RAIO-1118-62980

November 16, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 497 (eRAI No. 9570) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 497 (eRAI No. 9570)," dated August 13, 2018
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 497 (eRAI No.9570)," dated October 15, 2018

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. 9570:

- 05.04.07-7

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
Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
Bruce Bavol, NRC, OWFN-8G9A

Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9570

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9570

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

eRAI No.: 9570

Date of RAI Issue: 08/14/2018

NRC Question No.: 05.04.07-7

10 CFR Part 50, Appendix A, GDC 34 requires in part that a system to remove residual heat shall be provided, the safety function of which shall be to transfer fission product decay heat and other residual heat from the reactor core at a rate such that design limits and conditions are not exceeded. NuScale has adopted a PDC that uses identical language to the GDC with the exception of the power provisions, which are not pertinent to this question. In order to satisfy GDC 34, NuScale states the DHRS design ensures the RCS average temperature is below 420 degrees F within 36 hours after an initiating event without challenging the RCPB or uncovering the core. While the analytical performance of the system is documented in the FSAR, the staff requires additional information to confirm that the decay heat removal function of the as-built system as a whole will perform in accordance with the analytical assumptions.

As part of the response to RAI 8817, Question 14.3-1, NuScale provided no information related to testing of the DHRS as part of ITAAC 02.08.08 that would demonstrate how the as-built DHRS thermal performance will exceed its design assumptions. While staff recognizes prototype and legacy testing play a large part in showing adequate system performance from a design perspective, staff believes it to be important to demonstrate adequate performance of the as-built system before it is called on to perform its safety function given the relative importance of the system.

As such, staff requests that NuScale include a test or a commitment to perform a test (either supplementing an existing test or a new one) that involves operating the DHRS valves with a heated system (not necessarily full temperature and pressure) such that natural circulation flow removes heat from the loop and the thermal performance of the system can be measured. The test, if not run at design basis conditions, should then be compared against a limiting analysis using the tool of record (NRELAP) for the test conditions to show that the as-built performance meets or exceeds analytical assumptions. This approach corresponds to that used for previous novel decay heat removal systems.

NuScale Response:

NuScale provided a response to request for additional information (RAI) 9570, Question 05.04.07-7, on October 15, 2018. During followup clarification discussions with the NRC regarding the RAI response NuScale and the NRC discussed the need for a description of the Decay Heat Removal System (DHRS) one-time-test to reside in the Final Safety Analysis Report (FSAR). With this supplemental response, NuScale is providing a markup to the FSAR that incorporates a description of the proposed DHRS in-situ test.

Impact on DCA:

FSAR sections 5.4.3.4 and 14.2.3.3 have been revised as described in the response above and as shown in the markup provided in this response.

RAI 09.03.06-2S1

The DHRS actuation valves are classified as Category B valves in accordance with OM Code Subparagraph ISTC-1300(b) because seat leakage in the closed position is inconsequential for fulfillment of the required function(s). Exercising the actuation valves while at power is not practicable. Therefore, the valves are full-stroke exercised during the equivalent of cold shutdown conditions as allowed by OM Code, Subparagraph ISTC-3521(c). As described in Section 3.9.6, NuScale Mode 3 safe shutdown with reactor coolant temperatures < 200 degrees Fahrenheit is considered to be the equivalent of cold shutdown as defined in the OM Code ISTA-2000. The DHRS actuation valves that are fully cycled as part of a plant shutdown satisfy the exercising requirements provided they meet the observation requirements for testing in accordance with ASME OM Code, Paragraph ISTC-3550. In addition, loss of valve actuator power and position verification testing is performed in accordance with OM Code, Paragraphs ISTC-3560 and ISTC-3700, respectively.

The DHRS automatic actuation testing and valve actuation testing, including position verification testing, is performed in accordance with plant technical specifications.

RAI 05.04.07-7S1

An in-situ test of the DHRS function to remove heat from the RCS is to be performed for the first installed reactor module. This one-time test will be performed as part of the initial test program, using the MHS to bring the RCS as close to normal operating conditions as practical. Once test conditions are reached, the DHRS actuation valves are opened and containment isolation valves are closed via the MPS. The RCS bulk temperature will be observed during the duration of the test and compared to a test analysis using the code of record to verify the performance of the DHRS meets design basis requirements.

5.4.4 Reactor Coolant System High-Point Vents

5.4.4.1 Design Basis

10 CFR 52.47(a)(4) requires addressing the need for high-point vents following postulated LOCAs pursuant to 10 CFR 50.46a. 10 CFR 50.46a requires high-point vents for the RCS, reactor vessel head and other systems required to maintain adequate core cooling if the accumulation of noncondensible gases cause a loss of function of these systems. 10 CFR 52.47(a)(8) requires demonstrating compliance with technically relevant portions of the Three Mile Island (TMI) requirements set forth in certain paragraphs of 10 CFR 50.34(f), including 10 CFR 50.34(f)(2)(vi). The RCS venting capability required by 10 CFR 50.34(f)(2)(vi) is substantively similar to 10 CFR 50.46a requirements.

5.4.4.2 System Design

The NPM design comprises a reactor core, two SGs, and a pressurizer, contained within a single RPV, surrounded and contained within a steel CNV.

Assessment Program (CVAP) Technical Report", TR-0716-50439. The CVAP is addressed in Section 3.9.2.

RAI 14.02-1

The following ITP test abstracts describe the on-site CVAP testing of FOAK design features:

- Table 14.2-44: Control Rod Drive System Flow-Induced Vibration Test #44
- Table 14.2-45: Reactor Vessel Internals Flow-Induced Vibration Test #45
- Table 14.2-75: Steam Generator Flow-Induced Vibration Test #72.
- Table 14.2-108: NuScale Power Module Vibration Test #108

RAI 05.04.07-7S1, RAI 14.02-1

The test results for the CVAP program testing of the first NPM are to inform the required CVAP testing on subsequent NPMs as described in Section 6.0 of TR-0716-50439. All other ITP testing of FOAK design features is performed for each NPM, except as described below.

RAI 05.04.07-7S1

Section 5.4.3.4 contains a description of the DHRS one-time in-situ RCS heat removal test. The test will be performed per test abstract Table 14.2-48: Decay Heat Removal System Test # 48.

RAI 14.02-1

Table 14.2-110 provides a summary of the ITP testing (i.e., preoperational and startup testing) for new design features. Each test will be performed for all NPMs.

RAI 14.02-1

Section 1.5.1 contains a description of testing programs which have been completed or are currently in progress for NuScale design features for which applicable data or operational experience did not previously exist. The section describes tests specific to fuel design, steam generator (SG) and control rod assemblies.

14.2.3.4 Generic Component Testing

Component testing is generally executed after a system's transfer from the construction organization to the startup organization. Generic component testing executes standardized tests for a family of related component types, independent of the component's system assignment. Each generic component test procedure will be completed and approved before the component is required as a prerequisite to a preoperational test performance. The completion of generic component testing will be listed as a prerequisite in each preoperational test procedure as applicable.

Examples of components that may require generic component testing are as follows:

- Mechanical Components
  - pumps

RAI 05.04.07-7S1

Table 14.2-48: Decay Heat Removal System Test # 48

Preoperational test is required to be performed for each NPM. System Test #48-1 is required to be performed once for NPM #1. This test supports FOAK testing described in Section 14.2.3.3.		
The DHRS is described in Section 6.3. FOAK Test #48-1 is described in Section 5.4.3.4. DHRS functions are not verified by DHRS tests. DHRS functions verified by other tests are:		
System Function	**System Function Categorization**	**Function Verified by Test #**
1. The DHRS supports the RCS by opening the DHRS actuation valves for DHRS operation.	safety-related	MPS Test #63-6 Reactor Trip from 100 Percent Power Test # 104
2. The DHRS supports the MPS by providing MPS actuation instrument information signals.	safety-related	MPS Test #63-1
3. The DHRS supports the MPS by providing PAM instrument information signals.	nonsafety-related	SDIS Test #66-2
4. The UHS supports the DHRS by accepting the heat from the DHRS heat exchanger.	safety-related	Reactor Trip from 100 Percent Power Test # 104
Prerequisites Verify an instrument calibration has been completed, with approved records and within all calibration due dates, for all instruments required to perform this test.		
Component Level Tests		
Test Objective	**Test Method**	**Acceptance Criteria**
i. Verify each DHRS instrument is available on an MCS or PCS display. (Test not required if the instrument calibration verified the MCS or PCS display.)	Initiate a single real or simulated instrument signal from each DHRS transmitter.	The instrument signal is displayed on an MCS or PCS display, or is recorded by the applicable control system historian.
System Level Test~~s~~ #48-1 **RCS is at normal operating pressure and the RCS has achieved the maximum temperature achievable by warming the RCS using MHS heating.**		
~~None~~Test Objective	**Test Method**	**Acceptance Criteria**
Verify DHRS removes heat from the RCS.	i. Verify RCS is at normal operating pressure and the RCS has achieved the maximum temperature achievable by warming the RCS using MHS heating. ii. Open DHRS actuation valves and close containment isolation valves by initiating a containment isolation via MPS. iii. Allow the RCS to cool down less than 420 degrees. iv. Compare RCS cooldown rate to test analysis conducted using the code of record as described in Section 5.4.3.4.	DHRS cooldown of RCS meets design basis requirements.

RAI 05.04.07-7S1, RAI 14.02-1, RAI 14.02-5

Table 14.2-110: ITP Testing of New Design Features

New System or Component Design	Design Feature Tested in the Initial Test Program	FSAR Section 14.2 Test Number
Containment isolation valves	• valve leak rate test • valve response to manual ESF action at hot functional test pressure and temperature • valve response time test at hot functional test pressure and temperature • valve response to manual reactor trip at 100% power	#43-1 #63-6 #63-7 #104
ECCS valve design	• valve response to manual ESF action at hot functional test pressure and temperature • test of valve inadvertent actuation block at design pressure	#63-6
DHRS valve design	• valve response to manual ESF action at hot functional test pressure and temperature • valve response to manual reactor trip at 100% power	#63-6 #104
DHRS heat exchanger design	• heat exchanger response to manual ESF action at hot functional test pressure and temperature • heat exchanger response to manual reactor trip at 100% power	#48-1 #104
Containment flooding and drain system	• automatic fill of containment • automatic drain of containment	#42
Containment evacuation system	• establish and maintain containment vacuum • provide RCS leakage detection	#41
CNTS level sensors	• provides containment level input for CFDS automatic fill and drain of containment	#42
RCS flow sensors	• provides RCS flow indication during HFT and power ascension testing	#77 #94
Pressurizer level sensors	• Provides input for pressurizer level control	#38-1
Island mode operation	• NuScale Power Modules can operate independently from offsite transmission grid.	#105 and #106