NuScaleDCRaisPEm Resource

From: Cranston, Gregory
Sent: Friday, June 15, 2018 10:56 AM
To: NuScaleDCRaisPEm Resource
Subject: Request for Additional Information No. 433 eRAI No. 9474 (6.2.6)
Attachments: Request for Additional Information No. 433 (eRAI No. 9474).pdf

Importance: High

Attached please find NRC staff's request for additional information (RAI) concerning review of the NuScale Design Certification Application.

Please submit your technically correct and complete response within 60 days of the date of this RAI to the NRC Document Control Desk.

If you have any questions, please contact me.

Thank you.

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Request for Additional Information No. 433 (eRAI No. 9474)

Issue Date: 04/23/2018
Application Title: NuScale Standard Design Certification - 52-048
Operating Company: NuScale Power, LLC
Docket No. 52-048
Review Section: 06.02.06 - Containment Leakage Testing
Application Section: 6.2.6

QUESTIONS

06.02.06-22

The regulatory bases for the question below are:

10 CFR 50.12 Specific Exemptions, (a)(1) The Commission may…grant exemptions from the requirements of the regulations which …will not present an undue risk to the public health and safety.

10 CFR 52.47, Contents of Applications; technical information, (a) The application must contain a final safety analysis report (FSAR) that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole, and must include the following information: (2) A description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished. The description shall be sufficient to permit understanding of the system designs and their relationship to the safety evaluations.

10 CFR 52.47 Contents of Applications; technical information,

(a)(2)(iv) which states, in part "The applicant shall perform an evaluation and analysis of the postulated fission product release, using the expected demonstrable containment leak rate … to evaluate the offsite radiological consequences."

10 CFR 50, GDC 16—Containment design. Reactor containment and associated systems shall be provided to establish an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment and to assure that the containment design conditions important to safety are not exceeded for as long as postulated accident conditions require.

10 CFR 50, Appendix J, defines La as the maximum allowable containment leakage rate in weight percent per day at peak containment accident pressure, Pa. The combined leakage rate of all penetrations and valves subject to Type B and C tests shall be less than 0.60 La.

This is a followup to RAI 271-9147, question 6.2.6-4.

10 CFR 50, Appendix J, requires that primary reactor containments meet the containment leakage test requirements to provide for preoperational and periodic verification by tests of the leak-tight integrity of the primary reactor containment, and systems and components which penetrate containment.

NuScale, has selected La to be 0.20 weight percent of the containment air mass per day at the peak containment accident pressure, Pa. La is established as a safety analysis operational limit and the containment Technical Specification limit for operability for the NuScale design. This maximum allowed leakage rate is the basis for the accident radiological leakage to the environment.

NuScale is requested to describe how the maximum allowable leak rate, La, will be demonstrated. Typically this would be shown through a combination of preoperational and periodic Types A, B and C testing. Since NuScale has requested an exemption from Appendix J Type A test requirements, this demonstration should include the technical basis for concluding that Types B and C testing are sufficiently representative of accident conditions to provide confidence that the test results from Types B and C assure that the assumed leak rate, La, would not be exceeded. Additionally, as required by 10 CFR 50, Appendix J, the acceptance criteria for Types B and C tests is to show that the expected leakage from all local penetrations, Types B and C, is less than 0.60 La. This demonstration should consider the differences in test volume pressurization during Type A and Types B and C testing and their potential impact on the test results. For example, the stresses on a bolted connection would be significantly different during Type A testing, where the containment volume is held at accident pressure, than a Type B test, where only the volume between a double o-ring seal is pressurized.

06.02.06-23

The regulatory bases for the question below are:

10 CFR 52.47, Contents of Applications; technical information, (a) The application must contain a final safety analysis report (FSAR) that describes the facility, presents the design bases and the limits on its operation, and presents a safety analysis of the structures, systems, and components and of the facility as a whole, and must include the following information: (2) A description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefor, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished. The description shall be sufficient to permit understanding of the system designs and their relationship to the safety evaluations.

This is a followup to RAI 271-9147, question 6.2.6-12.

This is a followup question to the NuScale response to the 12 Feb 2018 clarification call on question 6.2.6-12, in which staff asked where in the FSAR it was stated that the factory CNV hydrotest would be performed on an assembled containment vessel. NuScale responded that FSAR Section 6.2.1.6 states: "The CNV is hydrostatically tested in accordance with ASME BPVC Section III, Subsection NB-6000". This is an accurate quote from the FSAR. However, the ASME Code Section III, Subsection NB-6000 does not require hydrostatic testing of an assembled vessel.

NuScale is requested to confirm that the factory hydrotest of the CNV will be performed on an assembled containment vessel with the same bolting materials, same bolt preload tensioning and same double O-rings seals specified in the design. NuScale is requested to provide a description of the assembled CNV, and to state in FSAR section 3.8.2, FSAR section 6.2.6, NuScale Containment Leakage Integrity Assurance Technical Report, TR-1116-51962, Rev. 0, and NuScale ASME Design Specification for Containment Vessel, EQ-A013-1826, rev 1, that the factory hydrostatic test for the CNV will be performed on an assembled containment vessel. NuScale is requested to add to FSAR Tier 1, section 2.1 Nuclear Power Module, an ITAAC for the ASME Code requirement for the factory hydrostatic test to be performed successfully, i. e. showing zero leakage, on an assembled CNV as described in the above documents.

06.02.06-24

The regulatory bases for the question below are:

10 CFR 50.12 Specific Exemptions, (a)(1) The Commission may…grant exemptions from the requirements of the regulations which …will not present an undue risk to the public health and safety.

This is a followup to RAI 295-9216, question 6.2.6-18.

NuScale Containment Leakage Integrity Assurance Technical Report, TR-1116-51962, Rev. 0, section 5.3.1, Type B Test Method, states that all bolted flange penetrations will be as-found Type B tested at each refueling. And that all bolted flanges opened during refueling will also be as-left tested.

10 CFR 50, Appendix J, Option A, Section III.D.2, states Type B periodic tests shall be performed during reactor shutdown for refueling and, if opened following a Type A or B test, containment penetrations subject to Type B testing shall be Type B tested prior to returning the reactor to an operating mode requiring containment integrity. Staff agrees that this as-left Type B testing is an important component of reestablishing a leak tight containment, and should be included after each refueling. The importance of verifying as-left leak tightness of containment applies whether containment leak rate testing Option A or Option B is selected.

Each NuScale refueling not only involves disassembly and reassembly of the CNV, but also lifting the vessel, with the potential for distortion or flexing during movement operations. In order to account for any impact of the CNV movement operations on the leak tight integrity of the Type B flanges, staff requests NuScale either consider performing as-left testing on all flanges subject to Type B testing (not just flanges which were opened and reclosed) or demonstrate that lifting and movement operations would not distort or flex flange seals resulting in loss of seal integrity. This could provide partial assurance of a leak tight condition of the CNV after each refueling.

Please confirm NuScale's intention to restore and demonstrate the CNV leak tight integrity after each refueling by performing as-left Type B tests for all bolted flanges which were opened during refueling, under either Option A or Option B. Please reflect this commitment in FSAR section 6.2.6, Containment Leakage Integrity Assurance Technical Report, TR-1116-51962, Rev. 0, and NuScale Technical Specification 5.5.9, Containment Leakage Rate Testing Program.

06.02.06-25

The regulatory bases for the question below are:

10 CFR 50.12 Specific Exemptions, (a)(1) The Commission may…grant exemptions from the requirements of the regulations which …will not present an undue risk to the public health and safety.

This is a follow up to RAI 295-9216, questions 6.2.6-18 and 6.2.6-19, and RAI 9147, question 6.2.6-12.

NuScale's Exemption Request for 10 CFR 50, App A, GDC 52 is based upon providing CNV design specifications and design capability for local leak rate testing to demonstrate that the CNV leakage will not exceed the Technical Specification allowable leakage rate values. This reasoning is being applied to a first of a kind (FOAK) containment vessel design, and relies heavily on refueling, inspection and test procedures which have yet to be demonstrated for the NuScale CNV.

The NuScale CNV, with its many bolted flanges, illustrates the importance of proper flange design, including bolt materials and sizing, and bolt preload calculations. And the importance of correctly applying bolt preloads to all flanges which have been opened during each refueling. Because the CNV will be disassembled and reassembled at each refueling, opening and reclosing at least half of the 27 bolted flanges, configuration control will be crucial in reestablishing a leak tight containment.

NuScale is requested to identify the key attributes and inspections that will be verified during containment vessel reassembly and will be included in appropriate refueling procedures, including tensioning flange bolts to their preload design value, and as-left Type B testing of all flanges during each refueling. This level of detail is not currently found in NuScale OP-0000-10842, Rev 0, Module Refueling Operations. Please add the description of these key attributes to the FSAR, section 6.2.6, Containment Leak Rate Testing, and TR-1116-51962-NP, Containment Leakage Integrity Assurance.

NuScale response to RAI 295-9216, question 6.2.6-18, proposed to add to TR-1116-51962, Table 5-2, the inspection elements for the flange bolting (B-G-1) and cover bolting (B-G-2). The markup of Table 5-2 in the response does not include these inspection elements. Please resubmit the intended response reflected in Table 5-2.

06.02.06-26

This is a followup to RAI 295-9216, questions 6.2.6-19 and 6.2.6-20, and RAI 271-9147, question 6.2.6-5.

In order for staff to evaluate whether the design of the NuScale containment is capable of meeting the Types B and C acceptance criteria, NuScale is requested to identify and provide for audit the calculation(s) which show that the total leakage for all containment penetrations subject to Type B leakage at peak accident pressure would be expected to be less than 0.60 La. For example, staff needs to understand the basis for the NuScale maximum allowable leakage rate and be convinced that the NuScale design meets the NuScale selected leakage rate. Staff understands that the containment bolted flanges are each sealed with metal double o-rings, and that these flanges will demonstrate a flange gap at the containment design pressure. Identify and provide for audit the documents which establish the calculated stud preload values for each of the 27 bolted flanges in the NuScale containment vessel (CNV). This includes calculating or confirming the stud preload on the CNV refueling flange, whose status is currently identified as ODI-15-0141. In NuScale calculation EC-A013-1691, Containment Vessel Flange Bolting Calculation, stud preload values have been calculated for most of the flanges. Provide for audit the calculation which establishes the flange gap associated with each of the 27 bolted flanges in the NuScale CNV, evaluated at the peak accident pressure, Pa, of 951 psia with suitable margin, similar to the calculations for the three flange gaps identified in NuScale EC-A013-0003036, CNV Ultimate Pressure Integrity Analysis, and reported in NuScale TR-0917-56119-P, CNV Ultimate Pressure Integrity.

In the NuScale TR-1116-51962-NP, Section 5.3.5, Containment Vessel Flange, it states that, "The CNV flange is a large double O-ring design (~45-foot circumference). This seal maintains the containment boundary between upper and lower CNV assemblies. The CNV flange leakage limit for the CLIP is **estimated** [emphasis added] to be 0.4–0.5 SCFH based on the linear seal length and performance of off-the-shelf metal seals. Provide for audit the associated leakage in SCFH from each of the 27 bolted flanges evaluated at the flange gaps calculated above when the penetrations would be subjected to the CNV internal pressure Pa, with suitable margin. Provide the sum of the leakage from the 27 bolted flanges and compare it to 60% of the NuScale Tech Spec allowable leakage, La, of 0.20 wt. % per day. La has been calculated in NuScale calculation EC-A013-5846, rev 0, Containment Testing Leakage Limit.

List as references the calculations which establish flange bolt preload, flange gaps, and flange leakage, and include the above results for the sum of leakage from all the bolted flanges in TR-0917-56119-P, Rev 0, Dec 2017, CNV Ultimate Pressure Integrity. Include the TR-0917-56119-P as a reference in FSAR section 6.2.6, Containment Leakage Testing and FSAR section 3.13, Threaded Fastener (ASME Code Class 1, 2, and 3), and in FSAR section 3.8.2.