May 9, 2017

MEMORANDUM TO: Samuel Lee, Chief
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

FROM: Bruce Bavol, Project Manager **/RA/**
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

SUBJECT: SUPPLEMENT 1 TO THE AUDIT PLAN FOR THE REGULATORY AUDIT OF NUSCALE POWER, LLC DESIGN CERTIFICATION APPLICATION CHAPTER 4, "REACTOR"; CHAPTER 5, "REACTOR COOLANT AND CONNECTING SYSTEMS"; AND CHAPTER 9, "AUXILIARY SYSTEMS"

NuScale Power, LLC (NuScale) submitted by letter dated December 31, 2016, to the U.S. Nuclear Regulatory Commission (NRC), a Design Control Document for its Design Certification (DC) application of the NuScale design (Agencywide Documents Access and Management System Accession No. ML17013A229). The NRC staff started its detailed technical review of NuScale's DC application on March 27, 2017.

The purpose of the NRC's regulatory audit of NuScale's subject line chapters is to: (1) gain a better understanding of the NuScale design; (2) verify information; (3) identify information that will require docketing to support the basis of the licensing or regulatory decision; and, (4) review related documentation and non-docketed information to evaluate conformance with regulatory guidance.

The audit will take place at NuScale's offices in Rockville, Maryland, online via NuScale's electronic reading room, and/or at AREVA's Lynchburg, Virginia office. The audit entrance was held on May 3, 2017. This supplement highlights the updates discussed during the audit entrance meeting. The contents of the supplemented audit plan is provided as an enclosure.

Docket No. 52-048

Enclosure:
Audit Plan

cc w/encl.: DC NuScale Power, LLC Listserv

CONTACT: Bruce Bavol, NRO/DNRL
301-415-6715

SUBJECT: SUPPLEMENT 1 TO THE AUDIT PLAN FOR THE REGULATORY AUDIT OF NUSCALE POWER, LLC DESIGN CERTIFICATION APPLICATION CHAPTER 4, "REACTOR"; CHAPTER 5, "REACTOR COOLANT AND CONNECTING SYSTEMS"; AND CHAPTER 9, "AUXILIARY SYSTEMS" DATED May 9, 2017

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NAME	BBavol	MBrown*	BBavol (signed)
DATE	5/8/17	5/04/2017	5/9/17

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UNITED STATES NUCLEAR REGULATORY COMMISSION
AUDIT PLAN (SUPPLEMENT 1) FOR THE REGULATORY AUDIT OF
NUSCALE POWER, LLC DESIGN CERTIFICATION APPLICATION
CHAPTER 4, "REACTOR"; CHAPTER 5, "REACTOR COOLANT AND CONNECTING SYSTEMS"; AND CHAPTER 9, "AUXILIARY SYSTEMS"

DOCKET NO. 52-048

AUDIT PLAN (SUPPLEMENT 1)

APPLICANT:	NuScale Power, LLC (NuScale)
APPLICANT CONTACTS:	Marty Bryan Darrell Gardner Steven Mirsky Jennie Wike
DURATION:	180 days Phase 1: May 3, 2017 through July 31, 2017 Phase 2: August 1, 2017 through October 31, 2017
LOCATIONS:	NuScale (Rockville Office) 11333 Woodglen Drive, Suite 205 Rockville, Maryland 20852 Electronic Reading Room (eRR) AREVA NP Inc 3315 Old Forest Road Lynchburg, Virginia 24501
AUDIT TEAM:	Jeff Schmidt (NRO, Audit Lead) Rebecca Karas (NRO/SRSB Branch Chief) Matt Thomas (NRO) Chris Van Wert (NRO) Shanlai Lu (NRO) Ray Skarda (NRO) Carl Thurston (NRO) Jim Gilmer (NRO) Boyce Travis (NRO) Alex Burja (NRO) Tim Drzewiecki (NRO) Jason Thompson (NRO) Ryan Nolan (NRO) John Budzynski (NRO) Nick Klymyshyn (PNNL) Ken Geelhood (PNNL) Supporting staff (As needed) Bruce Bavol (NRO, Project Manager)

BACKGROUND AND OBJECTIVES

NuScale submitted by a letter dated December 31, 2016, to the U.S. Nuclear Regulatory Commission (NRC) a Design Control Document (DCD) for its Design Certification (DC) application of the NuScale design (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17013A229). The NRC staff initiated this DC review on March 27, 2017.

To facilitate the NRC staff's evaluation of information supporting the DCD, and to complete its safety review of the reactors systems portions of DCD Chapter 4, "Reactor"; Chapter 5, "Reactor Coolant System and Connecting Systems"; and Chapter 9, "Auxiliary Systems," the NRC staff is planning the following:

- An audit entrance meeting was held on May 3, 2017, at NuScale's Rockville office. The initial audit duration is 180 days, which includes audit Phases 1 and 2 as noted above in the Section titled "DURATION." The audit is expected to primarily be performed via the NuScale eRR or, if necessary, at NuScale's Rockville office or AREVA's Lynchburg office. During this audit, the NRC staff will examine the referenced documents and analyses mentioned, but not specifically cited, to support their statements in the DCD.

- If necessary, this audit plan will be updated to support the remainder of Phase 1. A new audit report will be developed supporting Phase 2.

The objectives of this audit are for the NRC staff to:

- gain a better understanding of the reactor system DCD sections given in the "REGULATORY AUDIT SCOPE" section below;

- verify information;

- identify information that will require docketing to support the basis of the licensing or regulatory decision; and

- review related documentation and non-docketed information to evaluate conformance with regulatory guidance.

The NRC staff determined efficiency gains would be realized by auditing the documents which support the DCD to inform RAIs. If the staff determines during the audit and interactions with the applicant that additional information is needed to support a safety finding, a corresponding RAI will be issued at that time even if before the conclusion of the audit.

REGULATORY AUDIT BASIS

Title 10 of the *Code of Federal Regulations* (CFR), Section 52.47(a)(3)(i) states:

> *A DC application must contain a final safety analysis report (FSAR) that includes a description of principle design criteria for the facility.*

An audit is required to evaluate the safety conclusions that need to be made regarding NuScale DCD sections given in the ”REGULATORY AUDIT SCOPE” section, and identify detailed information related to the applicant’s principle design criteria. The NRC staff must have sufficient information to ensure that acceptable risk and reasonable assurance of safety can be documented in the NRC staff’s safety evaluation.

This regulatory audit is based on the following regulations:

- 10 CFR 52.47, “Contents of applications; technical information in final safety analysis report.”

- General Design Criteria (GDC) 4 “Environmental and dynamic effects design bases,” of Appendix A to 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” as it relates to the structures, systems, and components important to safety that shall be designed to accommodate the effects of and to compatible with the environmental conditions during normal plant operation as well as during postulated accidents.

- GDC 10, “Reactor Design,” which requires that reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of anticipated operational occurrences.

- GDC 11, “Reactor inherent protection,” which requires that the reactor core and associated coolant systems shall be designed so that in the power operating range the net effect of the prompt inherent nuclear feedback characteristics tends to compensate for a rapid increase in reactivity.

- GDC 12, “Suppression of reactor power oscillations,” which requires that the reactor core and associated coolant, control, and protection systems shall be designed to assure that power oscillations which can result in conditions exceeding specified acceptable fuel design limits are not possible or can be reliably and readily detected and suppressed.

- GDC 13, “Instrumentation and control,” which requires that instrumentation shall be provided to monitor variables and systems over their anticipated ranges for normal operation, for anticipated operational occurrences, and for accident conditions as appropriate to assure adequate safety, including those variables and systems that can affect the fission process, the integrity of the reactor core, the reactor coolant pressure boundary, and the containment and its associated systems. Appropriate controls shall be provided to maintain these variables and systems within prescribed operating ranges.

- GDC 23, “Protection system failure modes,” which requires that the protection system shall be designed to fail into a safe state or into a state demonstrated to be acceptable on some other defined basis if conditions such as disconnection of the system, loss of energy (e.g., electric power, instrument air), or postulated adverse environments (e.g., extreme heat or cold, fire, pressure, steam, water, and radiation) are experienced.

- GDC 25, “Protection system requirements for reactivity control malfunctions,” which

requires that the protection system shall be designed to assure that specified acceptable fuel design limits are not exceeded for any single malfunction of the reactivity control systems, such as accidental withdrawal (not ejection or dropout) of control rods.

- GDC 26, "Reactivity control system redundancy and capability," which requires that two independent reactivity control systems of different design principles shall be provided. One of the systems shall use control rods, preferably including a positive means for inserting the rods, and shall be capable of reliably controlling reactivity changes to assure that under conditions of normal operation, including anticipated operational occurrences, and with appropriate margin for malfunctions such as stuck rods, specified acceptable fuel design limits are not exceeded. The second reactivity control system shall be capable of reliably controlling the rate of reactivity changes resulting from planned, normal power changes (including xenon burnout) to assure acceptable fuel design limits are not exceeded. One of the systems shall be capable of holding the reactor core subcritical under cold conditions.

- GDC 27, "Combined reactivity control systems capability," which requires that the reactivity control systems shall be designed to have a combined capability, in conjunction with poison addition by the emergency core cooling system, of reliably controlling reactivity changes to assure that under postulated accident conditions and with appropriate margin for stuck rods the capability to cool the core is maintained.

- GDC 28, "Reactivity limits," which requires that The reactivity control systems shall be designed with appropriate limits on the potential amount and rate of reactivity increase to assure that the effects of postulated reactivity accidents can neither (1) result in damage to the reactor coolant pressure boundary greater than limited local yielding nor (2) sufficiently disturb the core, its support structures or other reactor pressure vessel internals to impair significantly the capability to cool the core. These postulated reactivity accidents shall include consideration of rod ejection (unless prevented by positive means), rod dropout, steam line rupture, changes in reactor coolant temperature and pressure, and cold water addition.

- GDC 29, as it relates to protecting system against anticipated operational occurrences such that the design of the protection and reactor control systems should assure an extremely high probability of accomplishing their safety functions in the event of anticipated operational occurrences.

- GDC 62, as it relates to the prevention of criticality by physical systems or processes, preferably by using geometrically safe configurations.

- 10 CFR 50.46, 10 CFR 50.34, and 10 CFR 50.67, as they relate to the cooling performance analysis of the ECCS using an acceptable evaluation model and establishing acceptance criteria for light-water nuclear power reactor ECCSs.

- 10 CFR 50.68, "Criticality accident requirements," as it relates to preventing a criticality accident and to mitigating the radiological consequences of a criticality accident.

- 10 CFR 52.47(b)(1), which requires that a DC application contain the proposed inspections, tests, analyses, and acceptance criteria (ITAAC) that are necessary and

sufficient to provide reasonable assurance that, if the inspections, tests, and analyses are performed and the acceptance criteria met, a plant that incorporates the design certification is built and will operate in accordance with the design certification, the provisions of the Atomic Energy Act of 1954, as amended, and the NRC's regulations.

REGULATORY AUDIT SCOPE

The specific scope of this audit includes reviewing requested information supporting DCD Sections:

- 4.2, “Fuel System Design,” 4.3, “Nuclear Design,” 4.4, “Thermal and Hydraulic Design,” and 4.6, “Functional Design of Control Rod Drive System”;

- 5.2.2, “Overpressure Protection,” 5.4.3, “Decay Heat Removal System,” 5.4.4, “Reactor Coolant System High-Point Vent,” 5.4.5, “Pressurizer”;

- 9.1.1, “Criticality Safety of Fresh and Spent Fuel,” and 9.3.4, “Chemical and Volume Control System”; and

- Identify and evaluate and inspections, tests, analysis and acceptance criteria associated with associated with the above DCD Sections.

The documents supporting the technical areas listed above are to be made available to the NRC staff, preferably via the NuScale eRR. Some of the documents that have already been identified by the staff are listed in Attachment A; other documents will be requested by the staff on an as- needed basis (when referenced by a document being audited by the staff, for instance), and these documents will be added to the audit report prepared by the staff following the conclusion of the audit.

SPECIAL REQUESTS

The NRC staff requests the documents listed in Attachment A be available to the NRC auditors in NuScale’s eRR. Use of the eRR allows multiple auditors in different geographic locations to examine the same document at the same time which improves the efficiency and reduces the cost of the audit. Additional documents may be identified as the review progresses. When the staff’s review of the documents associated with a specific issue is complete the staff will notify either DNRL or NuScale that these documents can be removed from eRR thereby minimizing their residence time in eRR.

AUDIT ACTIVITIES AND DELIVERABLES

The NRC audit team is expected to consist of aforementioned individuals covering the technical areas affecting DCD Sections 4.2, 4.3, 4.4, 4.6, 5.2.2, 5.4.3, 5.4.4, 5.4.5, 9.1.1, and 9.3.4. The NRC staff acknowledges the proprietary nature of the information requested. It will be handled appropriately throughout the audit. While the NRC staff will take notes, the NRC staff will not remove hard copy or electronic files from the audit site(s).

The audit will initiate on May 3, 2017, and will consist of two phases. Phase 1 will last through July 2017 and will consist of the initial staff investigation of supporting documentation for the DCD Sections listed above. Phase 1 is expected to result in the closure of audit items related to Chapters 5 and 9, and the majority of audit items related to Chapter 4. The review of the

majority of the Attachment A documents is expected to be complete by the end of Phase 1. The documents needed for Phase 2 will be identified at the end of Phase 1.

Phase 2 will extend until October 2017 and is expected to result in the closure of the remaining audit items related to Chapter 4, and include additional items related to RAI responses, as necessary. If additional items are identified late in Phase 2, which could include items related to RAI responses or design changes, the audit plan may be revised to include additional phases to address these specific identified items, or a new audit plan may be generated. Audit reports will be generated upon completion of each phase and will be published in the NRC's ADAMS.

During each phase, the NRC will hold monthly audit calls and/or meetings with NuScale to identify issues that have been closed or will be resolved by another mechanism, such as RAIs or public meetings. In the monthly meetings, NRC will also identify any new emerging information needs as well as documents that can be removed from eRR.

The audit will assist the NRC staff in the issuance of RAIs (if necessary) for the licensing review of the NuScale DCD Sections identified in the "REGULATORY AUDIT SCOPE" section in preparation of the NRC staff's safety evaluation.

If necessary, any circumstances related to the conductance of the audit will be communicated to the NRC project manager, Bruce Bavol at 301-415-6715 or bruce.bavol@nrc.gov.

ATTACHMENT A – DOCUMENT LIST

1. Calculational package(s) (e.g., calcnotes or analysis packages) and any other documentation which supports the development of DCD Tier 2, Figure 4.3-2, “Power Dependent Insertion Limits.”

2. Calculational package(s) (e.g., calcnotes or analysis packages) and any other documentation which supports the development of DCD Tier 2, Figure 4.3-3, “Axial Offset Window.”

3. Calculational package(s) (e.g., calcnotes or analysis packages) and any other documentation which supports the statement in DCD Tier 2, Section 4.4.3.1.1.2, “Flow Leakage Between Reflector Blocks and Core Barrel” that flow bypass between the reflector blocks and the core barrel is negligible.

4. Calculation package(s) (e.g., calcnotes or analysis packages) and any other documentation which supports the finding made in DCD Section 5.4.3.3.2 that noncondensible gas accumulation does not impede the DHRS safety function.

5. Calculation package(s) (e.g., calcnotes or analysis packages) and any other documentation which demonstrates the DHRS performance as described in DCD Section 5.4.3.3.4

6. Input decks and calculation package(s) (e.g., calcnotes or analysis packages) and any other documentation supporting the spent fuel pool criticality analysis of 5 damaged fuel assemblies at the center of pool as described in Section 3.3.6.2 of technical report TR-0816-49833-P.

7. Input decks and calculation package(s) (e.g., calcnotes or analysis packages) and any other documentation supporting the spent fuel pool criticality analysis of the fuel storage rack seismic event assuming a separation reduction as described in Section 3.3.6.6 of technical report TR-0816-49833-P.

8. Documentation which describes the derivation of the viscous damping coefficient used to determine the zero-flow in-water damping coefficient used in the fuel assembly structural response analysis of DCD Section 4.2.