May 01, 2024 Docket No. 52-050

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 005 (RAI-10089-R1) on the NuScale Standard Design Approval Application

REFERENCE: NRC Letter to NuScale, "Request for Additional Information No. 005 (RAI-10089-R1)," dated October 18, 2023

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 the NuScale responses to the following RAI questions from NRC RAI-10089:

- 9.2.2-1
- 9.2.3-1

This letter makes no regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions, please contact Jim Osborn at 541-360-0693 or at josborn@nuscalepower.com.

I declare under penalty of perjury that the foregoing is true and correct. Executed on May 01, 2024.

Sincerely,

Mark W. Shaver
Director, Regulatory Affairs
NuScale Power, LLC

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Enclosure 1: NuScale Response to NRC Request for Additional Information RAI-10089, nonproprietary

Enclosure 1:

NuScale Response to NRC Request for Additional Information RAI-10089, nonproprietary

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Response to Request for Additional Information
Docket: 052000050

RAI No.: 10089
Date of RAI Issue:10/18/2023

NRC Question No.: 9.2.2-1

REGULATORY REQUIREMENT
“Content of Application; Technical Information,” 10 CFR 52.137(a)(2) states, in part, with regards to the systems, structures, and components (SSCs), that “the description shall be sufficient to permit understanding of the system design and their relationship to the safety evaluation.”

ISSUE
The staff reviewed the information provided in the FSAR in Part 2, Section 9.2.2, “Reactor Component Cooling Water System,” (RCCWS) and determined that it does not fully satisfy the regulatory requirement because it does not contain sufficient information necessary to obtain an understanding of the functional system design and operation, nor does it contain any schematic or drawings that show the functional arrangement. Specifically, Section 9.2.2 does not contain sufficient information on the system design, configuration, and operation to allow the staff to conclude that system failure will not adversely affect plant safety or radiological release from the plant during normal operation.

Additionally, the FSAR has included no information on the system operating parameters (i.e., flows, temperatures, and pressures) during normal operation, or the ability to isolate the system if there is a failure in part of the system, either specific to one module or common to all modules. The relevant requirements of the Commission’s regulations for this area of review, and the associated acceptance criteria, are given in Standard Review Plan (SRP) Section 9.2.2, Revision 4, “Reactor Auxiliary Cooling Water System,” issued March 2007. The requirements include the following:
• General Design Criterion (GDC) 2, ”Design bases for protection against natural phenomena,” as it relates to the capability of structures housing the system and the system itself to withstand the effects of natural phenomena such as earthquakes, tornadoes, hurricanes, floods, tsunami, and seiches without a loss of safety-related functions.

• GDC 4, “Environmental and dynamic effects design bases,” as it relates to the capability of the system and the structure housing the system to withstand the effects of missiles inside and outside of containment, the effects of pipe whip and jets, environmental conditions from high- and moderate-energy line breaks, and the dynamic effects of flow instabilities and loads (e.g., water hammer) during normal plant operation and upset or accident conditions.
• GDC 60, “Control of Releases of Radioactive Materials to the Environment,” as it relates to the turbine gland sealing system design for the control of releases of radioactive materials to the environment.
• GDC 64, “Monitoring Radioactivity Releases,” as it relates to the turbine gland sealing system design for monitoring releases of radioactive materials to the environment during normal operation, including anticipated operational occurrences.
• 10 CFR 20.1406, “Minimization of Contamination,” as it relates to the design features that will facilitate eventual decommissioning and minimize, to the extent practicable, the contamination of the facility and the environment and the generation of radioactive waste.

Also, GDC 26 requires “Reactivity control system redundancy and capability.” Specifically, two independent reactivity control systems of different design principles shall be provided. One of the systems shall use control rods, preferably including a positive means for inserting the rods, and shall be capable of reliably controlling reactivity changes to assure that, under conditions of normal operation, including anticipated operational occurrences (AOOs), and with appropriate margin for malfunctions such as stuck rods, specified acceptable “fuel design limits are not exceeded.” Therefore, although the non-safety related RCCWS is not required for safe shutdown, its operation is necessary to assure that the control rod drive system meets the requirements of GDC 26 for reliably controlling reactivity changes under conditions of normal operation, including AOOs.

For the staff to perform the review of the RCCWS, it is necessary that the system location, general configuration, and performance and design parameters be included in the design description. In order for the staff to understand the system design and its relationship to plant safety, FSAR Section 9.2.2 must provide a description of the system configuration including applicable schematic diagrams that identify system boundaries and interfaces, along with design and performance data, that identifies the normal operating parameters for the system including flow, pressure, temperature, etc. The ability to isolate the system or portions of the system in the event that intersystem leakage is detected or if there is a break in a RCCWS pipe inside the reactor containment or the reactor building should also be discussed in the FSAR.

FSAR Section 9.2.2 does not contain sufficient information on the system design, configuration, and operation to allow the staff to conclude that system failure will not adversely affect plant safety or radiological release from the plant during normal operation.

REQUESTED INFORMATION
The staff requests that NuScale provide and include in Section 9.2 of the FSAR the following information:
1. A RCCWS schematic that will allow the staff to review and determine, in accordance with GDCs 2 and 4, that failure of RCCWS SSCs in the reactor building or which pass through containment will not damage other SSCs important safety due to pipe whip, flooding, or other effects. A similar schematic was included in FSAR Section 9.2.2 of the design certification FSAR.
2. Design information on safety and seismic design categorization, in accordance with GDC 2, for the SSCs that penetrate the containment and are in close proximity to the reactor (RCCWS supply and return to and from the control rod drive mechanisms (CRDMs)).
3. Information on the RCCWS heat removal capacity and demand requirements, such as for the CRDMs, during normal operation (note that GDC 26 requires control rod drives to be operable during AOOs).
4. In accordance with 10 CFR 20.1406, information on how the system provides adequate radiation monitoring to indicate in-leakage to the system from a contaminated system that it interfaces with, how the system is designed so that leakage from the system can be detected, and how appropriate system isolation can be initiated.
5. System design information on leakage detection from the system and how it provides for isolation to comply with the requirements of GDC 60 and 64 as they relate to control of releases of radioactive materials to the environment and monitoring radioactivity releases.

NuScale Response:

Content of Application; Technical Information, 10 CFR 52.137(a)(2) requires,

*“A **description** and **analysis** of the SSCs of the facility, with emphasis upon performance requirements, the bases, with technical justification, upon which the requirements have been established, and the evaluations required to show that safety functions will be accomplished. It is expected that the standard plant will reflect through its design, construction, and operation an extremely low probability for accidents that could result in the release of significant quantities of radioactive fission products. **The description shall be sufficient to permit understanding of***

the system designs and their relationship to the safety evaluations*. Items such as the reactor core, reactor coolant system, instrumentation and control systems, electrical systems, containment system, other engineered safety features, auxiliary and emergency systems, power conversion systems, radioactive waste handling systems, and fuel handling systems shall be discussed insofar as they are pertinent."*

The reactor component cooling water system (RCCWS) does not perform safety related or risk significant functions. In accordance with 10 CFR 52.137(a)(2), NuScale's position is that there is sufficient description for understanding of the system design and the relationship to the safety evaluation. Furthermore, the pertinent regulations for the RCCWS are sufficiently described in SDAA FSAR section 9.2.2, or other sections, as described below.

Citing a sub-part of 10 CFR 52.137(a)(2) as the regulatory requirement for an RAI is non-specific and does not provide an understanding of the specific information missing in the application. The description provided in the "Issue" section of the RAI is specific, provides an adequate basis for understanding the NRC issue, and NuScale has provided responses to the individual concerns listed below:

1. A system schematic does not provide information related to GDC 2 or GDC 4. The RCCWS is located in the Reactor Building, which is a Seismic Category I structure designed to protect components from extreme winds and missiles that may result from natural phenomena such as earthquakes, tornadoes, and hurricanes. The Reactor Building also protects components from the effects of external flooding, as described in Section 3.4. SDA Table 9.2.2-1: Classification of Structures, Systems, and Components provides the seismic classification of the RCCWS structures, systems and components (SSC). Table 9.2.2-1, Note 4 and Section 9.2.2.3 explain that components of the RCCWS that could adversely affect Seismic Category I SSC are categorized as Seismic Category II. Section 3.6, Protection against Dynamic Effects Associated with Postulated Rupture of Piping, contains information about pipe whip and flooding with respect to RCCWS, including compliance with GDC 4. The reactor component cooling water system (RCCWS) supply and return lines are part of the control rod drive system (CRDS) inside the containment. The RCCWS supply and return lines are moderate energy. The effects of leakage cracks in the moderate-energy RCCWS lines are bounded by breaks in high-energy lines. Therefore, RCCWS does not challenge GDC 2 or GDC 4.

2. The RCCWS containment isolation valves are part of the containment systems. Section 6.2, Containment Systems, describes containment isolation valves and compliance with GDC 2. Table 6.2-5 documents a failure modes and effects analysis of the containment systems that

includes RCCWS penetrations into and out of the containment. Table 6.2-7 contains classifications of some of the RCCWS components that penetrate the containment. Consistent with GDC 2, RCCWS components whose failure could adversely impact Seismic Category I components are designed to Seismic Category II standards. Due to its proximity to the containment vessel, the RCCWS piping from the NPM disconnect flange to the module bay wall is designed to Seismic Category II standards. The RCCWS components beyond the pipe gallery wall are designed to Seismic Category III standards. Compliance with GDC 2 is not challenged (Section 9.2.2.3 and Table 9.2.2-1).

3. While the control rod drive mechanisms (CRDMs) are safety-related due to their function of safe shutdown of the reactor, the electromagnetic drive coils and rod position indication that are cooled by RCCWS do not impact the ability to safely shutdown the reactor. While continued cooling of the CRDMs is not required for safe shutdown, the reactor component cooling water system maintains the CRDM winding temperature below the maximum design temperature of 392 degrees Fahrenheit. Therefore, the RCCWS system does not affect CRDM compliance with GDC 26. Further detail about the CRDMs is contained in Section 3.9 Mechanical Systems and Components. Table 9.2.2-1: Classification of Structures, Systems, and Components, contains the safety and seismic classifications for RCCWS, including interfaces with CRDM.

4. The RCCWS design meets GDC 60 and GDC 64 as they relate to the control of radiological effluents and monitoring of releases. Table 12.3-31: Regulatory Guide 4.21 Design Features for Reactor Component Cooling Water System, and Table 12.3-35: Regulatory Guide 4.21 Design Features for Radioactive Waste Drain System, in Section 12.3, Radiation Protection Design Features, contain information about how the RCCWS system complies with 10 CFR 20.1406 and GDCs 60 and 64. Both Tables discuss leakage minimization and detection in the RCCWS and its drain system and thus, demonstrate compliance with GDC 60.

The RCCWS cools components that contain fluid that has the potential to contaminate the RCCWS with radioactivity. For these potentially contaminated loads, radiation monitors are located in the RCCWS piping downstream of the cooled components to alert the control room if there is a radioactive fluid leak into the RCCWS. Coolers and condensers contain manual isolation valves to isolate leaks. Table 11.5-1 describes RCCWS monitoring capabilities to demonstrate compliance with GDC 64.

Impact on US460 SDA:

There are no impacts to US460 SDA as a result of this response.

Response to Request for Additional Information
Docket: 052000050

RAI No.: 10089
Date of RAI Issue:10/18/2023

NRC Question No.: 9.2.3-1

REGULATORY REQUIREMENT
"Content of Application, Technical Information," 10 CFR 52.137(a)(2) states, in part, with regards to the systems, structures, and components (SSCs), that "the description shall be sufficient to permit understanding of the system design and their relationship to the safety evaluation."

ISSUE
The staff reviewed the information provided in SDAA Part 2, Section 9.2.3 and determined that it does not fully satisfy this requirement because it does not contain sufficient information regarding the demineralized water system (DWS) necessary to obtain an understanding of the system design and operation. Specifically, Section 9.2.3 does not contain sufficient information on the system design, configuration, and operation to allow the staff to conclude that system failure will not adversely affect plant safety or radiological release from the plant during normal operation.

SDAA, Section 9.2.3.2 does not provide a description of the DWS system that would allow the staff to review the design against applicable NRC regulations. It does not contain system design information or what plant SSCs it supplies with demineralized water. In SDAA Section 9.2.3.3, "Safety Evaluation," it states that: (1) consistent with GDC 2, the design and layout of the DWS includes provisions that ensure that a failure of the system does not adversely affect the functional performance of safety-related systems or components; (2) consistent with GDC 2, portions of the system in proximity to Seismic Category I SSCs are designed to the Seismic Category II standard; and (3) Section 12.3, "Radiation Protection Design Features," provides information on the design features of the DWS that demonstrate compliance with 10 CFR 20.1406.

Since the FSAR contains no DWS system design information, does not give the location of SSCs in the DWS system, and does not specify what SSCs it services, the staff is unable to make a finding on the system ability to comply with GDC 2 or 10 CFR 20.1406.

REQUESTED INFORMATION
The staff requests that NuScale provide and include in SDAA Section 9.2.3 the DWS design information, including a design description that identifies the systems that are serviced, a system flow diagram that shows the system functional arrangement and major components. Similar information that is being requested here was included in the corresponding sections of the design certification FSAR.

NuScale Response:

Section 9.2.3 of the SDAA provides design information for the Demineralized Water System (DWS). The information in this section includes a design description that identifies the system's major components and a simplified flow diagram that shows the system functional arrangement and flow distribution locations.

Impact on US460 SDA:

FSAR Section 9.2 has been revised as described in the response above and as shown in the markup provided in this response.

9.2.3 Demineralized Water System

RAI 10089 9.2.2-1, RAI 9.2.3-1

The demineralized water system (DWS) treats water from the utility water system and provides and distributes demineralized water to systems and areas throughout the plant. The DWS is a nonsafety-related system that performs no safety-related functions. However, the DWS does interface with safety-related CVCS isolation valves. Section 9.3.4, Chemical and Volume Control System and Section 7.1, Fundamental Design Principles provide more information about the DWS isolation.

RAI 10089 9.2.2-1, RAI 9.2.3-1

9.2.3.1 Design Bases

RAI 10089 9.2.2-1, RAI 9.2.3-1

The DWS does not perform safety-related functions, is not credited for mitigation of design-basis accidents, and has no safe shutdown functions. Table 9.2.3-1 identifies SSC classifications for DWS. General Design Criteria 2 and 5, and 10 CFR 20.1406 are considered in the design of the DWS. A diagram of the DWS is provided in Figure 9.2.3-1.

RAI 10089 9.2.2-1, RAI 9.2.3-1

9.2.3.2 System Description

RAI 10089 9.2.2-1, RAI 9.2.3-1

The DWS major components consist of the demineralized water treatment skid, demineralized water storage tank, and demineralized water pumps. If a demineralized water pump trips, the plant control system starts a non-running pump and sends an alarm to the main control room.

Section 11.5, Radiation Monitoring, provides information on the DWS radiation monitors.

RAI 10089 9.2.2-1, RAI 9.2.3-1

9.2.3.3 Safety Evaluation

RAI 10089 9.2.2-1, RAI 9.2.3-1

The design and layout of the DWS include provisions that ensure a failure of the system does not adversely affect the functional performance of safety-related systems or components, consistent with General Design Criterion 2. Portions of the system that are in proximity to Seismic Category I structures, systems, and components are designed to Seismic Category II standards.

RAI 10089 9.2.2-1, RAI 9.2.3-1

General Design Criterion 5 is considered in the design of the DWS. The DWS has no safety-related or risk-significant functions, and therefore the DWS has no functions that are impacted if there is an accident in one module coincident with the shutdown and cooldown of the remaining modules.

Audit Item A-9.2.3-1
RAI 10089 9.2.2-1, RAI 9.2.3-1

The DWS is a nonsafety-related system that performs no safety-related functions. However, the DWS does interface with safety-related CVCS isolation valves. Section 9.3.4, Chemical and Volume Control System and Section 7.1, Fundamental Design Principles provide more information about the DWS isolation.

RAI 10089 9.2.2-1, RAI 9.2.3-1

The DWS is designed to the standards of Regulatory Guide 1.26, Quality Group D.

Section 12.3, Radiation Protection Design Features, provides information on the design features of the DWS that demonstrate compliance with 10 CFR 20.1406.

RAI 10089 9.2.2-1, RAI 9.2.3-1

Table 9.2.3-1: Classification of Structures, Systems, and Components

SSC (Note 1)	Location	SSC Classification (A1, A2, B1, B2)	Augmented Design Requirements (Note 2)	Quality Group/Safety Classification (Ref RG 1.26 or RG 1.143) (Note 3)	Seismic Classification (Ref. RG 1.29 or RG 1.143) (Note 4)
DWS, Demineralized Water System					
All components	All Buildings	B2	None	D	III

Note 1: Acronyms used in this table are listed in Table 1.1-1

Note 2: Additional augmented design requirements, such as the application of a Quality Group, Radwaste safety, or seismic classification, to nonsafety-related SSC are reflected in the columns Quality Group / Safety Classification and Seismic Classification, where applicable. Environmental Qualifications for SSC are identified in Table 3.11-1.

Note 3: Section 3.2.2.1 through Section 3.2.2.4 provides the applicable codes and standards for each RG 1.26 Quality Group designation (A, B, C, and D). A Quality Group classification per RG 1.26 is not applicable to supports or instrumentation that do not serve a pressure boundary function. Section 3.2.1.4 provides a description of RG 1.143 classification for RW-IIa, RW-IIb, and RW-IIc.

Note 4: Where SSC (or portions thereof) as determined in the as-built plant that are identified as Seismic Category III in this table could, as the result of a seismic event, adversely affect Seismic Category I SSC or result in incapacitating injury to occupants of the control room, they are categorized as Seismic Category II consistent with Section 3.2.1.2 and analyzed as described in Section 3.7.3.8.

Note 5: IEEE Std 497-2016 as endorsed by RG 1.97 and implemented as described in Table 1.9-2

RAI 10089 9.2.2-1, RAI 9.2.3-1

Figure 9.2.3-1: Demineralized Water System Simplified Diagram