RAIO-0318-59138

March 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. 163 (eRAI No. 8907) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 163 (eRAI No. 8907)," dated August 11, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 163 (eRAI No.8907)," dated September 26, 2017

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 Questions from NRC eRAI No. 8907:

- 09.03.03-1
- 09.03.03-3
- 09.03.03-4

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 Supplemental Response to NRC Request for Additional Information eRAI No. 8907

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8907

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

eRAI No.: 8907
Date of RAI Issue: 08/11/2017

NRC Question No.: 09.03.03-1

GDC 60 requires, in part, a power unit design to “include means to control suitably the release of radioactive materials in liquid effluents … produced during normal reactor operation, including anticipated operating occurrences.” 10 CFR 52.6 requires, in part, that information provided to the Commission under Part 52 shall be complete and accurate in all material respects.

FSAR Tier 2, Section 9.3.3.2.1, indicates that the radioactive waste drainage system (RWDS) and balance-of-plant drainage system (BPDS) are designed to include surge capacity to support other routine activities such as runoff from firefighting activities. The FSAR shows and describes that firewater removal pumps are provided in certain sumps, but not all, to aid in removal of liquids in those sumps and prevent overflow of the sumps. FSAR Tier 2, Figure 9.3.3-2, “Balance-of-plant Drain System Diagram,” shows some sumps having a firewater removal pump while FSAR Tier 2, Figure 9.3.3.-1, "Radioactive Waste Drain System Diagram," shows none. It is not clear to the staff why some sumps, such as the Chemical Waste Collection Sump which receives drainage from floor drains, do not have this extra pump.

The applicant is requested to provide clarification on why firewater removal pumps are not required for some sumps. The FSAR is to be modified accordingly. In addition, describe the expected surge volumes, the capacity of the drain systems’ components designed to accommodate these surge volumes, and provide the basis for ensuring the sumps are sized appropriately or provide a COL information item to capture this design information.

NuScale Response:

This response supplements NuScale's response, dated September 26, 2017, to RAI 8907 (9.3.3-1).

After reviewing the response to RAI 8907, 09.03.03 Question 1, the NRC communicated the following concerns:

> The RAI response (9.3.3-1) states that the Chemical Waste Collection Sumps do not require a fire water removal pumps since there is no floor runoff (which is where the fire

suppression water is expected to come from); however, Figure 9.3.3-2 for the BPDS shows inflow from floor drains of the chemical treatment building. The concern is GDC 60 where a sump containing radioactive liquids could overflow (during a fire event) and therefore not control the radioactive materials/release.

The chemical waste collection sumps do receive runoff from the cooling tower chemical treatment buildings and from the feedwater treatment skids, which are located in the turbine buildings. These areas are relatively small, which results in relatively small flow rates from the fire suppression systems.

NuScale concludes that there is no GDC 60 concern because the capacity of the sump pumps exceeds the capacity of the potential flow into the sumps from firewater runoff. FSAR Section 9.3.3 has be revised to include this information, and to remove the statement that chemical waste collection sumps do not receive runoff from floors.

Impact on DCA:

FSAR Section 9.3.3 has been revised as described in the response above and as shown in the markup provided in this response.

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

eRAI No.: 8907
Date of RAI Issue: 08/11/2017

NRC Question No.: 09.03.03-3

10 CFR 52.6(a) states, in part, that the information provided by an applicant for a standard design certification shall be complete and accurate in all material respects. GDC 2 requires, in part, the capability of important to safety system portions of the equipment and floor drainage system (EFDS) to withstand the effects of natural phenomena (such as seismic event, floods, etc.) without loss of capability to perform safety functions.

As stipulated in Section III.2 of Standard Review Plan (SRP) Section 9.3.3, “Equipment and Floor Drainage System,” the drawings and descriptions are reviewed for whether safety-related EFDS portions are identified correctly and can be isolated from nonsafety-related portions.

Regulatory Guide 1.29, Revision 4, Regulatory Position C.2 states that those structures, systems, components (SSCs) of which continued function is not required but of which failure could reduce the functioning of any plant feature included in Regulatory Position C.1 to an unacceptable safety level should be designed and constructed so that the safe shutdown earthquake (SSE) would not cause such failure.

FSAR Tier 2 Table 3.2-1, “Classification of Structures, Systems, and Components,” under radwaste drainage system (RWDS) (FSAR page 3.2-11), lists the RWDS Seismic Classification as “III.” However, FSAR Tier 2, Section 9.3.3.1 states that “portions of the [RWDS and balance-of-plant drainage system (BPDS)] system that are in proximity to Seismic Category I SSCs are designed to Seismic Category II standards.” Without proper classification of a system's components, failures of those portions could damage important to safety equipment.

The applicant is requested to clarify the proper classification of the various portions of the EFDS. If there are portions that need to be Seismic Category II, the applicant is requested to identify those system portions in the FSAR.

In addition, FSAR Tier 2 Section 9.3.3.1 suggests there are sections within “proximity” of Seismic Category 1 SSCs. However, there was no definition/specification provided to quantify “in proximity.” The applicant is requested to provide clarification in the FSAR on what is defined as “in proximity.”

NuScale Response:

This response supplements NuScale's response, dated September 26, 2017, to RAI 8907 (9.3.3-3).

After reviewing NuScale's response to RAI 8907 (9.3.3-3), the NRC communicated the following concern:

> NuScale did not satisfactorily answer the RAI requesting NuScale to identify in the FSAR (Table 3.2-1 and 9.3.3) the Seismic Category for the RWDS and BPDS drainage systems. NuScale did not attempt to provide any classification; instead they requested to add a generic footnote to Table 3.2-1. In addition, NuScale did not answer the question regarding the meaning of “proximity” nor did they propose to remove/modify such statement(s).

NuScale Response:

The BPDS and RWDS are generally Seismic Class III systems. Final plant layout has not been completed at this point in the design. NuScale anticipates that, in the final design of the plant, no BPDS or RWDS components will be situated near enough to Seismic Category I SSCs such that a safe shutdown earthquake would cause a structural failure of a BPDS or RWDS component resulting in the inability of the Seismic I SSC to perform a function for which the component was designated Seismic Category 1. If such a situation does exist in the final plant layout, the BPDS or RWDS component would be restrained in accordance with Seismic Category II design criteria. That is the meaning of the footnote added to FSAR Table 3.2-1. If some component of the BPDS or RWDS was determined to have impacts on a Seismic Category I component at some point after the plant was licensed, then the design description would be changed in the FSAR via the 10 CFR 50.59 process.

The discussion of seismic categories in FSAR Section 9.3.3 has been revised to be more consistent with similar descriptions in other sections of the FSAR.

Impact on DCA:

FSAR Section 9.3.3 has been revised as described in the response above and as shown in the markup provided in this response.

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

eRAI No.: 8907
Date of RAI Issue: 08/11/2017

NRC Question No.: 09.03.03-4

GDC 60 requires, in part, a power unit design to “include means to control suitably the release of radioactive materials in liquid effluents … produced during normal reactor operation, including anticipated operating occurrences.” 10 CFR 52.6 requires, in part, that information provided to the Commission under Part 52 shall be complete and accurate in all material respects.

FSAR Tier 2, Sections 9.3.3 and 14.2 provide high-level descriptions about the testing, inspection, and maintenance of the equipment and floor drainage system. However, it is unclear to the staff which components will be inspected, tested, and maintained throughout the life of the plant. Inspection, testing, and maintenance is important to prevent radioactive liquid effluents from leaking and contaminating areas of the plant.

The applicant is requested to provide further information regarding the periodic inspection, testing, and maintenance of the equipment and floor drainage system (include both radioactive waste drainage system (RWDS) and balance-of-plant drainage system (BPDS)).

NuScale Response:

This response supplements NuScale's response, dated September 26, 2017, to RAI 8907 (9.3.3-4).

The NRC identified a number of issues with NuScale's response to RAI 8907 (9.3.3-4). Each issue is shown below, followed by NuScale's response.

Issue 1. The staff does not agree that by meeting 10 CFR 20.1406 and complying with RG 4.21, that the system therefore meets GDC 60 for control of radioactive liquid effluents.

Response to Issue 1: FSAR Section 9.3.3 does not state that by meeting 10 CFR 20.1406 and complying with RG 4.21, that the system therefore meets GDC 60 for control of radioactive liquid effluents. NuScale has revised the FSAR to provide a more complete explanation of how the RWDS and the BPDS comply with GDC 60.

Issue 2: Tier 1, Table 3.0-1 “Shared Systems Subject to Inspection, Tests, Analysis, and Acceptance Criteria,” lists one balance of plant drain system will support six modules. Nothing on the radioactive waste drain system unless the liquid radioactive waste system is the same.

Response to Issue 2: The ITAAC associated with the balance of plant system are found in Tier 1 Table 3.17-1: Radiation Monitoring - Automatic Actions for NuScale Power Modules 1-6, and Tier 1 Table 3.17-2: Radiation Monitoring - Automatic Actions for NuScale Power Modules 7-12. As reflected in these two tables, there are two essentially complete balance-of-plant drain systems, each of which supports the secondary side of up to six nuclear power modules. Each of these systems is subject to ITAAC and is, therefore, listed in FSAR Tier 1, and is shown as supporting six NPMs.

FSAR Tier 1, Table 3.0-1 lists only those systems for which ITAAC is required. The RWDS is not referenced because no ITAAC are required for the RWDS.

No change to Tier 1 is required.

Issue 3: Discrepancy between Tier 1 and Section 9.3.3 on how many modules each system can support.

Response to Issue 3: Refer to the response to Issue 2 for the reasoning behind the Tier 1 representation of the number of modules supported.

The complete BPDS supports up to 12 NPMs, as is stated in FSAR Tier 2, Section 9.3.3. The complete BPDS encompasses the equipment that services the secondary plants (including the equipment represented in Tier 1) and common BPDS equipment such as the oily waste tank and BPDS equipment located within the Control Building.

No change to Tier 2 is required.

Issue 4: Which version of RG 1.29 does NuScale use? Table 1.9-2; “Conformance with Regulatory Guides,” states Revision 5. Page 3.8-2 states Revision 4. Page 3.8-34 states Rev 5, Page 9.4-1 states Rev 4. In Section 9.3.3 they state: “The RWDS and BPDS do not have direct connections to Seismic Category I piping systems that would invoke the seismic design requirements of regulatory position C.3 of RG 1.29.” In Rev 5, item C3 refers to quality assurance. In Rev 4, item C3 refers to design.

Response to Issue 4: Corrections have been completed to a number of FSAR sections, including FSAR Sections 9.3.3 and 9.4.1, to indicate that the NuScale design conforms to Revision 5 of Regulatory Guide 1.29.

Impact on DCA:

FSAR Section 9.3.3 has been revised as described in the response above and as shown in the markup provided in this response.

provisions for preventing the backflow of combustible liquids into safety-related areas through the interconnected drain systems.

The BPDS uses double-walled lines with built-in leak detection capability in the piping between the TGB sumps to the LRWS, to contain radioactive material and prevent contamination spread from buried pipe. The connections and fittings for potentially contaminated BPDS tanks are welded in order to prevent leakage.

9.3.3.2.2 Major Component Description

Sumps and Tanks

The RWDS is designed to collect, accumulate, and transfer the expected amounts of radioactive liquid wastes to the LRWS, including chemical and detergent bearing wastes. The RWDS has excess capacity which supports periodic maintenance or other volume increases greater than routine operating capacities. Redundant pumps provide backup.

RAI 09.03.03-1

The internal flooding analysis for the RXB determined that pooling from fire suppression equipment does not impact safety-related or risk-significant equipment functions with no credit taken for the floor drain system, as described in Section 3.4. There are no safety-related or risk significant SSC on the lowest level of the CRB. In the event of fire suppression system activation, the excess water is allowed to pool on the impacted floor until it can drain into the floor drain sump tank. Floor drains from upper elevations are collected and routed through individual downcomers to the nearest floor drain sump, located in the lowest elevation. This feature prevents water collected on one floor from backing up to other floors. The RWDS sumps in the RXB, though not credited to prevent flooding in the respective buildings, will attenuate to some extent the flood levels from design basis fire suppression system flows. The BPDS sump in the CRB contains a fire water removal pump rated at the maximum single zone fire suppression system flow rate.

The RWDS sumps are provided with stainless steel liners to collect any leakage from the primary tank. The liners also contain leak detection which alarms in the Waste Management Control Room (WMCR). The sumps are covered to keep out debris, with an access port to facilitate inspection and cleanout operations. The RWDS tanks are vented to the RXB or RWB ventilation system which helps prevent gaseous and airborne radioactive contaminants from leaving the sump tanks by a path other than the vent piping.

RAI 09.03.03-1, RAI 09.03.03-1S1

The BPDS is designed to accommodate normal drainage into each of the five sumps. Sufficient storage volume and pump-out capacity is provided in the BPDS collection tanks to process normal and infrequent operational occurrences. The two TGB waste water sumps and the CRB sump are also equipped with firewater removal pumps sized to accommodate the design basis fire suppression system flows in the respective buildings without flooding. The chemical waste collection

sumps are not equipped with firewater removal pumps because the capacity of the sump pumps exceeds the potential runoff from firefighting activities.~~these sumps do not receive runoff from floors.~~

The BPDS sumps are closed tanks. The BPDS design provides positive leakage containment that excludes precipitation, groundwater, and runoff. The waste water sumps associated with the BPDS are equipped with coalescing media. Oily waste collected in the BPDS waste water sumps is processed by a BPDS oil separator to permit oily waste collection and transport offsite.

Underground tanks in the BPDS, regardless of material, are located in concrete enclosures with leak detection for secondary containment and covers to exclude precipitation. Each sump includes two pumps. The first pump turns on at high level. The second pump turns on at high-high level. All pumps turn off at low level. For the three tanks with firewater removal pumps, that pump turns on at high-high-high level.

RAI 09.03.03-1

The RCCWS drain tank is sized to accept the RCCWS water contained in the single largest piece of equipment in the RCCWS circuit. The chemical drain tank is sized to accept waste from the process sampling system and the 12 containment evacuation systems.

Pumps

Cleanable screens are installed on pump suction lines to minimize the potential for pump damage or plugging of system piping. The RWDS chemical drain tanks are provided with air diaphragm transfer pumps. The RCA drainage, with the exception of detergent waste, is collected by various RWDS drain tanks, each having two redundant pumps. Each pump is sized to accommodate the maximum anticipated flow into the sump. Thus, each sump has one pump ready for operation and one pump on standby. The pumps automatically start and stop based on level indication. The first pump is activated upon the tank reaching high level and the second pump is activated upon reaching high-high level. This provides automatic backup if one pump fails or if the inflow exceeds the capacity of one pump.

9.3.3.2.3 System Operation

The RWDS and BPDS operate during normal operation, maintenance, plant shutdowns, refueling, plant startup operations, and during anticipated operational occurrences.

For RWDS normal operation, liquid wastes drain by gravity to collection tanks or sumps. Sump pumps discharge the collected radiologically contaminated liquid wastes to the LRWS for further processing.

The RCCW drain and chemical drain subsystems receive waste, but transfer to the LRWS is manually initiated after sampling, analysis, and adjustment if necessary. The liquids contained in the RCCW drain tank are normally not radiologically

flow rates, the waste water sump pumps cycle on and off more frequently. The two BPDS collection tank levels require monitoring of discharge tank contents as the tanks are filled.

Radiologically contaminated liquid input to BPDS is an off-normal condition mitigated by automated system functions. The BPDS process radiation monitors provide continuous indication to the main and waste management control rooms. If a high radiation condition is detected an alarm initiates in the main and waste management control rooms, the associated waste water sump pumps automatically shut down and transfer to manual control, and the discharge flow path to the BPDS collection tanks automatically isolate. The radiation monitoring for the BPDS is discussed in Section 9.3.3.5. To provide an early indication of primary to secondary leakage, the high alarm setpoint is chosen for the radiation monitor that is set sufficiently low to detect abnormal conditions without causing spurious alarms in the control room. In the event of loss of power or air the sump pump discharge valves fail in their current positions. If required, the discharge flow path of the associated waste water sump pumps can be opened to the appropriate LRWS waste tank and the sump pumps can be restored to automatic operation to facilitate processing radiologically contaminated water and system flushing.

The BPDS chemical waste sump pumps require operator action to discharge tank contents. High chemical waste content may require arrangements for temporary storage in one of the collection tanks then metering the disposal to the outfall may be required.

9.3.3.3 Safety Evaluation

The RWDS and BPDS have no safety related or risk significant functions. The design and layout of these systems include provisions that ensure that a failure of the system will not adversely affect the functional performance of safety-related systems or components.

RAI 09.03.03-1S1

General Design Criterion 2 was considered in the design of the RWDS and BPDS. Consistent with GDC 2, the RWDS and BPDS are not provided with specific provisions related to protection against natural phenomena other than those portions of the systems located in Seismic Category I structures. Based on their safety classification, the RWDS and BPDS are designed as non-seismic (Seismic Category III). However, in areas ~~of the RXB and CRB~~ where portions of these systems could interact adversely with Seismic Category I SSC during a safe shutdown earthquake, the RWDS and BPDS are designed as Seismic Category II per Section 3.2.1.2 using the guidance of Regulatory Guide (RG) 1.29. ~~Additionally, BPDS drain piping and components in the CRB that have the potential to interact adversely with Seismic Category I equipment or could result in incapacitating injury to occupants of the control room during or following an SSE meet Seismic Category II design requirements.~~ The RWDS and BPDS do not have direct connections to Seismic Category I piping systems that would invoke the seismic design requirements of Staff Regulatory Guidance C.2 of RG 1.29. The RWDS and BPDS seismic and quality group classifications are identified in Table 3.2-1.

Sump tanks located in the RXB and RWB that contain radiologically contaminated liquids (equipment drains) consist of stainless steel tanks located in equally-sized, stainless steel-lined sumps in the bottom floors of the buildings. The RXB is a Seismic Category I building and the RWB is a Seismic Category II building. Thus, even if the sump tanks were to fail as the result of an earthquake, the sumps (secondary containments) would still be intact and capable of containing the liquid waste, with no adverse interaction with safety-related or risk significant equipment.

The RWDS and BPDS do not require protection against external flooding as the plant site selection criteria places the maximum external flood level at one foot below grade.

General Design Criterion 4 was considered in the design of the RWDS and BPDS. Consistent with GDC 4, the design of the RWDS and BPDS provides protection of safety-related and risk-significant SSC from the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents. The design of the RWDS and BPDS ensures that safety-related equipment functions are not impacted by undue water accumulations within the plant. The internal flood analysis provided in Section 3.4.1 evaluates the potential flooding impact on SSC due to pipe breaks, equipment failures, and fire suppression water. The RWDS and BPDS are not safety-related, single-failure proof, or seismically designed. The flood analysis takes no credit for water removal by the RWDS or BPDS. In some areas of the RXB and CRB, the flood analysis identifies the need for implementing elevated equipment mounting details, waterproof design features, or watertight doors to minimize impact from water accumulation as described in Section 3.4. Implementation of the measures identified by the internal flood analysis ensures that safety-related equipment functions are not impacted by water accumulations within the plant.

RAI 09.03.03-1

The BPDS waste water drain tanks that serve the TGBs and the CRB sump contain fire water removal pumps rated for the design basis fire suppression system flow in the respective buildings. The subsystems operate automatically without the need for operator intervention. The design of the RWDS can help mitigate the consequences of flooding from internal sources, such as pipe breaks, tank leaks, discharge from fire suppression systems, and other potential flooding sources, by providing waste collection and transfer capability. The chemical waste collection sumps do not require firewater removal pumps, as these sumps do not receive runoff from floors.

General Design Criterion 5 was considered in the design of the RWDS and BPDS. Consistent with GDC 5, although the RWDS and BPDS are shared by up to 12 NPMs, in the event of an accident in one NPM, the failure of these systems to perform their nonsafety-related functions does not prevent an orderly shutdown and cooldown of the remaining NPMs.

RAI 09.03.03-1S1

General Design Criterion 60 was considered in the design of the RWDS and BPDS. ~~Consistent with GDC 60, the RWDS and BPDS designs control the release of radioactive materials in gaseous and liquid effluents during normal operations including anticipated operational occurrences. RWDS and BPDS process radiation monitoring and automated functions described in Section 9.3.3.5 limit the release of radioactive~~

~~materials, conforming to GDC 60~~The RWDS and BPDS design features include adequate surge capacities to support maintenance activities and runoff from firefighting and decontamination activities. These systems are designed with radiation monitoring which includes functions to automatically terminate tank discharges. These design features control the release of radioactive materials in effluents during normal operations, including anticipated operational occurrences.

The design of the RWDS and BPDS considers "as low as reasonably achievable" and minimization of contamination guidelines. Consistent with 10 CFR 20.1101(b), the design of the RWDS and BPDS supports keeping radiation exposures ALARA. To maintain the radiation exposure to operating and maintenance personnel ALARA, the RWDS and BPDS are designed to facilitate maintenance, inspection, and testing in accordance with the guidance in Regulatory Guide (RG) 8.8.

The design of the RWDS and BPDS satisfies the requirements of 10 CFR 20.1406 as it relates to minimization of contamination of the facility.

The RWDS is designed to receive radiologically contaminated liquids and normally non-contaminated liquids including the RCCWS drains. Equipment, floor, chemical, and detergent drains are transferred to the LRWS for treatment, storage, and disposal. The normally non-contaminated liquid from the RCCWS drains may contain corrosion inhibitors and is segregated within the RWDS. Liquid from drains related to the RCCWS are monitored by a radiation monitor located on the RCCWS drain tank as described in Section 9.3.3.5 to alert the operators to an off-normal condition within the drain tank. In addition, the provision for Reactor Building RCCWS drain tank grab sampling is located on the Reactor Building RCCW drain tank pump minimum flow line to allow for tank recirculation to obtain a representative sample. Grab sampling provides the capability to analyze the Reactor Building RCCWS drain tank contents and ensure no radioactivity is present prior to return to the reactor component cooling system, and provides a secondary method of initial detection, if the related radiation monitor is not available. The normally non-contaminated liquid is recycled back to the RCCWS; if contamination is detected greater than pre-established thresholds, the liquid is transferred to the HCW collection tanks for treatment, storage, and disposal.

The RWDS is designed to preclude the transfer of contaminated fluids to a non-contaminated drainage system for disposal.

Potential sources of BPDS contamination include 1) a primary-to-secondary steam generator tube leak, which can arrive through the condensate polishers or leaking condensate, or 2) a leak in one of the NPM heatup heat exchangers into the high pressure auxiliary steam and into the auxiliary boiler system blowdown cooler discharge.

The BPDS inputs that could introduce radiologically contaminated liquids into the system are monitored for radiation as described in Section 9.3.3.5. If a high radiation condition is detected an alarm initiates in the main and waste management control rooms, the associated waste water sump pumps automatically shut down and transfer to manual control, and the discharge flow path to the BPDS collection tanks automatically isolate. System sampling provisions located on the discharge of the BPDS sump tank pumps allow the process fluid to be recirculated to ensure a representative