RAIO-0418-59465

April 10, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 198 (eRAI No. 9068) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 198 (eRAI No. 9068)," dated August 25, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 198 (eRAI No.9068)," dated October 24, 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 Question from NRC eRAI No. 9068:

- 19-28

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 Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9068

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9068

NuScale Power™

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

eRAI No.: 9068
Date of RAI Issue: 08/25/2017

NRC Question No.: 19-28

10 CFR 52.47(a)(27) states that a design certification application (DCA) must contain a final safety analysis report (FSAR) that includes a description of the design-specific probabilistic risk assessment (PRA) and its results. 10 CFR 52.47(a)(2) states that the standard plant should reflect through its design, construction, and operation an extremely low probability for accidents that could result in the release of radioactive fission products. 10 CFR 52.47(a)(4) states that each design DCA must contain an FSAR that includes an analysis and evaluation of the design and performance of systems, structures and components (SSCs). The objectives of the analysis and evaluation are to assess the risk to public health and safety resulting from operation of the facility and to determine the margins of safety during normal operations and transient conditions anticipated during the life of the facility.

SRP 19.0, Revision 3, states, "The level of detail of the applicant's [probabilistic risk assessment (PRA)] should be commensurate with the identified uses and applications of the PRA (e.g., sufficient to gain risk- informed insights and use such insights, in conjunction with assumptions made in the PRA, to identify and support requirements important to the design and plant operation)."

1. Pumped injection using the Containment Flooding and Drain System (CFDS) is credited in core damage frequency and large release frequency cutsets in the NuScale PRA. In FSAR Chapter 9, it states, "In addition, for the selected NPM [Nuclear Power Module], the CFDS module isolation valve cannot be opened and CFDS pump start is prevented if RCS wide range hot leg temperature is greater than 350° F. These features, coupled with administrative controls in plant procedures, prevent inadvertent CFDS makeup to an operating NPM."
    a. The staff requests a clarification in the FSAR Chapter 19 whether this interlock, which is not discussed in FSAR Chapter 7, needs to be defeated when CFDS is credited in a beyond design basis event.
    b. If the interlock needs to be defeated, the staff requests a clarification in FSAR Chapter 19 of how this action was modeled in the human reliability analysis.
    c. The staff requests a clarification of why the CFDS isolation valve was screened from the PRA as documented in Table 19.1-24: Containment Penetrations.
2. The staff understands that there was a recent update to the chemical and volume control

(CVCS) PRA notebook, dated February 3, 2017, which explicitly added the CVCS dependency on the boron addition system (BAS) . According to the update, the demineralized water system (DWS) isolation valves close following a reactor trip, and therefore, only the BAS is available to provide the CVCS suction source in the short term, and alignment of the DWS is needed to support CVCS injection for the PRA mission time. Furthermore, operator action includes locally opening the demineralized water isolation valves. To allow the staff to confirm that the PRA reasonably reflects how the plant is expected to be operated, please discuss how the operator action to unisolate the demineralized water system is accounted for in the human reliability analysis for actions related to aligning CVCS for both internal events and internal fires. The staff requests that FSAR Table 19.1-14, “Modeled Human Actions (Post-initiator),” be updated accordingly.

NuScale Response:

NuScale is supplementing its response to RAI 9068 (Question 19-28) provided in letter RAIO-1017-56753, dated October 24, 2017. This supplemental response is provided in response to discussions with the NRC in a public meeting held on February 27, 2018.

The following paragraph provided in the response to Item 2 of RAIO-1017-56753 identified changes made to FSAR Revision 0:

> Consistent with the above discussion, FSAR Table 19.1-14 has been modified to include Footnote 5 to clarify override of containment isolation for aligning CFDS and CVCS; Footnote 6 has been added to clarify alignment of DWS to support CVCS.

The paragraph provided in RAIO-1017-56753 is supplemented to add the following text to reflect changes made to FSAR Revision 1:

> Footnote 1 of Table 19.1-5 and Footnote 6 of Table 19.1-14 have been modified to clarify that local action is required to align the DWS water supply. The BAS boric acid storage tank (BAST) level provides operators with information to support aligning an additional inventory source for CVCS (if needed) by either refilling the BAST or re-aligning the CVCS suction source from the BAS to the DWS. FSAR Section 9.3.4.2.2 has been modified to state that the BAST is provided with local and main control room instrumentation for monitoring tank level.

Impact on DCA:

FSAR Section 9.3.4.2.2, and Tables 19.1-5 and 19.1-14, have been revised as described in the response above and as shown in the markup provided in this response.

A motor driven BAS boric acid batch tank impeller mixer is mounted to the batch tank to completely and uniformly dissolve boric acid in demineralized water.

Boron Addition System Boric Acid Transfer Pump

The BAS boric acid transfer pump recirculates the solution of borated water in the batch tank to facilitate mixing and accurate sampling and transfers mixed solutions of borated water from the batch tank to the storage tank.

Boron Addition System Boric Acid Storage Tank

RAI 19-28S1

One BAST is provided to store borated water for use by the CVCS and SFPCS. The BAST and batch tank capacities are conservatively sized and include sufficient quantity to support a 12 NPM shutdown with conservative RCS boron concentration requirements. The tank is equipped with instrumentation to monitor level locally and in the MCR.

Boron Addition System Boric Acid Supply Pumps

Two BAS boric acid supply pumps are provided to supply borated water to the CVCS and SFPCS. The pumps normally supply borated water from the BAST; however the system is designed to allow the pumps to draw from either the BAST or the batch tank. The pumps can also be used to recirculate the inventory of the BAST or transfer inventory from the batch tank to the BAST.

9.3.4.2.3 System Operation

The CVCS is used during normal operations except for refueling when the NPM is disconnected from the CVCS. The CVCS is used to establish the boron concentration necessary to make mode changes and to modulate reactor power. The CVCS has sufficient makeup and letdown capacity to supply borated water to the RCS and maintain RCS water inventory within the allowable pressurizer level range for normal modes of operation.

RAI 09.03.04-10

The MHS design precludes boron dilution via intersystem leakage by providing double isolation valves with drains and pressure monitoring between the isolation valves. The normal operating mode of the MHS is reactor startup. During times when the MHS is not required for service the system is isolated from the CVCS by the two isolation valves on each supply and return line and monitored for leakage. The fail-closed double isolation valves between each MHS to CVCS interface are de-energized when the MHS is not in use for a NPM.

Borated water supply from the BAS to the CVCS, then into the RCS, can be used to add negative reactivity to the core during normal operations. The boron concentration is increased by discharging reactor coolant to the LRWS while making up coolant with borated water from the BAS.

RAI 19-25, RAI 19-28S1

Table 19.1-5: System Dependency Matrix

		Frontline PRA System							
		BPSS[A]	CFDS	CNTS[B]	CVCS	DHRS	ECCS	RCS[C]	RTS[D]
Support Systems	BAS[1]				X				
	CNTS[2]		X		X	X			
	DWS[1]				X				
	EDSS[3]		X		X				
	EHVS[4]	X							
	ELVS	X	X		X				
	MPS		X	X[5]	X	X[5]	X[5]		X[5]
	UHS		X			X	X		

Notes on support system dependencies (shaded boxes):

1. Although the PRA models the DWS to support CVCS injection, the BAS provides an immediate source of inventory and allows time for operators to locally align the DWS supply isolation valves following a reactor trip. The DWS pumps and isolation valves are powered from the ELVS.
2. As a support system, CNTS is modeled in the Level 1 PRA to open the CIVs (i.e., the CFDS and the CVCS) and close the CIVs and the backup isolation valves (i.e., the FWS and the MSS).
3. The EDSS is powered from the ELVS with backup power from batteries.
4. In the PRA, EHVS is powered from offsite power.
5. The NuScale design is fail-safe; in response to a loss of all power (AC and DC), the MPS actuates the RTS and the ESFAS (i.e., the CNTS, the DHRS, and the ECCS).

Notes on PRA frontline systems:

A. Includes the BDGs and a CTG as the AAPS.
B. As a frontline system, the CNTS is modeled to close the CIVs and backup FWS and MSS isolation valves.
C. In the PRA, the RCS is RPV pressure relief via an RSV.
D. In the PRA, the RTS includes the reactor trip breakers and the CRDS, including control rod assembly insertion.

RAI 19-28, RAI 19-28S1

Table 19.1-14: Modeled Human Actions (Post-Initiator)

Name	Description	Applicable Initiating Event	HEP [1, 2, 3, 4] (Diagnosis + Action)
CFDS--HFE-0001C-FOP-N[5]	Operator fails to unisolate and initiate CFDS injection. This action is completed in the control room.	Used for CVCS line breaks outside containment, SGTFs, and general transients • IE-CVCS--ALOCA-COC • IE-CVCS--ALOCA-LOC • IE-MSS---ALOCA-SG- • IE-TGS---TRAN--NPC	4.0E-03
CNTS--HFE-0001C-FTC-N	Operator fails to manually actuate CIVs following the failure of the MPS to automatically isolate. This action is completed in the control room.	Backup action to MPS autofunction failure. Applicable to core damage sequences with an intact containment. This is a Level 2 operator action.	2.2E-04
CVCS--HFE-0001C-FOP-N [5, 6]	Operator fails to unisolate and initiate CVCS injection through either the injection line or the pressurizer spray line. This action is completed in the control room.	Used for CVCS injection line LOCA inside containment, CVCS discharge line break outside containment, inadvertent ECCS valve opening, SGTF, RCS line LOCA, secondary side line break, and general transients: • IE-CVCS--ALOCA-CIC • IE-CVCS--ALOCA-LOC • IE-ECCS--ALOCA-RV1 • IE-MSS---ALOCA-SG- • IE-RCS---ALOCA-IC- • IE-TGS---FMSLB-UD- • IE-TGS---TRAN-NPC	4.0E-03
CVCS--HFE-0002C-FOP-N [6]	Operator fails to locally unisolate and initiate CVCS injection through either the injection line or the pressurizer spray line. This action is completed locally.	Local action due to lack of control due to a partial loss of DC power: • IE-EDSS--LODC-----	1.4E-03
ECCS--HFE-0001C-FTO-N	Operator fails to manually open the ECCS valves following the failure of the MPS to automatically actuate. This action is completed in the control room.	Backup action to MPS autofunction failure: Applicable to all initiating events.	2.2E-04
EHVS--HFE-0001C-FTS-N	Operator fails to start and load the CTG following the deenergization of the eight 13.8 kV and switchyard system (EHVS) busses. This action is completed in the control room or locally at the CTG and the local breakers.	Backup local action to control room initiation failure during LOOP: • IE-EHVS--LOOP-----	1.4E-03

Table 19.1-14: Modeled Human Actions (Post-Initiator) (Continued)

Name	Description	Applicable Initiating Event	HEP [1, 2, 3, 4] (Diagnosis + Action)
ELVS--HFE-0001C-FTS-N	Operator fails to start and load the BDGs following the deenergization of the eight 13.8 kV EHVS busses. This action can be completed in the control room or locally at the BDGs and local breakers.	Backup local action to control room initiation failure during LOOP: • IE-EHVS--LOOP-----	1.4E-03

1.) HEP = 4.0E-03
For diagnosis, operators have at least 30 minutes (based on thermal hydraulic analyses), and the time available to perform the action is nominal (i.e., greater than the time required to perform the action).
2.) HEP = 2.2E-04
For diagnosis, operators have at least 30 minutes (based on thermal hydraulic analyses), and the time available is significantly greater than the time required to perform the action.
3.) HEP = 1.4E-03
For diagnosis, operators have an hour or more (based on thermal hydraulic analyses), and the time available is significantly greater than the time required to perform the action, however complexity is greater as the action is local.
4.) Even though individual calculations were performed for each post-initiator operator action, as a modeling convenience, a generic HFE basic event quantification approach has been incorporated in the PRA model by setting the first HFE in a sequence to the bounding calculated post-initiator HEP.
5.) The containment system isolation override allows operators to take manual control to support injection.
6.) The PRA models the DWS to support CVCS injection; the BAS provides an immediate source of inventory and allows time (i.e., hours) for operators to locally align the DWS supply isolation valves, if additional inventory is needed.