RAIO-0318-59050

March 08, 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. 255 (eRAI No. 9164) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 255 (eRAI No. 9164)," dated October 13, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 255 (eRAI No.9164)," dated December 12, 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. 9164:

- 06.02.06-2

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
NuScale Power, LLC

Distribution: Omid Tabatabai, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
Prosanta Chowdhury NRC, OWFN-8G9A

Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9164

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9164

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

eRAI No.: 9164
Date of RAI Issue: 10/13/2017

NRC Question No.: 06.02.06-2

Pursuant to Title 10 of the *Code of Federal Regulations* (10 CFR) Section 52.7, “Specific exemptions,” NuScale Power, LLC. (NuScale) is requesting an exemption from Appendix A, “General Design Criteria for Nuclear Power Plants,” to 10 CFR Part 50, General Design Criterion (GDC) 52, “Capability for Containment Leakage Rate Testing,” which requires the capability for containment leakage rate testing at design pressure. Appendix J, “Primary Reactor Containment Leakage Testing for Water- Cooled Power Reactors,” to 10 CFR Part 50 specifies Type A testing directly related to GDC 52.

NuScale Design Control Document, Part 2 – Tier 2, Section 6.2.6, “Containment Leakage Testing,” states that further details of the exemption are provided by technical report (TeR)-1116-51962-NP, “NuScale Containment Leakage Integrity Assurance,” Revision 0.

Section 5.6, “Type A Testing Challenges,” of TeR-1116-51962 states that temporary temperature sensors may need to be installed for each Type A test. Section 5.6.1, “Temperature,” of TeR-1116-51962-NP states that:

> While the exact number of additional sensor required is not known, including the additional permanently installed sensors in the NuScale design would significantly increase the number of sensors for the CNV [containment vessel] and add more signal leads to those already required

Note of Figure 5-2, “Reactor pressure vessel, containment vessel, ultimate heat sink temperature gradients,” of TeR-1116-51962- NP states that:

> Requires significant additional instrumentation solely for ILRT [integrated leak rate test] purposes, which would require additional containment penetrations.

The NRC staff requests the applicant to provide the following information for the additional instrumentation solely for ILRT (i.e., pressure, temperature, and relative humidity):

1. Describe the location of the penetrations needed for the permanently installed or field

installed instrumentation solely for ILRT.

2. What permanently installed or field installed instrumentation for the ILRT is required for the test rig, test stand, or test bench?

3. What test instrumentation for ILRT would be temporary installed inside the containment vessel?

4. Would the temporary test instrumentation for ILRT remain inside the containment vessel during operation?

5. As far as the instrumentation specifications, explain why the instrumentation requirements for NuScale design is different from that of an existing reactor.

6. For each penetration, explain why it is not possible for use to support ILRT as the penetration(s) design exists now, and why it would not be possible to modify the penetration(s) design to accommodate for ILRT.

NuScale Response:

Heat transfer boundaries within the CNTS and RCS provide dynamic conditions that do not allow a stable environment where small leakage can accurately be detected. Even if ideal instrumentation was used, a satisfactory ILRT could not be performed due to pressure/temperature conditions inside the high pressure steel containment.

For the NuScale plant performing a Type A test with water filled to the baffle level of the reactor vessel, the following gas and water volumes would be present in containment. The water filled containment volume is approximately 5000 ft^3 and the gas filled volume is approximately 3700 ft^3.

A change in water temperature of 1°F (minimum resolution required by ANS 56.8) that is not detected (over the 24 hr test period) with water at 100°F and decreasing to 99°F would lead to a change in water density that would result in a decrease of about 1 ft^3 of water volume. This decrease in water volume would cause a decrease in pressure during the test of approximately 1.65 psi. It has been determined that a loss of 1.35 psi would fail a NuScale Type A test. This demonstrates that a 1°F undetected temperature change in the water would fail a NuScale Type A test.

For the NuScale module with an air filled containment and water in the RPV up to the baffle plate area, a 1°F undetected change in air temperature would lower the pressure by approximately 1.7 psi.

The following changes to the NuScale design would be required to perform a hypothetical

NuScale ILRT. However, as previously discussed, an ILRT can not be realistically performed. In addition, adding the additional instrumentation penetrations discussed below would increase maintenance costs and also increase radiation exposure to workers, which would result in a net reduction of safety.

1. A redesign of the CNV head would be required to facilitate additional permanently installed instrumentation. Temporary field instrumentation would either require new penetrations or a redesign of the CNV head manway cover (CNV24) to include EPAs for field instrumentation. A detailed study to determine the feasibility of this design concept has not been performed because 1) the required instruments are not commercially available, and 2) even if ideal instrumentation was used, an accurate ILRT could not be performed.

2. The ILRT would require:

- Air compressors (temporary or permanent) that could produce a minimum of 1000 psia pressure at a suitable capacity for the refueling outage.
- Additional numerous temperature instruments with suitable accuracy (discussed below) that are installed at different elevations and polar coordinates within the CNV and RPV to accurately generate a temperature profile of the CNV atmosphere and within the RPV. Changes in heat flux due the reactor and ultimate heat sink temperature gradients would determine the number and location of detectors. Precise temperature measurement throughout the module is required to avoid inaccuracies that could be either conservative or non-conservative in nature.
- Additional pressure instrument with suitable accuracy to detect very small pressure changes (discussed below). This instrument can be located in a convenient area.
- New EPAs to facilitate temporary instrumentation cables from the detectors to the test stand.
- Temporary test stand that supported instrumentation and graphic interface for test reading and calculation.

3. Temporary test instrumentation would include numerous temperature detectors and associated cabling in the tested gas and water spaces, temporary dewpoint/moisture detectors in the gas spaces, and temporary pressure detector and cabling. The locations for these instruments would likely require permanent mounting locations to be incorporated into the CNV and RPV designs.

4. Temporary instrumentation would not remain inside the CNV during normal operation. It would not be designed for the CNV operating environment.

5. The sensors listed and specified below are an example of the types reviewed, with the greatest accuracies, to determine if the accuracies required by 10CFR50, Appendix J and ANSI/ANS-56.8-1994 for a NPM CILRT, were achievable.

ANSI/ANS-56.8-1994, Paragraph 4.3.1.3 requires an absolute pressure accuracy of ±0.02 psi

NuScale Power™

and resolution of ±0.001 psi, which is not achievable with readily available sensors. The required temperature and flow accuracies are possible with readily available sensors.

The values of flow and temperature that are listed in ANSI/ANS-56.8 are used to determine humidity and induced flow rate for compensation of pressure readings. The expected values for the NuScale containment are not significantly different than those expected in a conventional containment. Similarly, measurement of the ambient, external pressure in Paragraph 4.3.1.5 would be the same for both. The pressure measurement within the NuScale containment at testing pressure is the only variable that will be significantly different. Given the accuracy of the industrial and laboratory grade instruments noted in the table below, it is unlikely that an instrument of any type could be customized to achieve the required accuracy.

Note: ANSI/ANS-56.8-2002 relaxes the accuracy requirements to ±0.025 psi, however, this accuracy is unachievable for the NuScale CILRT range as shown in the table below.

All stated accuracies are reference accuracy and neglect any temperature and drift effects. Accuracy percentages are percent of calibrated range.

Industrial Grade Sensors

Vendor	Model	Range	Accuracy	Accuracy
Wika	CPG1500 digital pressure gauge	0-1500 psi	0.1% (0.05% optional)	1.5 psi (0.75 psi)
Vega	VegaBar 83	0-100 bar (0-1450 psi)	0.1%	1.45 psi
Rosemount	3051N	0-2000 psi	0.075%	1.5 psi
Heise (Ashcroft, Inc.)	Model CMM	0-1500 psi	0.1%	1.5 psi
Core Sensors	CS-HTP	0-1500 psi	0.15%	2.25 psi
Rosemount	Wireless pressure gauge	0-1500 psi	0.2%	3 psi

Laboratory Grade Instruments

Vendor	Model	Range	Accuracy	Accuracy
GE	RPS/DPS 8100	0-50 psi	0.01%	0.005 psi
GE	RPS/DPS 8200/8300	0-1000 psi	0.01%	0.1 psi
Noshok	Series 640	0-1000 psi	0.025% optional	0.25 psi
Microsensor	MPM280	0-10 kPa (0-1450 psi)	0.0275% (sum of squares)	0.4 psi
Omega	MMA1.5KC1P1D2T4A6 (Custom configuration)	0-1500 psi	0.03%	0.45 psi

6. Each containment penetration is designed for a specific type of instrument and cannot be temporarily used for another instrument. The number of penetrations has been minimized to reduce the potential for containment leakage. However, there is still limited room on the CNV head for additional EPAs. As discussed in Question 1 above, temporary field instrumentation would either require new penetrations or a redesign of the CNV head manway cover (CNV24) to

include EPAs for field instrumentation.

Impact on DCA:

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