c. The effective flow capacity of cleaned water into the UHS used to calculate the two month cleanup time.
    d. An estimate of the number of gallons of water filtered during the two month cleanup.

    Update the DCD Tier 2 information as necessary to describe the PCUS cleanup capability for normal operations.

2) The PCUS should be designed to maintain the UHS water chemistry in accordance with the water chemistry parameters described in DCD Tier 2 FSAR Table 9.1.3-2, "Water Chemistry Parameters Monitored for Ultimate Heat Sink Pools." The DCD Tier 2 FSAR does not describe how the design of the PCUS is sufficient to maintain water chemistry.

   Provide the staff with additional information on the PCUS. This should include:

   a. A technical basis that describes how normal operation of the PCUS over a two month period maintains water chemistry considering (i) constant introduction of contaminates into the UHS from the reactor building (dust, etc.) and (ii) sudden introduction of contaminates into the UHS.
   b. A discussion how sampling the UHS from a single location upstream of the demineralizer is an accurate representation of the bulk water chemistry of the UHS. The applicant should describe any additional UHS water chemistry samples taken from the bulk pool.
   c. A discussion of local water chemistry uncertainty considering that the water chemistry parameters apply to bulk water chemistry. The discussion should include mixing of the UHS will be achieved by procedures or natural flow and estimated stagnant water areas in the UHS.

   Update the DCD Tier 2 information as necessary to describe the PCUS cleanup capability for normal operations.

3) For a NuScale plant with twelve power modules the applicant states that refueling outages will be staged such that a refueling outage will occur every two months. Considering that the PCUS is "capable of cleanup of the combined volume of the UHS every two months" the staff is concerned that the UHS water chemistry may not be sufficiently clean due to an introduction of contamination into the UHS prior to a scheduled refueling outage.

   If contaminates were introduced into the UHS how would plant personnel determine if refueling operations should begin or if refueling should be halted? Does the PCUS have the ability to rapidly clean the UHS if necessary or would a licensee need to use the NuScale reactor module's Chemical and Volume Control Systems to treat the UHS water?

   Provide the staff with a discussion on how normal operation of the PCUS provides sufficient cleaning of the UHS to enable a two month refueling interval. Update the DCD Tier 2 information as necessary to describe the PCUS cleanup capability for normal operations.

NuScale Response:

The NuScale FSAR, Section 9.1.3, describes the requirements, purpose, and operation of the Spent Fuel Pool Cooling and Cleanup System (SFPCCS). The NuScale DSRS 9.1.3, Subsection II identifies the acceptance criteria for the design of the SFPCCS. GDC 4, "Environmental and Dynamic Effects Design Bases" is listed as one of the sources for the requirements which applies to the safety review of this system, however, the DSRS states, "This criterion does not apply to the cleanup system or the cooling water system, but the makeup system, its source, the building, and its ventilation and filtration system are extreme-wind-protected, and the ventilation and filtration system meets the guidelines of RG 1.52." Therefore, the DSRS does not include an acceptance criteria which addresses water chemistry controls and the timing of SFP cleanup. Although it is recognized in the FSAR Section 9.1.3.2.3, that the PCUS performs the nonsafety-related functions of 1) removing impurities to reduce radiation dose rates, and 2) removing impurities to maintain water chemistry and clarity in the UHS pools and dry dock, the PCUS does not perform a safety-related function associated with water chemistry controls in the SFP and the timing of SFP cleanup.

The cleanup basis for the system is to provide removal of 99.9 percent of the impurities in the water over the course of two months operation, which is calculated to require a cleanup flow rate of 594 gpm. The system is capable of providing continuous cleanup from one train of PCUS operating at 1250 gpm. This flowrate is more than two times the calculated minimum flowrate to remove the expected 99.9 percent of impurities. Since the system can be operated intermittently, this is stated as a capability rather than a required capacity. The single cleanup train flow of 1250 gpm through the PCUS will pump the equivalent volume of pool water (7.57 E6 gallon) in 4.2 days, providing a pool turnover of more than 14 times during the two month period. With two demineralizer trains available to provide continuous cleanup, this rate can be doubled should operations determine a need to do a rapid cleanup, providing more than four times the cleaning capacity needed to meet the 594 gpm calculated to remove 99.9 percent of the impurities in the UHS pool water over a two-month time period.

The pool is continuously mixed by the cooling system pumps. Introduction of contaminants from the air or adjacent pool environments will have minimal effects. The large size of the pool means that addition of any air or pool side contamination will mix into the water and be swept into the cooling and cleanup systems, allowing cleanup operations to minimize the effects of contamination buildup in the pool water. Heat from the modules will create convection currents near the modules, aiding mixture of the water in the reactor pool. Cooling water is added to each module bay to aid in cooling the pool near the heat source as well as aid in water mixing from the flow of the cooling water. Similarly, in the spent fuel pool, water mixing is enhanced by the cooling spent fuel creating convection currents, as well as cooling water added at one end of the pool and removed on an adjacent corner. Due to the location of cooling and cleanup water suctions and discharges, coupled with the convection currents from the heat sources, the pool is expected to be well mixed, with only minor stagnant areas.

System sampling occurs in multiple locations. Each cooling system (SFPCS and RPCS) has a conductivity instrument and a sample point. At least one coolant system pump in each system will be operated to ensure mixing of the pools, regardless of required system heat load removal. The sample locations in the coolant system can be used along with direct pool samples to determine an increase in contaminants that require cleanup. Each train of the PCUS has a sample point upstream of the demineralizers and downstream of the demineralizers. These sample points are used to corroborate the coolant system results as well as verify the effectiveness of the demineralizers. These points are also used to determine when a demineralizer resin bed needs to be replaced. Each PCUS demineralizer has an outlet conductivity instrument to monitor the processed water. A COL applicant will provide the sampling schedule to monitor system parameters to maintain the UHS pools within EPRI water chemistry guidelines. COL Item 5.2-4 states, "A COL applicant that references the NuScale Power Plant design certification will develop and implement a Strategic Water Chemistry Plan. The Strategic Water Chemistry Plan will provide the optimization strategy for maintaining primary coolant chemistry and provide the basis for requirements for sampling and analysis frequencies, and corrective actions for control of primary water chemistry consistent with the latest version of the Electric Power Research Institute Pressurized Water Reactor Primary Water Chemistry Guidelines."

In preparation for an outage, the pool water is sampled and verified to be within the chemistry limits before commencing refueling operations. During refueling operations, chemistry monitoring will continue, with the potential to increase pool cleanup rates to match changing conditions, as needed. In general, unless chemistry issues cause cloudiness of the water to the point operations cannot be properly observed, cleanup will be maintained and refueling operations continue. Refueling operations is the most likely contributor to possible degraded chemistry conditions; therefore completion of refueling operations will decrease the probability that contamination is introduced into the pool. Cleanup, as needed, will return and maintain the pool parameters to within guidance recommendations.

Impact on DCA:

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

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eRAI No.: 9247
Date of RAI Issue: 12/15/2017

NRC Question No.: 09.01.03-5

Regulatory basis: 10 CFR Part 50, Appendix A, GDC 4 requires SSCs to be designed and fabricated to accommodate the effects of environmental conditions during normal, off normal, and accident conditions. As stated in the NuScale DCD, the spent fuel assemblies, spent fuel racks, and the NuScale containment modules sit within the UHS. The staff seeks further information on the water chemistry controls to ensure that important to safety and safety-related components within the UHS will perform their safety functions.

In DCD Tier 2 FSAR Table 9.1.3-2, "Water Chemistry Parameters Monitored for Ultimate Heat Sink Pools," the applicant described the water chemistry parameters for the UHS.

In Table 9.1.3.2 the "expected value" parameters for Conductivity and pH are "trend for unexpected changes." This acceptance criteria insufficient – the only means to violate this criteria is to fail to maintain a monitoring program which is not the intent of water chemistry control parameters.

Update FSAR Table 9.1.3-2 to specify Conductivity and pH acceptance criteria values.

NuScale Response:

The NuScale FSAR Section 9.1.3 describes the requirements, purpose, and operation of the Spent Fuel Pool Cooling and Cleanup System(SFPCCS). The NuScale DSRS 9.1.3, Subsection II identifies the acceptance criteria for the design of the SFPCCS. GDC 4, "Environmental and Dynamic Effects Design Bases" is listed as one of the sources for the requirements which applies to the safety review of this system, however, the DSRS states, "This criterion does not apply to the cleanup system or the cooling water system, but the makeup system, its source, the building, and its ventilation and filtration system are extreme-wind-protected, and the ventilation and filtration system meets the guidelines of RG 1.52." Therefore, the DSRS does not include an acceptance criteria which addresses the monitoring, sampling, or establishment of acceptable limits of particulates in the SFP. Although it is recognized in the FSAR Section 9.1.3.2.3, that the PCUS performs the nonsafety-related functions of 1) removing impurities to reduce radiation dose rates, and 2) removing impurities to maintain water chemistry and clarity in the ultimate heat sink (UHS) pools and dry dock, the PCUS does not perform a safety-related function associated with the monitoring, sampling, or establishment of acceptable limits of particulates in the SFP.

The UHS chemistry monitoring parameters listed in FSAR Table 9.1.3.2 are consistent with the list of chemistry monitoring parameters in the EPRI PWR Primary Water Chemistry Guidelines, Appendix B.7, Spent Fuel Pool Cooling and Cleanup System. The EPRI guidelines do not specify any spent fuel pool (SFP) chemistry monitoring parameters as “control” or “diagnostic” parameters as defined in Chapter 5 of the guidelines, but rather list a set of “suggested” parameters for monitoring. The only suggested parameters with limits are boron, chloride, fluoride, and sulfate. The SFP boron limit is set by technical specifications. The SFP limits for chloride, fluoride, and sulfate are consistent with the reactor coolant system (RCS) cold shutdown control limits described in FSAR Section 5.2.3.2. The basis for these limits is to limit the potential for contamination of the RCS during refueling when the RCS is cross connected with the refueling pool and minimize corrosion of spent fuel assemblies and SFP materials of construction.

Conductivity and pH are among other SFP chemistry analyses mentioned in the EPRI guidelines that are performed by utilities. However, SFP conductivity and pH do not have any suggested limits or frequency of sampling associated with them in the EPRI guidelines.

Therefore, Table 9.1.3-2 will not be updated to specify Conductivity and pH acceptance criteria values.

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.: 9247
Date of RAI Issue: 12/15/2017

NRC Question No.: 09.01.03-6

Regulatory basis: 10 CFR Part 50, Appendix A, GDC 4 requires SSCs to be designed and fabricated to accommodate the effects of environmental conditions during normal, off normal, and accident conditions. As stated in the NuScale DCD, the spent fuel assemblies, spent fuel racks, and the NuScale containment modules sit within the UHS. The staff seeks further information on the water chemistry controls to ensure that important to safety and safety-related components within the UHS will perform their safety functions.

In DCD Tier 2 FSAR Table 9.1.3-2, "Water Chemistry Parameters Monitored for Ultimate Heat Sink Pools," the applicant described the water chemistry parameters for the UHS.

The water chemistry parameters mirror the guidance in the EPRI Primary Water Chemistry Guidelines, Appendix B.7, "Spent Fuel Pool Cooling and Cleanup System." However FSAR Table 9.1.3-2 does not include sampling frequency.

Update the DCD Tier 2, FSAR the UHS water chemistry control sampling frequency.

NuScale Response:

The NuScale FSAR Section 9.1.3 describes the requirements, purpose, and operation of the Spent Fuel Pool Cooling and Cleanup System (SFPCCS). The NuScale DSRS 9.1.3, Subsection II identifies the acceptance criteria for the design of the SFPCCS. GDC 4, "Environmental and Dynamic Effects Design Bases" is listed as one of the sources for the requirements which applies to the safety review of this system, however, the DSRS states, "This criterion does not apply to the cleanup system or the cooling water system, but the makeup system, its source, the building, and its ventilation and filtration system are extreme-wind-protected, and the ventilation and filtration system meets the guidelines of RG 1.52." Therefore, the DSRS does not include an acceptance criteria which addresses the monitoring, sampling, or establishment of acceptable limits of particulates in the SFP. Although it is recognized in the FSAR Section 9.1.3.2.3, that the PCUS performs the nonsafety-related functions of 1) removing impurities to reduce radiation dose rates, and 2) removing impurities to maintain water chemistry and clarity in the ultimate heat sink (UHS) pools and dry dock, the PCUS does not perform a safety-related function associated with the monitoring, sampling, or establishment of acceptable limits of particulates in the SFP.

The UHS chemistry monitoring parameters listed in FSAR Table 9.1.3.2 are consistent with the list of chemistry monitoring parameters in the EPRI PWR Primary Water Chemistry Guidelines, Appendix B.7, Spent Fuel Pool Cooling and Cleanup System. COL Item 5.2-4 states, "A COL applicant that references the NuScale Power Plant design certification will develop and implement a Strategic Water Chemistry Plan. The Strategic Water Chemistry Plan will provide the optimization strategy for maintaining primary coolant chemistry and provide the basis for requirements for sampling and analysis frequencies, and corrective actions for control of primary water chemistry consistent with the latest version of the Electric Power Research Institute Pressurized Water Reactor Primary Water Chemistry Guidelines."

Therefore, the sampling frequencies for the UHS water chemistry parameters listed in Table 9.1.3-2 are addressed in the COL item discussed above and will not be added to Table 9.1.3-2.

Impact on DCA:

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