RAIO-0518-59901

May 08, 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. 385 (eRAI No. 9356) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 385 (eRAI No. 9356)," dated March 12, 2018

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 Question from NRC eRAI No. 9356:

- 09.02.07-6

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,

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9356

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NuScale Response to NRC Request for Additional Information eRAI No. 9356

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

eRAI No.: 9356
Date of RAI Issue: 03/12/2018

NRC Question No.: 09.02.07-6

10 CFR 52.47(a)(24) & (25) require a design certification application to contain a final safety analysis report (FSAR) that describes the facility … and must include "a representative conceptual design for those portions of the plant for which the application does not seek certification, to aid the NRC in its review of the FSAR and to permit assessment of the adequacy of the interface requirements," which "must be sufficiently detailed to allow completion of the FSAR."

In RAI 9116, Question 09.02.07-4, the staff requested the applicant to clearly describe in FSAR Sections 1.2 and 9.2.7 which portions of the site cooling water system (SCWS) are parts of the design certification and which are considered site-specific or conceptual design information (CDI). In its response to the RAI dated November 13, 2017, the applicant stated that the entire SCWS is conceptual design and proposed changes to FSAR Section 1.2 to indicate the design of the SCWS as CDI by enclosing the information within double brackets [[ ]]. The staff considered this response incomplete in that the applicant did not propose any conforming changes to FSAR Section 9.2.7 to specifically mark in the detailed description of the SCWS the applicable CDI including specifying all interface requirements to other plant systems that are in the scope of the certified design. Therefore, the applicant is requested to revise FSAR Section 9.2.7 to provide such markings or otherwise justify their omission.

NuScale Response:

NuScale reevaluated the response to RAI 09.02.07-4 and concluded the response incorrectly stated that the "entire" Site Cooling Water System (SCWS) is Conceptual Design Information (CDI).

FSAR Table 1.8-1 indicates that the Site Cooling Water System (SCWS) contains Conceptual Design Information (CDI). FSAR Figure 1.2-2, as revised by RAI 09.02.07-4, also now depicts the SCWS cooling towers as CDI. However, the CDI portion of the SCWS is limited to site specific details regarding the location and orientation of the cooling towers as well as equipment design and operation.

Therefore the sentence added to Section 1.2 as part of the response to RAI 09.02.07-4 has been modified for clarity. In addition, conforming changes [[brackets]] have been added to FSAR Section 9.2.7 and several sentences deleted or clarified as the information was at a level of detail inappropriate for a non safety-related, site specific system. Because the final location and arrangement must conform to the location constraints stated regarding Seismic Category I or II structures, brackets have not been added to these paragraphs.

Impact on DCA:

Section 1.2 and 9.2.7 have been been revised as described in the response above and as shown in the markup provided in this response.

5) [[Diesel Generator Buildings (DGBs): house the backup diesel generators and associated equipment.]] Additional details of the DGBs are provided in Section 1.2.2.5.5.

RAI 09.02.07-4. RAI 09.02.07-5, RAI 09.02.07-6

6) [[Site Cooling Water System (SCWS): provides cooling water to plant auxiliary systems.]] Details associated with location and orientation of the cooling towers as well as equipment design and operation are site specific. Additional details of the SCWS are provided in Section 1.2.1.6.

1.2.1.1 Facility Description

Process Overview

The reactor core is located in a core support assembly, which is seated in the lower RPV assembly. A central hot leg riser is connected to the top of the core support assembly. The reactor core transfers heat into the reactor coolant and the heated reactor coolant flows upward through the core and lower and upper riser assemblies. The heated coolant exits the upper riser assembly and is redirected downwards into the SG region between the vessel wall and the upper riser assembly. As the reactor coolant transfers heat to the SGs, it cools and becomes denser, which drives the natural circulation flow. The coolant returns to the bottom of the vessel through the downcomer and back into the reactor core, where the cycle begins again (Figure 1.2-7).

On the secondary side, preheated feedwater is pumped into the tube side of the SGs where it boils. As the steam flows upward in the tubes, it is continually heated to produce superheated steam before exiting the top of the SGs.

The superheated steam is directed to a dedicated steam turbine. A generator, driven by the turbine, creates electric power that is delivered to the utility grid through a step-up transformer. A turbine bypass line provides up to 100% of the rated main steam flow directly from the associated steam generators to the main condenser in a controlled manner to remove heat from the reactor following a load reduction or loss of electrical load.

Steam that exits or bypasses the turbine is directed to the condenser. A shared circulating water loop removes heat and condenses the steam for up to 6 condensers. The condensate is pumped through condensate polishing equipment to the inlet of the variable speed feedwater pumps. A small amount of steam is extracted from turbine stages to preheat the feedwater and increase plant efficiency. Feedwater regulating valves control feed flow into the SGs.

[[Heat from the circulating water loop from up to 6 condensers is rejected to atmosphere by a set of evaporative mechanical-draft cooling towers. Two sets of cooling towers are provided for 12 NPMs.]]

1.2.1.1.1 Principal Design Criteria

The design provides a simple, safe reactor and provides the following:

- process sampling system chillers
- condensate and feedwater sample coolers
- main steam sample coolers
- turbine generator heat exchangers, lube oil, and governor
- instrument air compressors and coolers

The major components of the SCWS include the SCWS pumps and associated piping, the cooling tower and associated basin, and traveling screens. Figure 9.2.7-1 shows the SCWS process piping and components. Table 9.2.7-1 provides the SCWS equipment design data.

SCWS Pumps and Piping

RAI 09.02.07-6

[[Three 50%-percent capacity vertical wet pit]] pumps take suction from intake bays at the cooling tower and discharge into a network of piping that supplies cooling water to the various services around the plant. Each pump can be isolated to ensure system function, control system leakage, and allow system maintenance. The main SCWS pipe is located below grade. ~~Expansion joints at the discharge of each pump compensate for thermal expansion and pump forces. A valve at the discharge of each SCWS pump with monitored position, and opening and closing valve operations are interlocked with their associated pump drivers to prevent reverse flow. Above ground SCWS piping and valves are lined carbon steel designed to ASME B31.1 (Reference 9.2.7-1). The SCWS underground piping is reinforced or pre-stressed, or both, concrete pressure piping and designed to the American Water Works Association standards.~~

Cooling Tower and Basin

RAI 09.02.07-6

The cooling tower consists of rectangular banks [[of three cells]]. Each cell includes a motor-driven mechanical draft fan, and isolation valves. The cooling tower is constructed of nonflammable (nonwooden) materials. The cooling tower superstructure and basin are concrete and are designed to ACI 318 (Reference 9.2.7-2) and ACI 334.2 (Reference 9.2.7-3) standards, as applicable.

RAI 09.02.07-6

The cooling towers are located away from Seismic Category I or II structures, and safety-related components. If structural failure of the cooling towers occurred, no Seismic Category I or II structures or safety-related systems or components would be impacted. ~~A failure of a fan could result in the generation of missiles, but due to site arrangement, damage is confined to the cooling towers, with no damage to Seismic Category I or II structures or safety-related systems or components.~~

RAI 09.02.07-6

[[Traveling Screens

RAI 09.02.07-6

Traveling screens and associated trash rakes are located at the entrance of the individual pump intake bays. The continuously moving screens are designed to filter large particles or debris from the cooling tower basin water, preventing debris from entering the individual pump bays where the SCWS pumps draw suction. Trash rakes are provided to prevent large debris from entering the SCWS pumps.]]

9.2.7.2.2 System Operation

Normal Operations

RAI 09.02.07-6

[[Two 50-percent]] site cooling water pumps are in operation to provide full flow through the SCWS to support operation of up to 12 NuScale Power Modules. The number of cooling tower cells in operation is dependent upon system demand and the ambient wet bulb temperature. Fans are placed in operation as required to obtain the required cold water design temperature. During cold weather, a portion of the SCWS water flow is diverted to freeze-protection spray headers on the cooling tower to de-ice the central cooling tower spray baffles, and a portion of the flow to the cooling tower may be diverted directly to the basin via the bypass valve to maintain system temperature above a desired minimum at partial loads.

RAI 09.02.07-6

Under normal plant operating conditions, environment conditions (e.g., ambient temperature, humidity, radiation, noise~~, etc.~~) allow personnel access to SCWS equipment for operation, inspection, maintenance, and testing.

RAI 09.02.07-6

[[During system startup or shutdown, SCWS pump motors and cooling tower fans are manually started and stopped. The idle SCWS pump automatically starts upon trip of an active pump. During normal power operation, the standby pump is started automatically on low system pressure.]]

RAI 09.02.07-6

~~The SCWS pump start sequence is interlocked with its discharge valve, which partially opens on start of the first pump to prevent water hammer and allow the system piping to fill. On confirmation of system fill, operators fully open the discharge valve, and additional SCWS pumps are started. Stop commands begin by closing the associated pump's discharge valve. Full valve closure is timed with pump shutoff to ensure minimal reverse flow. Discharge valves also automatically close following a pump trip.~~

The proper concentration of chemicals is applied to maintain desired pH and biocide concentrations per the SCWS chemistry analysis. Control valves provide for system blowdown to a specified area as necessary to help regulate chemistry.

Off-Normal Operations

The site cooling water system is connected to the plant backup power supply system in case of loss of normal power.

RAI 09.02.07-6

~~During cold weather the cooling tower operation must be adjusted to prevent freezing. A cooling tower bypass diverts the hot water return to raise the water temperature in the basin to prevent freezing.~~

For services in the Reactor Building, there is a potential for radioactive contamination in the SCWS in the event of heat exchanger leakage. Radiation detectors are provided in the SCWS outlet of the reactor pool cooling system heat exchangers, spent fuel pool cooling system heat exchangers and the reactor component cooling water system heat exchangers to detect the presence of radiation in the SCWS.

RAI 09.02.07-1, RAI 09.02.07-6

The SCWS is provided with low system pressure monitoring at various points and with isolation valves so that large leaks which could impact safety-related equipment may be identified and isolated promptly.

System Shutdown

In the event of a plant wide shutdown, the SCWS is not required for safe shutdown of the plant.

RAI 09.02.07-6

~~Portions of the SCWS are removed from service by closing the isolation valves for the various services. If the entire SCWS is removed from service in cold weather, all cooling tower fans are stopped and the piping is drained to the cooling tower basin to prevent freezing.~~

RAI 09.02.07-6

[[For shutdown, pumps are shut down in sequence, and equipment and piping ~~are~~may be drained to the cooling tower basin. Headers ~~are~~may be drained or pumped via the supply header bypass line to the cooling tower basin using a portable pump if required. ~~During prolonged shutdowns, biocide is added and circulated as needed.~~]]

9.2.7.3 Safety Evaluation

RAI 09.02.07-6

The SCWS does not perform safety-related or risk-significant functions. The SCWS does not provide cooling to safety-related or risk-significant components. During normal and off-normal conditions, sufficient redundancy exists to remove heat from the serviced systems.

The SCWS design is consistent with GDC 2. The SCWS is located sufficiently far from Seismic Category I or II structures, or safety-related components. The SCWS is Seismic Category III. A description of the seismic design for SSC is provided in Sections 3.7 and 3.8. Also consistent with GDC 2, since the SCWS serves no safety-related or risk-significant function, failure of SCWS due to the effects of natural phenomena such as tornadoes, hurricanes, floods, and externally generated missiles will not adversely impact safety-related or risk-significant functions.

RAI 09.02.07-1, RAI 09.02.07-6

Consistent with GDC 4, the SCWS is provided with the ability to promptly identify and isolate large leaks which could impact safety-related equipment.

The SCWS design is consistent with GDC 5. The SCWS does not have safety-related or risk-significant functions that are shared between modules. The components in the SCWS that are shared among modules do not impair other systems' ability to perform their safety functions, including, in the event of an accident in one unit, an orderly shutdown and cooldown of the remaining units. SCWS components can be isolated on failure and do not affect the operation of other units.

The SCWS design is consistent with GDC 60. The SCWS is designed to reduce the potential for radioactive effluent release by maintaining the process fluid at a higher pressure than potentially contaminated interfacing systems. System drains within the isolation boundary are directed to the liquid radwaste system. The SCWS design provides radiation monitoring and sampling to ensure the operators are alerted to abnormal conditions. Component isolation within the SCWS is a manual process and an operator action in response to an abnormal plant condition. Sampling capability is provided within the isolation boundaries of monitored components to confirm alarmed conditions and allow sampling of process fluid prior to maintenance.

The SCWS design satisfies 10 CFR 20.1406 requirements relating to minimization of contamination of the facility. Further discussion of the facility design features to protect against contamination is provided in Section 12.3. The SCWS provides cooling water to the tube side of heat exchangers with systems that contain, or could contain, radioactive material. The SCWS is monitored to detect leakage of radionuclides into the system. Provisions are also provided to safely drain isolated sections of the piping that could possibly become contaminated to the radioactive waste drain.

Fire protection is addressed in Section 9.5. The safety, risk significance, seismic, quality, and other design classifications for the SCWS structures, systems and components is provided in Table 3.2-2. The SCWS is classified as Quality Group D per RG 1.26, Seismic Category III, and is located sufficiently far from Seismic Category I or II structures, or safety-related components to preclude adverse interactions.

9.2.7.4 Inspection and Testing Requirements

The SCWS components are inspected and tested as part of the initial testing and startup program in accordance with Regulatory Guide 1.68 as described in Section 14.2. SCWS design provides for in-service valve testing and inspection, and components are periodically tested and inspected in accordance with the maintenance program.

Inspection and testing demonstrates effective management of fouling and degradation mechanisms to maintain acceptable system performance and integrity.

COL Item 9.2-4: A COL applicant that references the NuScale Power Plant design certification will provide details on the prevention of long-term corrosion and organic fouling in the site cooling water system.

9.2.7.5 Instrumentation Requirements

RAI 09.02.07-1, RAI 09.02.07-6

Control and monitoring of the common portions of the SCWS water system is performed through the plant control system. Module-specific control and monitoring associated with the individual heat exchangers is performed through the module control system. Instrumentation includes low system pressure at various points in the system so that sudden large leaks which could impact safety-related equipment may be promptly identified. Appropriate alarms and displays are available in the main control room. There are no instruments or controls associated with safety-related functions in the SCWS.

9.2.7.6 References

9.2.7-1 American Society of Mechanical Engineers, Power Piping - ASME Code for Pressure Piping B31, ASME B31.1, New York, NY.

9.2.7-2 American Concrete Institute, ACI 318, "Building Code Requirements for Structural Concrete," Farmington Hills, MI.

9.2.7-3 American Concrete Institute, ACI 334.2R-91, "Reinforced Concrete Cooling Tower Shells-Practice and Commentary," Farmington Hills, MI.

RAI 02.03.01-8, RAI 09.02.07-6

Table 9.2.7-1: Site Cooling Water System Equipment Design Data

Description	Technical Data
Site Cooling Water Pumps	
[[Quantity	3
Type	Vertical wet pit type
Flow rate (max).	24,000 GPM each (50% capacity)
Motor brake horsepower	1500 HP
Cooling Tower - Three Cells (Two Cell Tower plus Spare Cell)	
Type	Mechanical draft, induced
Flow maximum (GPM) over 2 cells	48,000 (design flow plus margin)
Number of cells	3 (2 active)
Fan motor (horsepower)	300 each, three fans required.
One percent annual exceedance non-coincident wet bulb temperature	80 °F
Cold water temperature	90 °F
Travelling Screens with Motors with Trash Rakes	
Flow (GPM)	24,000 each maximum (design flow plus margin)]]

RAI 09.02.07-6

Figure 9.2.7-1: [[Site Cooling Water System Diagram]]