

June 20, 2016

MEMORANDUM TO: Mark Tonacci, Chief
Licensing Branch 1
Division of New Reactor Licensing
Office of New Reactors

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

SUBJECT: AUDIT PLAN FOR NUSCALE POWER, LLC PRE-APPLICATION
ACTIVITIES ASSOCIATED WITH NUSCALE EMERGENCY CORE
COOLING SYSTEM/ CONTAINMENT PERFORMANCE TESTING AT
NIST-1 TEST FACILITY (PROJ0769)

On January 26, 2015, NuScale Power, LLC (NuScale) provided an initial test matrix for the NuScale Integral System Test Facilities (NIST-1) located in Corvallis, Oregon. These tests at NIST-1 form an integral part of the development of the code models and scaling arguments to be used in the safety analysis of the NuScale small modular reactor (SMR) design.

During the week of June 27, 2016, the U.S. Nuclear Regulatory Commission (NRC) Containment and Ventilation Branch (SCVB) and the Reactor Systems, Nuclear Performance, and Code Review Branch (SRSB) staff plans to observe the test facility, and audit the documents supporting the testing of containment heat transfer performance and chemical volume and control system (CVCS) line break, prior to the NuScale submission of a design certification (DC) application in the fourth quarter of calendar year 2016.

The NRC staff will review documentation associated with the High Pressure Condensation Test (HP-02) and Cooling Pool Characterization Test (HP-04); these tests were performed on October 7 - 8, 2015, and November 11 - 12, 2015, respectively, which the NRC staff could not observe. However, the NRC staff plans to conduct an audit of the test facility, instrumentation, test procedure, and the test data to make sure that the test results can be used in the full-scale reactor design safety analyses. One objective of the audit is to collect maximum information and assess the separate-effect containment heat transfer performance tests. In addition, the NRC staff's audit plan includes observing the CVCS Discharge Pipe Break Failure Test (HP-28) and audit the related information.

The audit will also give the NRC staff an opportunity to identify and verify the information that will have to be docketed to support the licensing basis and safety review activities for the NuScale design.

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The audit will take place at the NuScale Test Facility, Oregon State University, Corvallis, Oregon 97331.

The NRC staff's detailed audit plan is enclosed. The plan contains the audit purpose, location, background, regulatory basis, information and other materials necessary for the audit, and other necessary information. An audit agenda is attached to this plan. A list of the NRC staff's questions and concerns, which the NRC staff considers as being proprietary, has been conveyed to NuScale.

Project No.: PROJ0769

Enclosure:
As stated

cc: DC NuScale Power LLC Listserv

M. Tonacci

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ADAMS Accession No:

ML16168A118 – Audit Plan ***via email** **NRO-002**

OFFICE	NRO/DNRL/LB1/PM	NRO/DNRL/LB1/LA	NRO/DSRA/SRSB: BC	NRO/DSRA/SBCV: BC	NRO/DNRL/LB1/PM
NAME	PChowdhury*	MBrown*	RKaras*	JBarr, HWagage for*	PChowdhury
DATE	06/17/2016	06/16/2016	06/17/2016	06/17/2016	06/20/2016

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PRE-APPLICATION AUDIT PLAN FOR NUSCALE ECCS/ CONTAINMENT PERFORMANCE TESTING AT NIST-1 TEST FACILITY TO PREPARE THE NRC STAFF FOR THE REVIEW OF THE DESIGN CERTIFICATION APPLICATION

June 27 - 30, 2016

Location

The regulatory audit will be conducted at the following site:

NuScale Test Facility, Oregon State University, Corvallis, Oregon 97331

Purpose

The purpose of the audit is to review NuScale Power, LLC (NuScale) test facility as well as the testing conducted to characterize the heat transfer performance of the NuScale containment design, in-vessel water inventory, two-phase water level transient behavior, and reactor core temperature history under design basis loss-of-coolant accident (LOCA) conditions. The NRC staff needs to perform an assessment of the test facility's configuration, instrumentation (on both the containment and pool sides), test procedures, data acquisition and reduction, and test results. The NRC staff expects to review the supporting documentation describing the calculations, assumptions, and uncertainties, to gain in-depth understanding of the testing.

Background

On January 26, 2015, NuScale provided an initial test matrix [Reference 1] for the NuScale Integral System Test Facilities (NIST-1) located in Corvallis, Oregon. These tests at NIST-1 form an integral part of the development of the code models and scaling arguments to be used in the safety analysis of the NuScale small modular reactor (SMR) design. The test series was intended to qualify a number of phenomena relevant to the LOCA and non-LOCA PIRTs for the NuScale design.

The Containment and Ventilation Branch (SCVB) and the Reactor Systems, Nuclear Performance, and Code Review Branch (SRSB) plans to observe the test facility, and audit the documents supporting the testing of containment heat transfer performance and CVCS line break prior to future submission of the DC application from NuScale expected in the fourth quarter of calendar year 2016. The audit will also give NRC staff an opportunity to identify and verify the information that will have to be docketed to support the licensing basis and safety review activities for the NuScale design. The U.S. Nuclear Regulatory Commission (NRC) staff needs to conduct a pre-application audit of the NIST-1 critical path tests HP-02 and HP-04 characterizing the heat rejection capacity of the NuScale containment design from the condensing steam to the quiescent pool under design basis accident conditions. Another objective of the audit is to witness the Chemical Volume and Control System (CVCS) Discharge Pipe Break test (HP-28) and audit the related information.

Enclosure

The HP-02 and HP-04 tests were performed on October 7 - 8, 2015 and November 11 - 12, 2015, respectively, which the NRC staff could not observe. However, the NRC staff plans to conduct an audit of the test facility, instrumentation, test procedure, and the test data to make sure that the test results can be used in the full-scale reactor design safety analyses. The audit will be essentially conducted to collect relevant information about the test set-ups and assess the containment heat transfer and emergency core cooling system (ECCS) performance tests.

These audit activities will prepare the NRC staff for the expected submittal of the NuScale DC application in in the fourth quarter of calendar year 2016, to conduct a more efficient and timely review of the relevant information and to perform confirmatory analyses of their own. Observing the NuScale NIST-1 test setup and reviewing the associated documentation and the applicability of the test results to NuScale's SMR design will allow NRC technical staff to gain a better understanding of the containment thermal-hydraulic performance. In addition, the NRC staff would have a chance to observe the in-vessel flow and core temperature behavior. This will also allow the NRC staff to identify potential issues upfront that may affect the completeness or validity of the tests, which will reduce the need for issuing requests for additional information (RAIs) in the future in order to perform the licensing review and write the safety evaluation report (SER) for the related submittals. During the audit and interactions with NuScale, there may be NRC requests for information developed that would be part of the formal future correspondence.

Regulatory Audit Bases

This proposed technical audit is based on the following regulatory requirements:

- General Design Criteria (GDC) 38, "Containment heat removal," of Appendix A to Title 10 *Code of Federal Regulations* (10 CFR) Part 50
- General Design Criteria (GDC) 50, "Containment design basis," of Appendix A to 10 CFR, Part 50
- 10 CFR, Part 52, Section 157 (52.157)
- 10 CFR 50.43(e), concerning testing to qualify and assess the capability of submitted designs to meet safety criteria
- 10 CFR 50.46, Acceptance criteria for ECCS for Light-Water Nuclear Power Reactors

The NRC staff will conduct this audit in accordance with the guidelines provided in the Office of New Reactors (NRO) Office Instruction NRO-REG-108 (Revision 0), "Regulatory Audits" [Reference 2].

Regulatory Audit Scope

NuScale has conducted a series of tests that will assist in validating the methodology to be used in safety analyses in the NuScale DC application. The NRC staff will familiarize itself with the

test setup and facility design, as the primary value derived from this audit will lie in the staff's familiarization with the test set-up and the test results. The NRC staff will focus on the instrumentation parameters and locations, test scaling, facility parameters, and the test layout. This acquaintance with the test facility will better inform the NRC staff, both for the future review of topical reports and the application referencing the test data, and for observations that will be documented in the audit report.

The audit will focus on the test plans, procedures, calculations, and specifications associated with the NIST-1 tests of interest. The NRC staff will require access to the test equipment and experimental setup in order to familiarize with the physical layout of the test, the instrumentation locations, and other test characteristics in order to make adequate observations about the test facility. Collection and reduction of the test data to conclude the condensation heat transfer coefficient and pool-side heat transfer coefficient will be of special interest. The NRC staff would need to interact with the knowledgeable NuScale staff on the overall heat balance, instrumentation grid, experimental uncertainties, flow patterns being representative of the full-scale reactor transient, and any flow visualization NuScale might have conducted during the HP-02, HP-04, and HP-28 tests at the NIST-1 test facility. The NRC staff will also review results of the HP-02 and HP-04 tests as well as any subsequent correlation development.

Information and Other Material Necessary for the Audit

The NRC staff requests the following NIST facility and design documents pertaining to each of the NuScale containment heat transfer performance and CVCS break tests (HP-02, HP-04, HP-28) be made available to the audit team to perform the audit. NuScale should furnish the following information to support a seamless and productive audit activity.

- Test procedure (including acceptance criteria and test matrix). Ensuring the overall heat balance, condensate drainage measurement, flow patterns, and repeatability of the test results will be of special interest to the NRC staff during the audit.
- Test specification including justification used for scaling the dimensions and thermal hydraulic-parameters of the test setup.
- Test plan (including acceptance criteria and complete test matrix). Initial conditions for each test in the test matrix.
- Instrumentation, experimental uncertainties, and an overall uncertainty analysis.
- Data acquisition system, measurements, measurement grids/location, frequency of measurement and averaging, a typical test output file.
- A sample calculation associated with data reduction including the detailed method used to evaluate the parameters of interest, e.g., the local heat transfer co-efficient distribution.
- A description of the methodology and important correlations used in NRELAP5 (or/and GOTHIC) for calculation of film condensation.
- Test results and description of any resulting correlation development.

- Any comparison of the test data with test data taken at other test facilities over the same (or similar) parameter space. Are the NuScale condensation heat transfer data taken under near-vacuum and at high pressure similar to some other test data taken under similar pressure conditions?
- Detailed drawings (schematic, piping and instrumentation diagrams) for the test facility.
- Justification that the test facility configuration, section geometry, and the resulting flow fields are representative of prototypic plant conditions during the transients of interest.
- Prototype (NuScale design) and model (NIST-1) design parameters including the geometry and the operating conditions.
- Any documentation of how the 1/3rd height facilities condensation and cooling pool characterization data will be used in the full scale reactor design safety analyses (NIST-1 scaling analysis report).
- Instrumentation calibration description, calibration records and frequency.
- Relevant pre-test and/or post-test predictions and discuss results.
- Related test reports, if available.

This is not a comprehensive list of documents the NRC staff will be reviewing as part of the audit, as there may be a need to review additional data and calculations supporting the basis for these documents. Therefore, NuScale should include any relevant information that the NRC staff might not have explicitly included in the above.

While reviewing the above-mentioned material during the audit, the NRC staff intends to pursue a series of questions and concerns, which are proprietary in nature. These questions and concerns have been conveyed to NuScale. The NRC staff developed these to facilitate writing of the audit report as an agency record of the NRC staff observations about the tests of interest. NuScale is requested to either address those questions and issues during the audit or justify their lack of relevance to the test results usage. NuScale should furnish all the documents that would support the resolution of these questions and concerns. NuScale is also requested to provide a list of all the audit documents for NRC records, including the document titles, identifying numbers, and revisions. NuScale should furnish the documents regardless of whether or not they will be referenced in their future DC application. The proprietary versions of the documents, if applicable, would be needed for review during the audit.

Audit Team:

Syed I. Haider:	Reactor Systems Engineer	(NRO/DSRA/SCVB)
Shanlai Lu:	Sr. Reactor Systems Engineer	(NRO/DSRA/SRSB)
Carl Thurston:	Reactor Systems Engineer	(NRO/DSRA/SRSB)

Other NRC staff members may be added as the need arises.

Logistics

This audit will be conducted on June 27 - 30, 2016, at the NuScale NIST-1 test facility in Corvallis, Oregon. Interaction with knowledgeable NuScale staff would be needed to be directed to the required information. The NRC Staff requests that NuScale make subject matter expert(s) available to discuss the test apparatus, test procedures, data collection, data reduction, results and their application. The NRC Project Manager will coordinate with NuScale in advance of the specifics and any changes to the audit schedule and agenda.

Special Requests

The NRC staff requests that NuScale provide a conference room or other working space for the NRC staff near the test facility with hardcopies or electronic copies of the proprietary versions of the supporting documentation available.

Deliverables

The audit team will issue a regulatory audit summary report within 90 days after the completion of the audit that will be placed on the docket and in the Agencywide Documents Access and Management System (ADAMS). The audit outcome could also identify any additional information to be reviewed in a follow-up audit or submitted separately for making regulatory decisions.

References

1. "NuScale Power, LLC Submittal of the Preliminary NuScale Integral System Test Facilities (NIST) Test Identifier List", ADAMS Accession Number ML15026A755, January 26, 2015.
2. NRO-REG-108, "Regulatory Audits", ADAMS Accession Number ML081910260, April 2, 2009.

Attachment

Agenda

The audit will take place at the NuScale Test Facility, Oregon State University, Corvallis, Oregon 97331. The audit is scheduled to begin on June 27, 2016, and conclude on June 30, 2016.

Monday, June 27, 2016

(9:00AM – 9:30AM)

Entrance meeting discussion

(NRC/NuScale)

(9:30AM – 4:00PM)

NuScale Facility tour

(NRC/NuScale)

Audit team members interview NuScale staff

(NRC/NuScale)

Audit team members review documentation

(NRC/NuScale)

(4:00PM – 4:30PM)

Audit team members meet to discuss findings

(NRC)

Tuesday, June 28, 2016

(8:30AM – 4:00PM)

Audit team members review documentation (cont.)

(NRC/NuScale)

(4:00PM – 4:30PM)

Audit team members meet to discuss findings

(NRC)

Wednesday, June 29, 2016

(8:30AM – 4:00PM)

Audit team members observe HP-28 test

(NRC/NuScale)

Audit team members review documentation (cont.)

(NRC/NuScale)

(4:00PM – 4:30PM)

Audit team members meet to discuss findings

(NRC)

Thursday, June 30, 2016

(8:30AM – 3:00PM)

Audit team members observe HP-28 test (cont.)

(NRC/NuScale)

Audit team members review documentation (cont.)

(NRC/NuScale)

(3:00PM – 4:00PM)

Audit team members meet to discuss findings

(NRC)

(4:00PM – 5:00PM)

Exit meeting discussion

(NRC/NuScale)