



UNITED STATES  
NUCLEAR REGULATORY COMMISSION  
WASHINGTON, D.C. 20555-0001

December 28, 2018

MEMORANDUM TO: Samuel Lee, Chief  
Licensing Branch 1  
Division of Licensing, Siting,  
and Environmental Analysis  
Office of New Reactors

FROM: Rebecca Karas, Chief **/RA/**  
Reactor Systems, Nuclear Performance and  
Code Review Branch  
Division of Safety Systems Risk Assessment and  
Advance Reactors  
Office of New Reactors

SUBJECT: DRAFT AUDIT PLAN FOR THE REGULATORY AUDIT OF NUSCALE  
POWER, LLC TOPICAL REPORT TR-0516-49422-P, "LOSS-OF-  
COOLANT ACCIDENT EVALUATION MODEL" REVISION 1

By letter dated December 30, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML17004A202), NuScale Power, LLC (NuScale) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review topical report TR-0516-49422-P, Revision 0, "Loss-of-Coolant Accident Evaluation Model," in support of the NuScale design certification application. On April 27, 2017, the NRC staff started its detailed technical review of TR-0516-49422-P, Revision 0. NuScale submitted draft Revision 1 of TR-0516-49422-P on September 21 and September 28, 2018 (ADAMS Accession No. ML18271A166 and ML18264A337), to incorporate detailed changes in response to staff requests for additional information (RAIs) issued in 2018 and expand the scope of this topical report to cover the evaluation model for inadvertent opening of RPV valves.

The purpose of this regulatory audit is to examine underlying calculations, analyses, and evaluations supporting several selected RAI responses as well as Appendix B of the draft revision 1 which was submitted as part of the response to RAI No. 9536 on September 1, 2018. In conducting this audit, the staff will gain a better understanding of new or changed calculations or information that supports the draft revision of TR-0516-49422-P and review the underline technical reports in support of the newly submitted Appendix B.

CONTACT: Shanlai Lu, NRO/DSRA  
301-415-4016

S. Lee

The audit will take place via the Electronic Reading Room and/or at NuScale's offices in Rockville, Maryland.

The contents of the draft audit plan are provided as an enclosure. Please have your staff coordinate and schedule the audit entrance meeting at a mutually acceptable time.

Docket No. 52-048

Enclosure:

1. Draft Audit Plan

SUBJECT: AUDIT PLAN FOR THE REGULATORY AUDIT OF NUSCALE POWER, LLC  
TOPICAL REPORT TR-0516-49422-P, "LOSS-OF-COOLANT ACCIDENT  
EVALUATION MODEL," REVISION 1 DATED: December 28, 2018

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**ADAMS Accession No: ML19008A355**

NRO-002

OFFICE	NRO/DSRA	NRO/DSRA
NAME	SLu	RKaras
DATE	12/27/18	12/28/18

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**UNITED STATES NUCLEAR REGULATORY COMMISSION  
AUDIT PLAN FOR THE REGULATORY AUDIT OF  
OF NUSCALE POWER, LLC DESIGN CERTIFICATION APPLICATION, CHAPTER 15,  
“TRANSIENT AND ACCIDENT ANALYSES”**

**Docket No. 52-048**

**AUDIT PLAN**

**APPLICANT:** NuScale Power, LLC (NuScale)

**APPLICANT CONTACTS:** Marty Bryan  
Paul Infanger  
Steven Mirsky

**DURATION:** 7 months

Phase 4: January 10, 2019, through March 31, 2019

Phase 5: April 1, 2019, through July 31, 2019

Note: Phase 4 and Phase 5 durations are contingent on the submittal of all responses to requests for additional information (RAIs) by January 10, 2019, and receipt of updated topical report (TR) containing any and all revised NRELAP5 calculations by April 30, 2019. The duration(s) may be extended if RAI responses and/or receipt of updated TR is delayed.

**LOCATION:** **U.S. Nuclear Regulatory Commission (NRC) Headquarters  
(via NuScale’s electronic reading room (eRR))**  
Two White Flint North  
11545 Rockville Pike  
Rockville, Maryland 20852-2738

**NuScale**  
11333 Woodglen Drive, Suite 205  
Rockville, Maryland 20852

**AUDIT TEAM:** Shanlai Lu, NRO, Audit Team Lead  
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Gregory Cranston, NRO, Project Manager  
Rebecca Karas, NRO, SRSB Branch Chief

## **I. BACKGROUND AND OBJECTIVES**

By letter dated December 30, 2016 (Agencywide Documents Access and Management System (ADAMS Accession No. ML17004A202), NuScale Power, LLC (NuScale) submitted for U.S. Nuclear Regulatory Commission (NRC) staff review of topical report TR-0516-49422, Revision 0, "Loss-of-Coolant Accident Evaluation Model," in support of the NuScale design certification application. On April 27, 2017, the NRC staff started its detailed technical review of this topical report. Between May 5, 2017 and March 15, 2018, the staff conducted the first three phases of audits. Based on the audit results, the staff issued several requests for additional information (RAIs) resulting from its review of TR-0516-49422. Furthermore, during the Chapter 6 Containment audit, the applicant discussed a planned revision to the LOCA TR to update NRELAP5 calculations and results due to a transition from NRELAP5 Version 1.3 to Version 1.4. On September 21, 2018, NuScale submitted a newly developed Appendix B to expand the topical report scope to cover the methodology for the evaluation model for inadvertent opening of RPV valves.

The objective of the Phase 4 audit is for the NRC staff to gain a better understanding of the newly developed methodology for inadvertent opening of RPV valves and new or changed calculations or information that supports the TR resulting from staff RAIs as well as the transition to NRELAP5 Version 1.4 and to confirm certain statements made in RAI responses. The staff needs to fully comprehend the new and changed calculations and information and the expanded scope of the methodology to ensure it supports the applicant's docketed conclusions of adequacy of the LOCA EM. During this audit, the NRC staff will examine the reference documents and analyses that support RAI responses, NRELAP5 computer code changes, and TR updates. The objective of Phase 5 of the audit is to understand and confirm information contained in updates to the LOCA TR.

To facilitate the NRC staff's understanding of the calculations and rationale underlying RAI responses and the updates to the LOCA TR as a result of implementing a new version of NRELAP5, the staff is planning the following:

- An audit entrance meeting is scheduled for January 10, 2019, via conference call.
- The audit plan will be updated as necessary to identify the specific items the staff needs to audit as the applicant submits RAI responses.
- The audit is expected to be performed primarily via the NuScale eRR or, if necessary, at NuScale's Rockville office.
- Should any information needs be identified during the audit in addition to those identified in this audit plan, the audit report will capture those items.

## II. REGULATORY AUDIT BASIS

10 CFR 52.47(a)(4) states that a final safety analysis report (FSAR) submitted as part of a standard design certification must include:

*[a]n analysis and evaluation of the design and performance of structures, systems, and components with the objective of assessing the risk to public health and safety resulting from operation of the facility and including determination of the margins of safety during normal operations and transient conditions anticipated during the life of the facility, and the adequacy of structures, systems, and components provided for the prevention of accidents and the mitigation of the consequences of accidents.*

10 CFR 50.46, "Acceptance Criteria for Emergency Core Cooling Systems for Light-Water Nuclear Power Reactors," requires:

*(a)(1)(i) that each PWR, fueled with uranium oxide pellets within cylindrical zircaloy or ZIRLO cladding, must be equipped with an ECCS. The ECCS must be designed in compliance with certain requirements pertaining ECCS analysis method, ECCS analysis scope, and ECCS performance criteria.*

The staff anticipates the need for an audit to examine the basis for some of the applicant's RAI responses related to the LOCA analysis methodology, which is incorporated by reference into Chapter 15 and Chapter 6 of the NuScale FSAR and used to develop safety conclusions documented therein. Additionally, the applicant has added Appendices B and C to the LOCA TR regarding inadvertent opening of RPV Valves, which significantly expands the scope of the LOCA TR, and the staff intends to audit calculations and other supporting documents underlying the statements made in these appendices. The staff also may need to audit updated calculations and test assessments referred to in recent responses.

The following general design criteria (GDC) from Title 10 of the Code of Federal Regulations (10 CFR), Part 50, Appendix A are applicable to the LOCA analysis:

- GDC 5, "Sharing of structures, systems, and components" GDC 10, "Reactor design"
- GDC 13, "Instrumentation and control"
- GDC 15, "Reactor coolant system design"
- GDC 17, "Electric power systems" GDC 20, "Protection system functions"
- GDC 26, "Reactivity control system redundancy and capability"
- GDC 27, "Combined reactivity control systems capability"
- GDC 28, "Reactivity limits"
- GDC 31, "Fracture prevention of reactor coolant pressure boundary"
- GDC 34, "Residual heat removal"

In addition, relevant regulatory guidance includes:

- Regulatory Guide 1.203, "Transient and Accident Analysis Methods," December 2005.
- NuScale Design-Specific Review Standard (DSRS) 15.6.5, "Loss of Coolant Accident" Revision 0, June 2016.
- Standard Review Plan (SRP) 15.0.2, "Review of Transient and Accident Analysis Method," Revision 0, March 2007.
- SRP 15.6.5, "Loss of Coolant Accident," Revision 3, March 2007.

### **III. REGULATORY AUDIT SCOPE**

The limited scope of this audit focuses on the information, documents, and supporting calculations related to the newly submitted Appendices B and C, the Version 1.4 NRELAP5 code development and the selected RAIs already submitted (RAI #8776, #9536, #8990, #9085, #9149, #9190 and # 9519), the scaling and distortion RAIs to be submitted in January, 2019, the latest HP49 test reports and NIST heater thermocouple design information, NuScale's planned revision to the LOCA TR to update NRELAP5 calculations and results, as NuScale described to the staff during the Chapter 6 Containment audit.

Additional audit tasks may be added, subject to the staff's review of RAI responses submitted in the future and the changes to the TR. All documents audited will be added to the audit report prepared by the staff following the conclusion of the audit.

Staff plans to examine the following items through the ERR or Certrec:

NuScale calculations:

- a. Engineering calculation "NuScale LOCA Evaluation Model Supporting Calculations" (EC-0000-4888, rev 1);
- b. NuScale Integral System Test (NIST-1) Facility Scaling Analysis (EE-T080-13757) and relevant documents supporting the new scaling related RAI responses;
- c. NuScale Distortion Analysis Report (EC-0000-3853, rev 1);
- d. HP-43 Assessment Test Report (EC-T080-5045);
- e. HP-49 Assessment Test Report (EC-T080-6620);
- f. NRELAP5 Basemodel (EC-A010-1782, rev 1);
- g. NRELAP5 Change Implementations (NCI) for version 1.4; and
- h. NIST heater rod thermal-couple installation documents.

Staff will plan to examine the following items in the NuScale Rockville office:

NRELAP5 source code and executable in the debugger mode:

Staff plans to debug the code to follow the newly implemented code features and understand how the new physics models, correlations and numeric are implemented through the FORTRAN coding.

In the process of the auditing, staff may find the need to examine other documents in support of the above mentioned topics.

#### **IV. SPECIAL REQUESTS**

The NRC staff requests the applicant make the identified documents available to the NRC auditors in NuScale's eRR to the extent possible. 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 audit progresses. When the staff's audit of the documents associated with a specific issue is complete, the NRC staff will notify NuScale that these documents can be removed from eRR, thereby minimizing their residence time in eRR.

In addition, the NRC staff may request in-person or telephone audit meetings with NuScale personnel to facilitate the staff's understanding of material to be audited. Such meetings will be scheduled based on mutual availability. The staff requests that document titles identified by NRC staff that are germane to an audit meeting be made available in the eRR prior to any scheduled audit meeting.

#### **V. DELIVERABLES**

The NRC audit team is expected to consist of aforementioned individuals reviewing the LOCA TR methodology. The NRC staff will conduct this audit in accordance with the guidance provided in NRO-REG-108, "Regulatory Audits" (ADAMS Accession No. ML081910260). The NRC staff acknowledges the proprietary nature of the information requested and will handle it 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).

The staff will hold audit calls and/or meetings with NuScale as necessary to understand audit material.

The NRC will inform NuScale of emerging information needs as well as documents that can be removed from eRR.

An audit report will be generated at the completion of the audit. If necessary, any circumstances related to the conductance of the audit will be communicated to Rani Franovich (NRC) at 301-415-7334 or [Rani.Franovich@nrc.gov](mailto:Rani.Franovich@nrc.gov).

#### **VI. REFERENCES**

1. Letter from NuScale Power, LLC, "NuScale Power, LLC Submittal of "Loss-of-Coolant Accident Evaluation Model," TR-0516-49422 (NRC Project No. 0769)," December 30, 2016, ADAMS Accession Number ML17004A202.
2. Letter to NuScale Power, LLC, "Acceptance Letter for the Review Of NuScale Power, LLC Topical Reports TR-0516-49422, "Loss-Of-Coolant Accident Evaluation Model,"



Revision 0, And TR-0516-49416, "Non-Loss-Of-Coolant Accident Analysis," Revision 0 (CAC RN6303, RN6305)," April 27, 2017, ADAMS Accession Number ML17116A063.

3. RAls 8930, 8990, 9085, 9208, 9190, 9317, 9325, 9351, 9373, 9380, 9390, 9466, 9475, 9482, 9492, 9494, and 9519.
4. NRO-REG-108, "Regulatory Audits," April 2, 2009, ADAMS Accession Number ML081910260.