RAIO-1217-57621

December 12, 2017

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 Response to NRC Request for Additional Information No. 255 (eRAI No. 9164) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 255 (eRAI No. 9164)," dated October 13, 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. 9164:

- 06.02.06-1
- 06.02.06-2
- 06.02.06-3

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: Gregory Cranston, NRC, OWFN-8G9A
Omid Tabatabai, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A

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

Enclosure 1:

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

NuScale Power

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

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

NRC Question No.: 06.02.06-1

NuScale Design Control Document (DCD), Part 2 – Tier 2, Table 1.9-2, "Conformance with Regulatory Guides," provides an evaluation of conformance with the guidance in Nuclear Regulatory Commission (NRC) regulatory guides (RG) in effect six months before the submittal date of the Final Safety Analysis Report. However, Table 1.9-2 does not specify the revision number of RG 1.163, "Performance-Based Containment Leak-Test Program," that will be used. The NRC staff requests the applicant to document in Table 1.9-2 what revision of RG 1.163 it is referencing in the NuScale DCD.

NuScale Response:

Regulatory Guide (RG) 1.163 currently does not document a revision number. The document has a date of September 1995 on its header, but no revision is noted. This is the only version available on the ADAMS website. A number of additional initial issue revision regulatory guides also do not denote a numerical revision number (e.g., RG 1.5, RG 1.6, etc),

Table 1.9-2 identifies numerical revision levels that are consistent with the version available in ADAMS. For cases such as RG 1.163, no numerical revision level is listed, which is consistent with the cover page of the version in ADAMS.

Impact on DCA:

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

NuScale Power™

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:

Preface:

NuScale's request for exemption from GDC 52 is based primarily on the special circumstances that application of the regulation in the particular circumstances is not necessary to achieve the underlying purpose of the rule, because NuScale's alternative approach to leakage integrity verification meets the underlying purpose of GDC 52. Although such special circumstances, if demonstrated, are sufficient to justify NuScale's request, the request for exemption additionally addresses other special circumstances that NuScale believes are present, including that compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted. The discussion in TeR-1116-51962 pertaining to additional instrumentation solely for ILRT informed NuScale's design but is not cited as a basis for NuScale's exemption request. Because NuScale has developed an alternative to ILRT to reasonably assure acceptable leakage integrity, NuScale has not developed a detailed ILRT plan. Notwithstanding, the following additional information is intended to aid NRC staff in their consideration.

Question 1:

Describe the location of the penetrations needed for the permanently installed or field installed instrumentation solely for ILRT.

Answer:

All penetration sites on the head are allocated, and there are no spare penetrations currently in the design. A new penetration would need to be designed and added to the vessel. With no space available, a modification of the containment manway is possible. A temporary containment head manway can be manufactured and used as a penetration source. The penetration would provide temperature and moisture instrument cable penetrations to provide ILRT mandated data input.

Question 2:

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

Answer:

To perform an ILRT with the instrumentation described in ANSI 56.8, NuScale would need to add temperature and moisture instruments to the containment and reactor vessel to provide ILRT mandated data input. The ILRT test package would need to add a precision pressure detector to the system installed on one of the pipe lines that are open to the containment atmosphere. A temporary manway penetration (as above) can be outfitted with instrument penetrations to provide the cabling for the moisture and temperature instruments to be temporarily installed to meet testing requirements. Readout from the normal installed containment level instrumentation would need to be provided to support testing.

To add these instruments and equipment to perform an as found test would require the containment to be breached prior to the testing, and would require a piping penetration to remain open during the test to supply a pathway for providing the pressure sensing and post-test leakage verification testing flow. The manway is one of the normally closed type B penetrations on the containment vessel.

Question 3:

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

Answer:

Temperature and humidity/moisture would be required to be temporarily added. Pressure would be added outside the CNV, and the normal containment level instrumentation can be made available to support testing.

Question 4:

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

Answer:

The ILRT temperature, humidity/moisture and pressure instrumentation is not permanently installed in the containment.

Question 5:

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

Answer:

NuScale leak limit is about 1/30th that of large LWRs. This requires the instrumentation to be more precise to obtain the leakage results compared to a standard LWR test.

The NuScale plant analyses show that the containment accident pressure will be about 951 PSIA. General testing at about 1000 psi is more than 10 times the test pressure for a standard LWR test.

The pressure gauge requirement in ANSI 56.8 calls for a gauge capable of ± 0.025 psi accuracy, 0.001 psi resolution and ± 0.005 psi repeatability for a 1000 PSI range. This accuracy and resolution is not readily available in commercial instrumentation.

Temperature instrumentation will be required to cover both the reactor vessel and the containment vessel. Areas of the reactor vessel pressurizer space would need temperature monitoring. Providing instruments in both of those areas is extremely difficult due to temperature, oxygen needs (for access), and physical access restrictions. Ideal placement of the instruments would vary from test to test due to water level variations, making permanent mounting not an option. The number of instruments needed to adequately monitor the containment vessel and the reactor vessel is above the currently required installed monitoring equipment.

Question 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.

Answer:

Current penetrations are all fillled. Power and instrument penetrations have conductor spaces slated for instruments to supply the current complement of instrumentation and power needs before additional ILRT instrumentation is added. Any added instrumentation will require added penetration(s) to accommodate. The head space to add permanent penetrations is not available. (As above) a temporary manway cover outfitted with instrument penetrations can be designed to support test instruments.

Impact on DCA:

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

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

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

NRC Question No.: 06.02.06-3

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.

The design of containment penetrations support performance of the integrated leak rate testing (i.e., Type A test) in accordance with the guidance provided in American National Standards Institute/American Nuclear Society (ANSI/ANS) 56.8, “Containment System Leakage Testing Requirements”, 1994; Regulatory Guide 1.163, “Performance-Based Containment Leak-Test Program”; and Nuclear Energy Institute 94-01, “Industry Guideline for Implementing Performance-Based Option of 10 CFR Part 50, Appendix J.” Section 4, “Instrumentation,” of ANSI/ANS-56.8–1994 specifies the accuracy requirements for each type of measurement required.

NuScale Design Control Document (DCD), Part 7, Section 7, “10 CFR 52, App. A, GDC 52 Containment Leakage Rate Testing,” states that:

> As discussed in TR-1116-51962, application of Type A testing requirements for the NuScale CNV [containment vessel] would likely yield inaccurate leakage results due to the limited effectiveness of Type A acceptance criteria when applied to the NuScale design.

NuScale DCD, Part 2 – Tier 2, Section 6.2.6 states that:

> Ensuring proper placement, accuracy, and calibration will be difficult, and meeting all ANSI/ANS 56.8 criteria appears insufficient to provide accurate test results and essentially not possible.

It further states that:

> As described in TR-1116-51962, the NuScale containment design presents unique challenges to performing integrated leak rate testing at containment design pressure. Type A testing requirements were not written to address the unique challenges of the NuScale containment design, and the regulation does not provide for testing acceptance criteria or alternatives which adequately address the temperature and pressure variations expected during Type A testing within the NuScale containment. The temperature and pressure impacts on Type A testing and associated acceptance criteria for the NuScale design increase the likelihood of inaccurate results, false test failures, and multiple testing iteration requirements. The relative hardship of such challenges is increased considering the rated power of the NuScale small modular reactor compared to the LLWR [large light water reactors] designs contemplated by the regulation. Therefore, application to the NuScale design represents undue hardships that are significantly in excess of those contemplated when the regulation was adopted.

Section 2.0, “Containment Leakage Integrity Assurance Overview, of TeR-1116-51962 states in part that:

> The NuScale containment is initially inspected and tested at the factory, including hydrostatic testing with an acceptance criterion of zero leakage, to verify that no unknown leak pathways exist. …. Periodic inspection and testing verifies that no unknown leakage pathways develop over time (i.e., any potential through-wall degradation will be precluded as a credible mechanism for containment leakage).

Section 5.6, “Type A Testing Challenges,” of TeR-1116-51962 states:

> Sensors, more accurate and located in different locations than the normal plant temperature sensors inside the RPV [reactor pressure vessel] and CNV [containment vessel], would be needed to monitor temperature changes of coolant in the RPV and the CNV.

The NRC staff requests the applicant to provide the following information:

1. Describe the instrumentation and specifications required for the hydrostatic testing with an acceptance criterion of zero leakage to verify that no unknown leakage pathways exists.
2. Describe the periodic inspection and testing would be needed to verify that no unknown leakage pathways develop over time?
3. Describe existing instrumentation and accuracy that is available for the existing NuScale design.
4. With regards to the statement, "the regulation does not provide for testing acceptance criteria or alternatives which adequately address the temperature and pressure variations

expected during Type A testing within the NuScale containment." Rather than hardship for not being able to meet the existing regulation, provide an alternative that meets the intent of Type A testing, including but not limited to measuring leak rate, that is viable for the NuScale design.

NuScale Response:

Question1:

Describe the instrumentation and specifications required for the hydrostatic testing with an acceptance criterion of zero leakage to verify that no unknown leakage pathways exists.

Answer

The initial hydrostatic testing is not intended to quantify the leakage, rather it is a visual verification, performed in the factory, to ensure that there are no weld or material defects that create leakage pathways.

Acceptance of the NuScale hydrostatic test requires the visual examination of the entire surface area with the pressure held within the required test parameters while inspection verifies no leakage is found. This initial hydrostatic test verifies that the containment vessel has no manufacturing flaws that create leakage pathways.

Question 2:

Describe the periodic inspection and testing would be needed to verify that no unknown leakage pathways develop over time?

Answer

The NuScale Containment Leakage Integrity Program provides reasonable assurance that no unknown leakage pathways develop over time. As discussed in TR-1116-51692, the containment vessel will be continuously monitored during normal operations for its ability to maintain system vacuum conditions. Leakage pathways that develop over time would be evident, since they would adversely affect the ability to maintain vacuum conditions. During outages, the ASME Class 1 containment vessel will be subject to the required ISI inspections which include visual examination (VT-3) of all surfaces external and internal. Vessel welds are subject to volumetric inspection as called out by the ISI program. Both visual and volumetric exams are required to provide 100% inspection of the total vessel within the 10 year ISI inspection interval. 100% of the visual exam will be completed during each outage period (one third of the inspection interval) while 100% of the volumetric exam will be completed during each inspection interval. Each fuel cycle approximately 20% of the welds will be volumetrically inspected while 50% to 100% of the surfaces will be visually examined. Periodic testing, that occurs during the outage, consists of performing the LLRT tests on all penetrations. The tests are done on an as found basis at the start of the outage, and then repeated at the end of the outage for penetrations that have been opened for maintenance use or for repairs. This ensures integrity of the flanged connections prior to reactor start-up.

Question 3:

Describe existing instrumentation and accuracy that is available for the existing NuScale design

Answer

The instrumentation provided in the containment vessel and the reactor vessel and its associated accuracy are contained in the Nuclear Steam Supply Advanced Sensors Technical Report (TR-0316-22048).

Question 4

With regards to the statement, "the regulation does not provide for testing acceptance criteria or alternatives which adequately address the temperature and pressure variations expected during Type A testing within the NuScale containment." Rather than hardship for not being able to meet the existing regulation, provide an alternative that meets the intent of Type A testing, including but not limited to measuring leak rate, that is viable for the NuScale design.

Answer

NuScale's request for exemption does not claim as a basis "not being able to meet the existing regulation." As stated in Section 7.3.1 of NuScale's request for exemption from GDC 52, amongst other special circumstances, NuScale believes that compliance would result in undue hardship or other costs that are significantly in excess of those contemplated when the regulation was adopted. As stated, the hardship is the expected increased likelihood of inaccurate results, false test failures, and multiple testing iteration requirements. That hardship is undue considering the alternative means NuScale has proposed that would reasonably assure leakage integrity. Accordingly, NuScale has not developed alternative ILRT acceptance criteria, but rather has proposed means other than ILRT adequate to demonstrate leakage integrity.The alternative NuScale proposes to Type A testing is the combination of testing as described in TR-1116-51962 and summarized in this response.

The unique design of the NuScale containment being a factory fabricated metal vessel, constructed to ASME Class I rules, with inservice inspections of all surfaces and welds, and the ability to test all leakage pathways via Type B or Type C testing provides justification for this alternative approach.

ASME Section III construction testing requires that 100% of the vessel surface area (internal and external) will be volumetrically inspected. The vessel will require a 125% pressure hydrostatic test. The hydrostatic test acceptance will require that no leakage be found.

Preservice inspection will include type B and C testing of all penetrations and valves within the program for the initial test program. Acceptance of the preservice testing based on passing the surface exams, the hydro test, and the type B and C testing meeting a total of ≤0.6La total leakage measured for all tests and inspections.

Outage tests to comply with the ISI program will require VT-3 examination of all internal and external vessel surfaces. ISI outage testing will require complete volumetric testing of all welds included on the vessel. For both the VT-3 and volumetric testing, ISI requires that 100% inspection be completed within the 10 year ISI inspection interval. 100% of the visual exam will be completed during each outage period (one third of the inspection interval) while 100% of the volumetric exam will be completed during each inspection interval. Each fuel cycle approximately 20% of the welds will be volumetrically inspected while 50% to 100% of the internal and external surfaces will be visually examined. The volumetric and visual examinations will reveal defects in the CNV welds and surfaces that develop over time.

The vessel will be continuously monitored for vacuum retention. This will allow continuous tracking of vessel condition to gauge ongoing response to expected performance for pressure retention during an accident.

Type B/C local leak rate testing will be performed on all openings at each refueling outage.

The alternative acceptance leakage criteria will be based on satisfactory completion of all testing required at each outage. Type B/C test results acceptance is assessed by the maximum leakage pathway B/C leakage testing totals meeting the ≤0.6La total allowance.

The above described alternative meets the intent of Type A testing.

Impact on DCA:

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