NuScale Power

RAIO-0917-56022

September 18, 2017

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 103 (eRAI No. 8916) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 103 (eRAI No. 8916)," dated July 25, 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. 8916:

- 09.03.06-2
- 09.03.06-3
- 09.03.06-4

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 Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 8916

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 8916

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

eRAI No.: 8916
Date of RAI Issue: 07/25/2017

NRC Question No.: 09.03.06-2

GDC 34 states that “Suitable redundancy...shall be provided to assure that for onsite electrical power system operation (assuming offsite power is not available) and for offsite electrical power system operation (assuming onsite power is not available), the system safety function can be accomplished, assuming a single failure.”

BTP 5-4 states that “The system(s) that can be used to take the reactor from normal operating conditions to cold shutdown shall satisfy the following functional requirements: A. The design shall be such that the reactor can be taken from normal operating conditions to cold shutdown using only safety-grade systems.”

SECY-94-084 allows an alternative to BTP 5-4 position for passive systems based on the following:

> After the passive RHR system or main steam system effected the initial shutdown, a non-safety-grade reactor shutdown cooling system will be available to bring the plant to cold shutdown conditions for inspection and repair. EPRI stated that “these non-safety systems are required to be highly reliable . . . and there is no single failure of these systems or their support systems which would result in inability to terminate use of the passive safety grade system and achieve cold shutdown if desired.

NuScale DCD Tier 2 Section 5.4.3.1 states the following:

> Water Reactor Utility Requirements Document (Reference 5.4-3) was determined to be acceptable by the Nuclear Regulatory Commission as documented in SECY-94-084. Per SECY-94-084 and NUREG-1242, Volume 3, Part 2, transition of a passive plant from safe shutdown conditions to cold shutdown conditions may be reached using nonsafety-related systems. The nonsafety-related containment flood and drain system is used to flood the containment to allow passive long term decay heat removal via convection and conduction to the reactor pool via the RCS, RPV shell, flooded containment, and CNV shell.

NuScale DCD Tier 2 Figure 9.3.6-2 shows that a single CFDS line to the module has valves in series (CFDS containment isolation valves, CFDS module isolation valve, and the valve upstream of the six module isolation valves in parallel), and therefore, a failure of any of those valves may make the CFDS inoperable.

Explain how the CFDS is protected from a single failure and provide a markup to update the DCD.

NuScale Response:

If required to shutdown without the use of the containment flooding and drain system (CFDS), the passive decay heat removal system (DHRS) can be used to reduce the reactor coolant temperature to a safe shutdown condition within 36 hours and maintain the reactor in a sub-critical, stable, safe shutdown condition for beyond 72 hours. The DHRS provides cooling for non-LOCA design basis events through natural circulation resulting from the density differences between steam and condensate portions of the DHRS and associated steam generators. The heat removed from the reactor coolant system (RCS) is exchanged with the ultimate heat sink (UHS), which has enough inventory to maintain the reactor at safe shutdown conditions well beyond 72 hours.

In SECY 94-084, the NRC staff concluded that 420°F is an acceptable safe shutdown temperature for passive safety systems. Additionally, from SECY-94-084:

> *A long-term safe stable, condition, however, can be maintained if a reliable non-safety support system or equipment is available to replenish the water pool to sustain long-term operation of the passive RHR system after 72 hours.*

Per FSAR Section 9.2.5, the safety-related UHS inventory is sufficient to provide cooling for greater than 72 hours without additional makeup water. See FSAR Table 9.2.5-2 for pool boil off event durations. The UHS design includes a makeup line that can provide additional water to the UHS, however, the makeup line is not required in order for the UHS to perform its safety function for the durations shown in FSAR Table 9.5-2. Without makeup, sufficient inventory is available to provide a long-term stable safe-shutdown condition. Therefore, a failure of the CFDS will not prevent the modules from reaching safe shutdown conditions.

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

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NRC Question No.: 09.03.06-3

NuScale DCD Tier 2 Section 9.3.6.5 states that "[t]he CES and the CFDS have indication and alarms associated with system critical parameters to alert operators in the MCR of potentially adverse conditions." The staff could not find a list of critical parameters.

The applicant is requested to provide a list of critical parameters for the CES and CFDS, identify the location in the DCD (if already listed), and provide a markup to update the DCD to clarify this section.

NuScale Response:

The containment evacuation system (CES) and containment flooding and drain system (CFDS) monitor the process variables necessary to ensure system parameters are within nominal values for reliable system operation. If the monitored values deviate from a nominal range, alarms are generated in the main control room to alert operators of a potentially adverse condition. The respective control system will also perform automatic actions to protect system integrity or for automation of repetitive tasks. The CES and CFDS do not monitor any variables which are required for safe shutdown of the reactor and no signals are utilized for emergency safety feature actuations.

Pressure, temperature, tank level, and radioactivity are among the process variables monitored for each system. For the CES, Section 9.3.6.2.1 of the FSAR states:

> *The MCS provides:*
>
> - *indication, alarms, and interlocks for CES flow, temperature, pressure, radioactivity level, humidity, and valve position*
> - *alarms and required automatic actuation for off normal conditions*

Further information on monitored parameters for the CES is included in FSAR Section 9.3.6.2.1 within the *Component Descriptions* section. For the CFDS, Section 9.3.6.2.2 of the FSAR

states:

> *The CFDS operation is controlled from the MCR using the plant control system (PCS), which provides:*
>
> - *automatic and operator control of key CFDS functions*
> - *CFDS valve alignment, except the NPM isolation valves, controlled by the module control system (MCS)*
> - *CFDS alarms and interlocks*
> - *indication of CFDS flow, temperature, pressure, containment drain separator tank level, gaseous discharge process radiation level, and valve position*

Further information on monitored process parameters for the CFDS is available within FSAR 9.3.6.2.2 under the *Component Descriptions* section. Further information on the radiation detection instrumentation for the CES is available in FSAR Section 11.5.2.2.7 and FSAR Section 11.5.2.2.9 for the CFDS. Further overall description of the instrumentation and controls for the CES and CFDS is available in FSAR Section 9.3.6.5. FSAR Section 9.3.6.5 has been revised to point to the FSAR sections that provide the the types of CES and CFDS parameters monitored in the control room.

Impact on DCA:

FSAR Section 9.3.6.5 has been revised as described in the response above and as shown in the markup provided in this response.

9.3.6.5 Instrumentation Requirements

RAI 09.03.06-3

There is one CES per NPM. No CES equipment or instruments are shared between NPMs. There are two independent containment flood and drain systems. Each CFDS is shared by up to six NPMs. The CES and the CFDS have indication and alarms associated with system critical parameters to alert operators in the MCR of potentially adverse conditions. The types of parameters monitored are presented under the General Description headings of Section 9.3.6.2.1 and Section 9.3.6.2.2.

The CES indication associated with determining CNV pressure for leak detection is supported by the MPS, providing a seismically qualified interface to the main control room. The remainder of the CES instrumentation signals are sent to the MCS providing indication and initiating automated features and alarms are when the monitored parameters exceed setpoints. The CFDS instrumentation signals are sent to the PCS and the MCS to provide control and indication, and automated features and alarms are initiated when the monitored parameters exceed setpoints.

The conditions that initiate alarms that are not associated with automated system functions require operator action to acknowledge, troubleshoot, and act to mitigate the condition. The automated component protection functions, interlocks, and system isolations for the CES and the CFDS are provided inSection 9.3.6.2 and Section 9.3.6.3.

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eRAI No.: 8916
Date of RAI Issue: 07/25/2017

NRC Question No.: 09.03.06-4

NuScale DCD, Tier 2, Section 9.3.6.2.3 states the following:

> High-radiation levels in the gases removed from the CNV actuate an alarm in the MCR. If the radiation level in the CES gaseous process flow exceeds a specified limit, or upon monitor failure, the discharge path is transferred from the RBVS to the GRWS and the following automated functions are initiated:
>
> - service air to the CES isolates
> - service air to the CES vacuum pumps isolates

NuScale DCD, Tier 2, Figure 9.3.6-1, shows only a single line coming from the service air system to the CES. Therefore, isolating service air to the CES would automatically isolate the CES vacuum pumps; as such, the reason for identifying two separate isolating functions is not clear.

NuScale is requested to clarify and provide a markup to update the DCD accordingly.

NuScale Response:

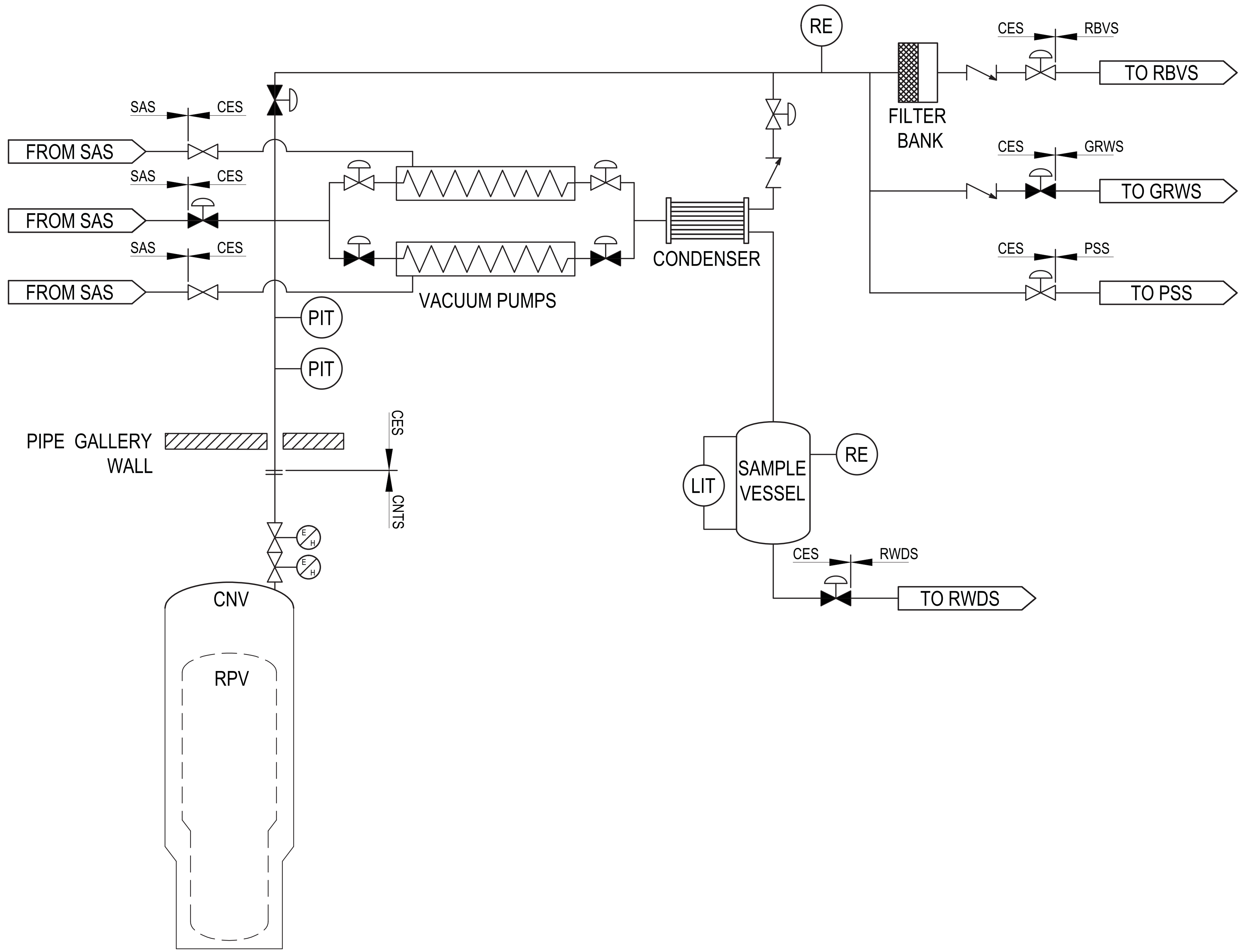
There is only one isolation function of service air to the CES triggered by the high radiation signal or failure of the radiation monitor. The redundancy noted in the RAI has been removed from FSAR Section 9.3.2.6. In addition, Figure 9.3.6-1 has been revised to show that the CES design includes three supply air lines from the SAS.

Impact on DCA:

FSAR Section 9.3.2.6 and FSAR Figure 9.3.6-1 have been revised as described in the response above and as shown in the markup provided in this response.

RAI 05.02.05-1

Figure 9.3.6-1: Containment Evacuation System Diagram



Non-condensable gases removed during the establishment of CNV and RCS vacuum are monitored for radiation. The CES gaseous process flow passes through charcoal-HEPA filter banks and is subsequently discharged to the environs through the continuously-monitored RBVS plant exhaust stack. During initial operation of the CES, the GRWS discharge path is not available because the quantity of air in the CES gaseous process flow exceeds the GRWS capacity. To prevent exceeding the GRWS system capacity, the discharge flow of the CES vacuum pump is monitored, and during high CES flow conditions the automatic transfer to the GRWS due to a gaseous process high radiation condition is prevented by an interlock. As a result, a gaseous process high radiation condition during the initial establishment of CNV vacuum results in CES isolation.

Non-condensable gases removed during the establishment of CNV and RCS vacuum are monitored for radiation using the process described for containment evacuation and drying.

Off-Normal Operations

The CES and CFDS are nonsafety-related and are not assumed to operate during or after any design basis accident. However, the CFDS can be used to add additional borated coolant inventory to the CNV to remove decay heat during a beyond design basis event.

The CES and CFDS off-normal operations include:

- high-radiation levels in gases discharged from the CES condenser
- high-radiation levels in gases discharged from the containment drain separator tank
- equipment failure affecting one or both CES vacuum pumps
- addition of coolant inventory into a CNV during a beyond design basis event

High Radiation Levels in Gases Discharged from the Containment Evacuation System Condenser

Non-condensable gases removed from the CNV by the CES are vented from the CES condenser past radiation monitors. If radiation levels of the non-condensable gases exceed specified limits, it could be an indication of RCS leakage into the CNV.

High-radiation levels in the gases removed from the CNV actuate an alarm in the MCR. If the radiation level in the CES gaseous process flow exceeds a specified limit, or upon monitor failure, the discharge path is transferred from the RBVS to the GRWS and the following automated functions are initiated:

- service air to the CES isolates

RAI 09.03.06-4

- ~~service air to the CES vacuum pumps isolates~~
- the containment evacuation system to PSS sample line isolates