

June 8, 2017

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

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

SUBJECT: AUDIT PLAN FOR THE REGULATORY AUDIT OF NUSCALE  
POWER, LLC; SECTIONS 3.9.4, "CONTROL ROD DRIVE SYSTEM,"  
AND 4.6, "FUNCTIONAL DESIGN OF CONTROL ROD DRIVE  
SYSTEM"

On January 6, 2017, NuScale Power, LLC (NuScale) submitted a design certification (DC) application for a small modular reactor to the U.S. Nuclear Regulatory Commission (NRC) (Agencywide Documents Access and Management System Accession No. ML17013A229). The NRC staff started its detailed technical review of NuScale's DC application on March 15, 2017.

The purpose of the subject audit, to be conducted by the NRC staff, is to: (1) gain a better understanding of the NuScale design; (2) verify information; (3) identify information that may 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 and compliance with NRC regulations.

The audit will take place at NuScale's offices, in Rockville, Maryland, and/or online via NuScale's electronic reading room. The audit is currently scheduled to start on June 13, 2017, and last for 40 days. The audit plan is enclosed.

Docket No. 52-048

Enclosure:  
Audit Plan

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

CONTACT: Marieliz Vera, NRO/DNRL  
301-415-5861

AUDIT PLAN FOR THE REGULATORY AUDIT OF NUSCALE POWER, LLC FINAL SAFETY ANALYSIS REPORT; SECTIONS 3.9.4, "CONTROL ROD DRIVE SYSTEM," AND 4.6, "FUNCTIONAL DESIGN OF CONTROL ROD DRIVE SYSTEM"

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**NRO-002**

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<b>DATE</b>	6/06/2017	6/07/2017	6/08/2017

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**U.S. NUCLEAR REGULATORY COMMISSION  
REGULATORY AUDIT OF SECTIONS 3.9.4, “CONTROL ROD DRIVE SYSTEM,” AND 4.6,  
“FUNCTIONAL DESIGN OF CONTROL ROD DRIVE SYSTEM OF THE NUSCALE  
STANDARD PLANT DESIGN CERTIFICATION”**

**DOCKET NO. 52-048**

**AUDIT PLAN**

**APPLICANT:** NuScale Power, LLC

**APPLICANT CONTACTS:** Marty Bryan  
Darrell Gardner  
Jennie Wike

**DURATION:** 40 days

**LOCATION:** NuScale Power, LLC (Rockville Office)  
11333 Woodglen Drive, Suite 205  
Rockville, Maryland 20852

Electronic Reading Room (eRR)

**AUDIT TEAM:** Nicholas Hansing, Mechanical Engineering  
Ryan Nolan, Plant Systems  
Ronald Lavera, Radiation Protection and Accident  
Consequences  
Edward Stutzcage, Radiation Protection and Accident  
Consequences  
Marieliz Vera Amadiz, Project Manager

**I. Background:**

The U.S. Nuclear Regulatory Commission (NRC) staff reviewed NuScale Power, LLC’s (NuScale) information contained in the NuScale DCD. To gain a better understanding of the design and testing methods of the control rod drive system (CRDS) and to confirm the adequacy of the testing methods used by NuScale, the NRC staff will audit the design and testing documentation for the CRDS. This audit will assist the NRC staff in completing its technical review of the CRDS and provide input to the development of a safety finding.

**II. Purpose:**

The purpose of this audit is to review the design and testing of the CRDS for the NuScale design. The staff intends to audit the related documentation for the design and testing of the CRDS for the NuScale design in order to:

- (1) Ascertain how the new design/configuration of the NuScale CRDS is subjected to a life cycle test program to determine the ability of the drive components to function during and after normal operation, anticipated operational occurrences,

seismic events, and postulated accident conditions over the full range of temperatures, pressures, loadings, and misalignment expected in service.

- (2) Evaluate the test program's determination of:
  - a. Insertion and withdrawal times,
  - b. Latching operation,
  - c. Scram operation and time,
  - d. Ability to overcome a stuck rod condition, and
  - e. Wear.
- (3) Review the elements of the test program to ensure all required parameters have been included.
- (4) Review the test results to determine acceptability.

The audit will review and evaluate the design and testing methods and their implementation for the CRDS for confirmation of their performance in accordance with the NuScale DCD Tier 2, Sections 3.9.4 and 4.6.

This audit follows the guidelines in the Office of New Reactors (NRO) Office Instruction, NRO-REG-108 (Revision 0), "Regulatory Audits" (Reference 1).

### **III. Regulatory Bases:**

The Standard Review Plan (SRP), NUREG-0800, Sections 3.9.4 and 4.6 provide guidance for NRC staff review of control rod drive systems (CRDS), including the CRDS. The associated regulations, as applied to this review, are discussed below:

The NRC regulations in Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 of the *Code of Federal Regulations* (CFR), Part 50 specify principal design criteria to establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components (SSCs) important to safety; that is, SSCs that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public. The CRDS is one such SSC.

General Design Criterion (GDC) 1, "Quality standards and records," in 10 CFR Part 50, Appendix A, (as further specified in 10 CFR 50.55a), requires that the CRDS be designed to quality standards commensurate with the importance of the safety functions to be performed.

GDC 2, "Design bases for protection against natural phenomena," and GDC 4, "Environmental and dynamic effects design bases," in 10 CFR Part 50, Appendix A, require that the CRDS be designed to withstand the effects and conditions of events, such as earthquakes and missiles, without loss of capability to perform its safety functions.

GDC 23, "Protection system failure modes," in 10 CFR Part 50, Appendix A, requires that the CRDS be designed to fail into a safe state in the event of adverse conditions or environments.

GDC 26, "Reactivity control system redundancy and capability," and GDC 29, "Combined reactivity control systems capability," in 10 CFR Part 50, Appendix A, requires that the CRDS be designed to assure its reactivity control and safety functions are assured under anticipated conditions.

GDC 27, "Combined reactivity control systems capability," in 10 CFR Part 50, Appendix A, requires that the CRDS be designed with appropriate margin, and in conjunction with the emergency core cooling system, be capable of controlling reactivity and cooling the core under postulated accident conditions. NuScale has proposed an exemption from this criterion and proposes a principal design criterion (PDC) 27, which states:

The reactivity control systems shall be designed to have a combined capability 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.

Following a postulated accident, the control rods shall be capable of holding the reactor core subcritical under cold conditions, without margin for stuck rods, provided the probability for a return to power assuming a stuck rod is sufficiently small and specified acceptable fuel design limits for critical heat flux would not be exceeded by the return to power.

GDC 28, "Reactivity limits," in 10 CFR Part 50, Appendix A, requires that the CRDS be designed with appropriate limits on the potential amount and rate of reactivity increase to prevent the adverse effects of postulated reactivity accidents.

The NRC regulations in 10 CFR Part 52, Section 47, "Contents of applications; technical information," states that:

*The application must contain a level of design information sufficient to enable the Commission to judge the applicant's proposed means of assuring that construction conforms to the design and to reach a final conclusion on all safety questions associated with the design before the certification is granted. The information submitted for a design certification must include performance requirements and design information sufficiently detailed to permit the preparation of acceptance and inspection requirements by the NRC, and procurement specifications and construction and installation specifications by an applicant. The Commission will require, before design certification, that information normally contained in certain procurement specifications and construction and installation specifications be completed and available for audit if the information is necessary for the Commission to make its safety determination.*

*10 CFR 52.47 further states that 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, including: The information necessary to demonstrate how operating experience insights have been incorporated into the plant design, a description of the kinds and quantities*

*of radioactive materials expected to be produced in the operation and the means for controlling and limiting radioactive radiation exposures, and information required by § 20.1406.*

#### **IV. Regulatory Audit Scope and Methodology:**

Details regarding the design and testing of the CRDS for the NuScale design will be reviewed by the NRC staff and used to support the evaluation of DCD Sections 3.9.4 and 4.6. In particular, the staff plans to audit documentation supporting the applicant's approach for:

1. The functional test determinations for insertion and withdrawal times,
2. The functional test determinations for latching operation,
3. The functional test determinations for scram operation and time,
4. The functional test determinations for the ability to overcome a stuck rod condition,
5. The functional test determinations for wear,
6. The consideration and treatment of unique design features within the testing program,
7. The determination of testing parameters that adequately represent the full spectrum of design basis conditions for the NuScale design,
8. The derivation of endurance testing parameters and the factors considered in this derivation,
9. The conduct and results of the failure modes and effects analysis for the system,
10. The creation of detailed system design descriptions (required CRDS cooling flow/temperature, necessary instrumentation for monitoring CRD conditions, etc.),
11. The methods for determining the wear rates of drive system components that may contribute to the Reactor Coolant System radioactive material concentrations,
12. The methods for modeling and monitoring control rod drive shaft vibrations, and
13. The methods for modeling wear rates from control rod assembly elements as they are inserted into the core.

#### **V. Information and Documents Necessary for the Audit:**

The NRC staff requests NuScale to provide the test plans, test summaries, analyses, test results, and related documents discussed in the audit scope. NuScale is also requested to identify other documents, which the applicant deems as necessary to support the NRC staff's audit (e.g., drawings, QA requirements) and any other documents or calculations referenced by

the various reports and related documents. NuScale is also requested to prepare a list of the documents that will be made available during the audit, including the document titles, identifying numbers, and revisions/dates.

All material subject to the site visit (hard copy or electronic) will be left at the site. If any documentation is required to be placed on the docket in support of the staff's regulatory findings, the staff will identify it in a request for additional information (RAI).

NuScale is requested to make available, personnel who are knowledgeable in the design and testing of the NuScale CRDS along with the associated documentation. NuScale should also have the ability to make available testing/analysis information as necessary to support the audit.

## **VI. Logistics:**

The NRC staff and the applicant have agreed that the audit will be conducted from June 13, 2017, through July 20, 2017, at the NuScale Power facilities in Rockville, Maryland, or at the NRC Headquarters via NuScale's electronic reading room (eRR). In support of this audit, the applicant has agreed to make knowledgeable staff available, along with relevant documentation, to support staff review and discussion of the material. The NRC staff will hold an entrance meeting/call to begin the audit and periodic status meetings weekly to provide information to NuScale on the audit. In the weekly meetings, NRC will also identify any new emerging information needs as well as documents that can be removed from eRR. The team will audit documents and discuss with the applicant as appropriate throughout the audit. An exit meeting will be conducted to summarize the staff findings at the end of the audit.

## **VII. Audit Activities and Deliverables:**

The NRC audit team review will cover the technical areas identified previously in this audit plan. The NRC Project Manager will coordinate with NuScale in advance of audit activities to verify specific documents and identify any changes to the audit schedule and requested documents.

The NRC staff acknowledges the sensitive nature of the information requested and it will be handled appropriately throughout the audit. While the NRC staff will take notes, the NRC staff will not remove hard copies or electronic files from the audit site(s).

At the completion of the audit, the audit team will issue an audit summary within 90 days that will be declared and entered as an official agency record in the NRC's Agencywide Documents Access and Management System (ADAMS) records management system, in accordance with NRO-REG-108. The audit outcome may be used to assist the NRC staff in the issuance of RAIs (if necessary) for the licensing review of the NuScale DCD and to identify any additional information to be submitted on the docket in support of the NRC staff's preparation of their SER.

If necessary, any circumstances related to the conductance of the audit will be communicated to Marieliz Vera Amadiz, NRC Project Manager, at 301-415-5861 or via email at [Marieliz.VeraAmadiz@nrc.gov](mailto:Marieliz.VeraAmadiz@nrc.gov).

## **VIII. References:**

1. NRO Office Instruction NRO-REG-108, Revision 0, "Regulatory Audits."

2. NuScale Final Safety Analysis Report, Tier 2, Section 3.9.4, Revision 0, "Control Rod Drive System."
3. NuScale Final Safety Analysis Report, Tier 2, Section 4.6, Revision 0, "Functional Design of Control Rod Drive System."
4. NuScale Final Safety Analysis Report, Tier 2, Section 1.5.1, Revision 0, "NuScale Testing Programs."
5. Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition (NUREG-0800), Section 3.9.4, Revision 3, "Control Rod Drive System."
6. Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition (NUREG-0800), Section 4.6, Revision 2, "Functional Design of Control Rod Drive System."