

June 7, 2017

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

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

SUBJECT: AUDIT PLAN FOR THE REGULATORY AUDIT OF NUSCALE
POWER, LLC TOPICAL REPORT TR-0516-49417-P, "EVALUATION
METHODOLOGY FOR STABILITY ANALYSIS OF THE NUSCALE
POWER MODULE"

NuScale Power, LLC (NuScale) submitted letters dated July 31, 2016, and December 3, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML16250A851 and ML16340A756, respectively), Topical Report (TR) TR-0516-49417, Rev. 0, "Evaluation of Stability Methodology for Stability Analysis of the NuScale Power Module," and the subsequent "Response to NRC Request for Supplemental Information to TR-0516-49417-P, Revision 0." The U.S. Nuclear Regulatory Commission (NRC) staff started its detailed technical review of the NuScale TR on March 7, 2017.

The purpose of the NRC's regulatory audit of NuScale's TR is to: (1) gain a better understanding of the NuScale methodology for stability analysis, including supporting calculations and documentation; (2) better determine whether the methodology meets NRC regulations and conforms to regulatory guidance; (3) develop requests for additional information (RAI) in areas not adequately covered in the TR documentation; and, (4) identify supplemental information that should be added to the TR to allow the NRC staff to make its safety finding.

The audit entrance will be held on June 8, 2017, via conference call. The contents of the audit plan are provided as an enclosure.

Docket No. 52-048

Enclosure:
Audit Plan

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

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

SUBJECT: AUDIT PLAN FOR THE REGULATORY AUDIT OF NUSCALE TOPICAL
REPORT TR-0516-49417-P, "EVALUATION METHODOLOGY FOR STABILITY
ANALYSIS OF THE NUSCALE POWER MODULE," DATED June 06, 2017

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ADAMS Accession No: ML17151B024***via email****NRO-002**

OFFICE	NRO/DNRL/LB1: PM	NRO/DNRL/LB1: LA	NRO/DNRL/LB1
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DATE	6/7/2017	5/31/2017	6/7/2017

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**REGULATORY AUDIT PLAN FOR NUSCALE TOPICAL REPORT TR-0516-49417-P,
“EVALUATION METHODOLOGY FOR STABILITY ANALYSIS OF THE NUSCALE POWER
MODULE”**

DOCKET NO. 52-048

AUDIT PLAN

APPLICANT: NuScale Power, LLC (NuScale)

APPLICANT CONTACTS: Marty Bryan
Darrell Gardner
Steven Mirsky
Jennie Wilke

DURATION: 180 days
Phase 1: June 8, 2017, through September 6, 2017
Phase 2: September 7, 2017, through December 6, 2017

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

NuScale
11333 Woodglen Dr.
Suite 205
Rockville, Maryland 20852

AUDIT TEAM: Ray Skarda, NRO, Audit Team Lead
Jim Gilmer NRO
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Steve Bajorek, RES
Kathy Gibson, RES
Ron Harrington, RES
Peter Lien, RES
Peter Yarsky, RES
Jason Thompson, RES
Bruce Bavol, NRO, Project Manager

I. BACKGROUND AND OBJECTIVES

By letters dated July 31, 2016, and December 3, 2016 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML16250A851 and ML16340A756, respectively), NuScale submitted for NRC staff review topical report (TR) TR-0516-49417, Rev. 0, “Evaluation of Stability Methodology for Stability Analysis of the NuScale Power Module,” and the subsequent “Response to NRC Request for Supplemental Information to TR-0516-49417-P,

Revision 0,” in support of the NuScale design certification application, which the NRC accepted for review on March 7, 2017 (ADAMS Accession No. ML17044A203).

To facilitate the NRC staff’s evaluation of information supporting the TR, the staff is planning the following:

- An audit entrance meeting is scheduled for June 8, 2017 via conference call. 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. During this audit, the NRC staff will examine the reference documents and analyses mentioned but not specifically cited to support their statements in the FSAR.
- If necessary, this audit plan will be updated to support the remainder of the review.

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

- gain a better understanding of the NuScale methodology for stability analysis, including supporting calculations and documentation
- better determine whether the methodology meets NRC regulations and conforms to regulatory guidance
- develop requests for additional information (RAIs) in areas not adequately covered in the TRdocumentation
- identify supplemental information that should be added to the TRto allow the staff to make its safety finding.

The NRC staff determined efficiency gains would be realized by auditing the documents which support the TRto 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.

II. REGULATORY AUDIT BASIS

Title 10 of the *Code of Federal Regulations* (CFR), Section 52.47(a)(2) states,

a final safety analysis report (FSAR) must include a description of the structures, systems, and components (SSCs) of the facility, with emphasis on bases and technical justifications that have been used to establish facility’s performance requirements and the evaluations required to show that safety functions will be accomplished. The descriptions shall be sufficient to permit understanding of the system designs and their relationship to the safety evaluation.

10 CFR 52.47(a)(19) states,

that the FSAR must also include a quality assurance program applied to the design of the facility's SSCs.

An audit is needed to evaluate the stability analysis methodology, which is incorporated by reference into Chapter 15 of the NuScale FSAR and used to develop safety conclusions documented therein. The NRC staff must have sufficient information to ensure that acceptable risk and adequate assurance of safety can be documented in the NRC staff's safety evaluation reports for the stability analysis TR and Chapter 15 of the FSAR.

This regulatory audit is based on the following regulatory requirements from 10 CFR Part 50, Appendices A and B.

Appendix A, "General Design Criteria (GDCs) For Nuclear Power Plants":

- GDC 10, "Reactor design," requires that specified acceptable fuel design limits (SAFDLs) are not to be exceeded during normal operation, including the effects of anticipated operational occurrences (AOOs).
- GDC 12, "Suppression of reactor power oscillations," requires that the reactor core and associated coolant, control, and protection systems shall be designed to assure that the power oscillations which can result in conditions exceeding SAFDLs are not possible or can be reliably detected and suppressed.
- GDC 13, "Instrumentation and control," requires the availability of instrumentation to monitor variables and systems over their anticipated ranges to assure adequate safety, and of appropriate controls to maintain these variables and systems within prescribed operating ranges.
- GDC 20, "Protection system functions," requires that the protection system initiate automatically appropriate systems to assure that SAFDLs are not exceeded as a result of AOOs and to sense accident conditions and initiate the operation of systems and components important to safety.
- GDC 25, "Protection system requirements for reactivity control malfunctions," requires that the reactor protection system be designed to assure that SAFDLs are not exceeded in the event of a single malfunction of the reactivity control systems.
- GDC 26, "Reactivity control system redundancy and capability," requires two independent reactivity control systems of different design principals to be provided. One system shall use control rods, while the other system shall be capable of reliably controlling reactivity rate changes to assure acceptable fuel design limits are not exceeded. One of the systems shall be capable of holding reactor core subcritical under cold conditions.
- GDC 29, "Protection against operational occurrences," requires that reactivity control systems be designed to assure extremely high probability of accomplishing their safety functions in the event of anticipated operation occurrences.

Appendix B, “Quality Assurance Criteria For Nuclear Power Plants and Reprocessing Plants”:

- Section II., “Quality Assurance Program,” states that a quality assurance program providing control over activities affecting the quality of SSCs important to safety shall be established.
- Section III., “Design Control,” states that design control measures shall be applied to reactor physics, thermal hydraulic, and accident analyses.

Relevant regulatory guidance includes:

- Regulatory Guide 1.203, “Transient and Accident Analysis Methods,” December 2005.
- NuScale Design-Specific Review Standard (DSRS) 15.0, “Introduction – Transient and Accident Analyses,” Revision 0, June 2016.
- Standard Review Plan (SRP) 15.0.2, “Review of Transient and Accident Analysis Method,” Revision 0, March 2007.
- DSRS 15.9.A, “Thermal Hydraulic Stability Review Responsibilities,” Revision 0, June 2016.

III. REGULATORY AUDIT SCOPE

The scope of this audit includes information, documents, and supporting calculations related to the methodology described in TR-0516-49417-P. In addition to the initial set of audit documents and information requested in Attachment A, the staff may request other information to be audited as identified during review of the TR, audit documents, or RAI responses. These documents will be added to the audit report prepared by the staff following the conclusion of the audit.

IV. 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 the NRC’s Division of New Reactor Licensing (DNRL) or 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 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 in-person audit meeting be made available in the eRR prior to any scheduled in-person audit meeting.

V. AUDIT ACTIVITIES AND DELIVERABLES

The NRC audit team is expected to consist of aforementioned individuals reviewing the Stability methodology. The NRC staff will conduct this audit in accordance with the guidance provided in NRO-REG-108, "Regulatory Audits" (Reference 5). 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 and maintain notes in accordance with Reference 5, the NRC staff will not remove the applicant's hard copies or electronic files from the audit site(s).

The audit will initiate on June 8, 2017. The audit is scheduled for a period of 180 days and will consist of two phases, each approximately 90 days. Phase 1 will consist mainly of the initial staff investigation of supporting documentation for the stability methodology. The review of the majority of the documents identified in Attachment A is expected to complete by the end of Phase 1. The documents needed for Phase 2 will be identified at the end of Phase 1. Phase 2 is expected to result in the closure of the remaining audit items and may 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 Stability Methodology TR in preparation of the NRC staff's safety evaluation. If necessary, any circumstances related to the conductance of the audit will be communicated to Bruce Bavol (NRC) at 301-415-6715 or Bruce.Bavol@nrc.gov.

VI. REFERENCES

1. Letter from NuScale Power, LLC, "NuScale Power, LLC Submittal of "Evaluation Methodology for Stability Analysis of the NuScale Power Module," TR-0516-49417-P (NRC Project No. 0769)," July 31, 2016, ADAMS Accession Number ML16250A851.
2. Letter from NuScale Power, LLC, "NuScale Power, LLC Submittal of "NuScale Response to NRC Request for Supplemental Information to TR-0516-49417-P (NRC Project No. 0769)," December 3, 2016, ADAMS Accession Number ML16340A756.
3. Letter to NuScale Power, LLC, "Acceptance Letter for the Review of NuScale Power, LLC Topical Reports TR-0516-49417-P, " 'Evaluation Methodology for Stability Analysis of the NuScale Power Module, Revision 0,' and Response For Supplemental Information to the TR, Rev. 0" March 7, 2017, ADAMS Accession Number ML17116A06.

4. Letter to NuScale Power, LLC, "NuScale Power, LLC. – Acceptance of an Application for Standard Design Certification of a Small Modular Reactor," March 23, 2017, ADAMS Accession No. ML17074A087.
5. NRO-REG-108, "Regulatory Audits," April 2, 2009, ADAMS Accession Number ML081910260.

ATTACHMENT A – DOCUMENT LIST AND INFORMATION NEEDED

1. Current version of engineering drawing(s), “Steam Generator,” ED-A011-2689.
2. Current version of engineering drawings(s), “DHRP Passive Condenser,” ED-B030-2770.
3. Current version of engineering drawings(s), “Reactor Vessel Internals,” ED-A023-1958.
4. Current version of engineering drawings(s), “Reactor Vessel Internals - Lower Riser,” ED-A023-2304.
5. Current version of engineering drawings(s), “Reactor Vessel Internals – Upper Riser,” ED-A023-2303.
6. Current version of engineering drawing(s), “Main Steam Piping Layout,” ED-C010-2375.
7. Current version of engineering drawing(s), “Feedwater Piping Layout,” ED-C020-2355.
8. Documents supporting Table 4-1, “PIRT Table,” in TR-0516-49427-P, given that sections 4.3.2.3, 4.3.2.5, 4.3.3.4, and 4.4 of the TR suggest significant influence on the decay ratio.
9. Documents listing the range of pressure drops and power associated with each SIET-TF2 test (curve) shown in Figure 6 of the TR supplement, “NuScale Response to NRC Request for Supplemental Information to TR-0516-49417-P.”
10. Stability PIRT development documentation, including the full PIRT (i.e., including low- and medium-ranked phenomena in addition to the high-ranked phenomena), details of the PIRT development process such as PIRT panel discussions and findings, and the bases for the rankings.
11. Documents justifying why extraction steam, to feedwater heaters, from steam lines and turbine can be neglected, such that the secondary closed-loop is approximated as an open-loop with no feedback. The TR supplement, “NuScale Response to NRC Request for Supplemental Information to TR-0516-49417-P,” states “There is no closed-loop feedback process between the SG and the primary flow that can influence the stability of the later; rather there is an open-loop where the dynamic two-way coupling is broken” (page 1, 2nd paragraph).
12. Documents describing how feedwater flow oscillation effects are represented in PIM. Section 8.2.7 of TR-0516-49427-P shows flow and power oscillations that are predicted from PIM for oscillating feedwater flow.
13. Code maintenance procedures to include quality assurance procedures related to PIM.
14. SIET Helical Coil Steam Generator Test Program – Fluid heated Facility Test Section Installation and As-Built Report TI-0415-13067, Rev. 0.
15. SIET Helical Coil Steam Generator Test Program, NP-SW-0911-019, Rev. 8.
16. NRELAP5 Model for the SIET Fluid Heated Test Facility, EC-T050-3234, Rev. 0.

17. NRELAP5 input deck for the SIET TF-1 and TF-2 tests.
18. Achilli, A. and Ferri, R., SIET Helical Coil Steam Generator Test Program – Electrically heated test facility design, SIET sperimentiamo le tue idee, document 01 828 RT 12, revision 1 (or revision providing most accurate representation of test geometry and conditions)
19. Ferri, R. and Achilli, A., SIET Helical Coil Steam Generator Test Program – Technical Specification for Electrically Heated Test Section Fabrication, SIET sperimentiamo le tue idee, document 01 896 ST 12, revision 1 (or revision providing most accurate representation of test geometry and conditions).