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

March 27, 2018

MEMORANDUM TO: Technical Staff Reviewing the NuScale Initial Test Program
Office of Nuclear Reactor Regulation
Office of New Reactors

FROM: Timothy J. McGinty, Director ***/RA/***
Division of Construction Inspection
and Operational Programs
Office of New Reactors

SUBJECT: REVIEW APPROACH AND EXPECTATIONS FOR THE NUSCALE POWER, LLC, INITIAL TEST PROGRAM

After internal discussion, the staff is piloting a new review approach regarding the NuScale Power, LLC (NuScale), initial test program (ITP). Consistent with the memorandum, "Proposed Pilot Approach for the NuScale Power, LLC, Initial Test Program Review," dated March 7, 2018 (Agencywide Documents Access and Management System (ADAMS) Accession No. ML18060A298), the staff is ceasing review of certain components of the ITP that are considered not risk significant and not required for review at the design certification stage. Instead, the review of administrative requirements for an ITP and the review of structures, systems, and components (SSCs) that are not risk significant will be evaluated at the later combined operating license stage. This information was presented to NuScale during a public teleconference on March 7, 2018 (ADAMS Accession No. ML18075A312) and NuScale was amendable to this approach.

The focus of the revised ITP review is on providing reasonable assurance that the risk significant SSCs functions are being tested, and that they have a test abstract that adequately addresses the design functionality. This approach aligns with the methodology proposed in SECY-11-0024, "Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews." The Office of the General Counsel determined there was no legal impediment to the staff's proposed approach.

Title 10 of the *Code of Federal Regulations* (10 CFR) Section 52.47(c)(2), states, in part:

> An application for certification for a nuclear power reactor design that differs significantly from the light-water reactor designs described in paragraph (c)(1) of this section . . . must provide an essentially complete nuclear power reactor design . . . and must meet the requirements of 10 CFR 50.43(e).

CONTACT: Taylor Lamb, (301) 415-7128
Paul Prescott, (301) 415-3026

The regulations in 10 CFR 50.43(e), as applicable here, state that an application for a design certification will only be approved if:

> the performance of each safety feature of the design has been demonstrated through either analysis, appropriate test programs, experience, or a combination thereof.

As such, the U.S. Nuclear Regulatory Commission (NRC) staff reviews the ITP at the design certification stage to determine whether the safety-related functions of the risk-significant SSCs are appropriately addressed.

As of March 7, 2018, Phase 1 is considered to be complete. There is no longer a need to issue a request for additional information. Instead, the staff will hold a multi-day public meeting with NuScale to ask any clarifying questions. The staff's ultimate safety finding will be based on information provided by the applicant on the docket. The first meeting held with NuScale using the new approach was the digital instrumentation and control (I&C) meeting on March 7, 2018 (ADAMS Accession No. ML18072A285). The results of this meeting demonstrated that this approach can be successfully implemented. Per the commitment in the March 7, 2018 memorandum, the purpose of this memorandum is to provide specific guidance regarding the new review strategy, and will be discussed in two training sessions to be held on March 29, 2018, and one training session to be held on April 12, 2018.

The staff in the Division of Construction Inspection and Operational Programs (DCIP) have identified a set of fundamental questions for the reviewers to ensure alignment with the new approach. During the training sessions on March 29, 2018, the DCIP staff will meet with the technical staff to discuss these questions. This shift in review will focus on the following:

1. NuScale identified a number of safety and risk-significant system functions in Section 17.4 of the design certification application (DCA), which are categorized as A1 or B1. NuScale has identified a number of systems as having risk significant functions:

Containment System (A1, B1[1])	Steam Generator System (A1)
Reactor Core System (A1)	Control Rod Drive System (A1)
Reactor Coolant System (A1)	Chemical Volume and Control System (A1)
Emergency Core Cooling System (A1)	Decay Heat Removal System (A1)
Ultimate Heat Sink (A1)	Module Protection System (A1)
Neutron Monitoring System (A1)	Reactor Building (A1)
Control Building (A1)	Reactor Building Crane (B1)

   Does the technical staff agree with NuScale's assessment? Are there any other SSCs that are required to perform risk significant system functions?

2. Have the staff identified any unique NuScale design SSC testing that should be required?

3. Are there any non-safety support systems required to support a risk significant SSC that should be tested?

These first three steps should be completed on or before May 15, 2018, to ensure a timely and effective review. Email the resolution of these items to the contacts of this memorandum.

[1] Containment System function that supports the Reactor Building Crane

4. Is there sufficient design information for the test? (For example, values such as amount of heat going into the fuel pool during an accident condition rather than the spent fuel pool cooling system flow rates/pressures.)

5. Do test abstracts exist in revision 1 of the DCA that demonstrate the functionality of the risk significant SSC in the preoperational phase? The tests should provide reasonable assurance that the SSC will perform its intended function(s) when the reactor is operating.

Once the technical staff have determined the SSCs within the review of the ITP, the following guidance should be followed to determine the acceptability of the applicant's submittal.

- Evaluate whether the inspection test and acceptance criteria (ITAAC): (a) has an acceptable ITP test(s) associated with it to ensure completion; (b) determine if a pre-operational test should be added; or (c) determine if additional elaboration of the test abstract is required.

- Focus on confirming that the proposed tests verify a risk significant system has the capability to perform the function in accordance with its performance characteristics.

- Consideration should be given to the design review/evaluation findings and whether the testing adequately verifies the specific system performance characteristics.

- Consideration should be given to the design review/evaluation finding and whether the applicant is proposing that the system function will be proven by an alternative to testing through analysis, prototype testing, legacy testing data, or a combination thereof.

- Determine if the functionality of the system through an ITP test is addressed by an alternate system test (e.g., the Module Protection System testing addresses several systems in its proposed ITP tests).

- As a note, pre-operational tests proposed for non-risk significant ITAAC are outside the scope of review (see the attached table for a list of identified ITAAC with preoperational tests).

- If the staff has identified information that may be incorrect or is inconsistent with a current regulatory requirement for risk significant SSCs that have been identified in #1 above, then the issue should be identified and discussed with the relevant management on the need to address.

- As the RAI process will not be used to screen questions to the applicant, the staff should brief management on ITP-related questions prior to meeting with the applicant.

As the revised ITP review approach is more focused, and Phase 2 completion is currently scheduled for September 21, 2018, the expectation is that the technical staff completes the ITP review, consistent with this memorandum, and identifies any outstanding issues on or before June 29, 2018. The issues should be emailed to the contacts of this memorandum, and an internal meeting will be held with the technical staff in early July 2018 to ensure alignment and a consistent review approach. The appropriate NRC staff will then hold a multi-day public meeting with NuScale at the NRC Headquarters offices to discuss the issues. Any information needed in order to make a regulatory decision will need to be submitted by NuScale on the docket following the public meeting.

SUBJECT: REVIEW APPROACH AND EXPECTATIONS FOR THE NUSCALE POWER, LLC, INITIAL TEST PROGRAM Dated: March 27, 2018

Enclosures:
1. Enclosure 1: Example: Risk Informed Approach to the Initial Test Program Review
2. Enclosure 2: List of ITAAC with Associated Preoperational Tests
3. Enclosure 3: List of Acronyms

DISTRIBUTION:
Public
TLamb, NRO
TMcGinty, NRO
RCaldwell, NRO
ACampbell, NRO
EBenner, NRR
David Curtis, NSIR
PPrescott, NRO
PKrohn, NRO
ABradford, NRO
JMonninger, NRO
SHelton, NRR
JMartin, OGC
KKavanagh, NRO
CCarpenter, NRO
RTaylor, NRO
KCoyne, NRO
JAndersen, NSIR
SVrahoretis, OGC

ADAMS Accession Nos.: ML18074A124 **NRO-002**

OFFICE	NRO/DCIP/QVIB-2	NRO/DCIP/QVIB-2	NRO/DCIP/QVIB-2	NRO/DCIP
NAME	TLamb	PPrescott	KKavanagh	TMcGinty
DATE	03/15/2018	03/15/2018	03/15/2018	03/27/2018

OFFICIAL RECORD COPY

Example: Risk Informed Approach to the Initial Test Program Review

Begin by verifying whether the system, structure, or component (SSC) has a risk significant function identified in Table 17.4-1. For example, the Module Protection System (MPS) has risk significant functions associated with the Emergency Core Cooling System (ECCS), as found in Table 17.4-1. The MPS:

a. Supports ECCS by removing electrical power to the trip solenoids of the Reactor Vent Valves (RVVs) on an ECCS actuation signal.
b. Supports ECCS by removing electrical power to the trip solenoids of the Reactor Recirculation Valves (RRVs) on an ECCS actuation signal.

The next step is to confirm a test exists to verify this risk significant function. To continue with the MPS example, Table 14.2-63, "Module Protection System Test #63," identifies Test #63-4 and Test #63-6 as testing the ECCS RVVs and RRVs.

Upon identifying the associated preoperational tests in Table 14.2-63, proceed to the specific system level tests. For instance, the test objective of Test #63-4 instructs the reader to, "verify the MPS automatically initiates an ESF [engineered safety feature] actuation signal." Under the corresponding test method, the reader is instructed to initiate an automatic ESF actuation function for each ESF actuation function in Table 7.1-4 in Chapter 7, "Instrumentation and Controls." The instruction also identifies that, "all combinations of the 2 out of 4 logic must be actuated for each ESF function." In this case, the logic required to be met is high containment water level (2 out of 4 logic) and low reactor pressure vessel riser level (2 out of 4 logic) and low voltage alternating current (AC) electrical distribution system 24-hour timer (2 out of 3 logic).

The acceptance criteria was identified as, "an ESF actuation signal is displayed in the main control room (MCR) for all 2 out of 4 logic combinations each reactor ESF actuation function." This acceptance criteria is associated with inspections, tests, analyses and acceptance criteria 02.05.09 in Table 14.3-1.

Test 14.2-63 also pointed to system level Test #63-6 which the test objectives are to: (i) verify the MPS can manually actuate the ESF equipment from the MCR; (ii) verify that deliberate operator action is required to return the ESF actuated equipment to its non-actuated position; and (iii) verify the MPS can automatically actuate ESF equipment from all ESF actuation signals.

Table 7.1-4 lists the RVVs and RRVs as ESF functions and verifies the design response of ESF actuation signals using both a single manual ESF signal and a single ESF function to provide an automatic ESF actuation signal. This test will verify that all manual and automatic ESF actuation signals are tested.

Test 14.2-63, system level Test #63-6 acceptance criteria is that the MPS actuates the ESF equipment (RVVs and RRVs) to perform its safety-related function.

List of ITAAC with Associated Preoperational Tests

System	ITAAC	Test	System Tests
NPM (CNTS)	02.01.07	14.2-43	Leakage rate for local leak rate testing meets acceptance criteria
NPM (MPS)	02.01.08	14.2-63	CIV full open to full closed position
NPM (MPS)	02.01.13	14.2-63	CNTS S-R valves
NPM (MPS)	02.01.14	14.2-63	ECCS S-R valves
NPM (MPS)	02.01.15	14.2-63	RHR S-R valves
NPM (RCS)	02.01.16	14.2-46	RCS check valves
NPM (RCS)	02.01.17	14.2-46	RCS check valves
NPM (MPS)	02.01.18	14.2-63	CNTS S-R hydraulic operated valves
NPM (MPS)	02.01.19	14.2-63	ECCS S-R Rx recirculation and vent valves
NPM (MPS)	02.01.20	14.2-63	DHRS S-R hydraulic operated valves
NPM (CNTS)	02.01.21	14.2-43	CNTS S-R check valves
CVCS	02.02.03	14.2-38	CVCS Class 3 valves
CVCS	02.02.04	14.2-38	CVCS Class 3 check valves
CVCS	02.02.05	14.2-38	CVCS Class 3 AOVs
MPS	02.05.02	14.2-63	MPS configuration control
MPS	02.05.08	14.2-63	Reactor trip signals
MPS	02.05.09	14.2-63	ESF auto actuation signal
MPS	02.05.10	14.2-63	Reactor trip signal (RTB)
MPS	02.05.11	14.2-63	ESF auto activates
MPS	02.05.12	14.2-63	RTB multi-open upon manual Rx trip
MPS	02.05.13	14.2-63	MPS actuates ESF equipment
MPS	02.05.14	14.2-63	Rx trip on LOEP
MPS	02.05.15	14.2-63	Separation group fail safe on LOEP
MPS	02.05.16	14.2-63	(2-part) Rx trip signal RTB open (do not close on clear signal); - ESF signal actuation, ESF equipment actuates and continues to perform S-R function once ESF actuation signal clears
MPS	02.05.17	14.2-63	Time of Rx trip is ≤ maximum values
MPS	02.05.18	14.2-63	MPS interlocks auto establish operating bypass for Rx trip actuation
MPS	02.05.19	14.2-63	MPS permissive allow manual bypass for Rx trip for ESF actuation
MPS	02.05.20	14.2-63	MPS overrides are established when manual override switch active and real or simulated RT-1 interlock established

MPS	02.05.21	14.2-63	Safety function module OOS switch activated, safety function placed in trip/bypass
MPS	02.05.22	14.2-63	Each operational MPS manual or auto bypass is indicated in MCR
MPS	02.05.23	14.2-63	Each MPS maintenance bypass is indicated in the MCR
MPS	02.05.26	14.2-63	Minimum inventory of controls identified by HF engineering process can be manually operated from operator workstation in MCR
Unlisted (CVCS)	02.07.02	14.2-38	CVCS automatically aligns the components on real or simulated ABS high radiation signal from CVC-RT-3016
Unlisted (CVCS)	02.07.03	14.2-38	CVCS automatically aligns the components on real or simulated ABS high radiation signal from 6B-AB-RT-0142
Unlisted (CVCS)	02.07.04	14.2-38	CVCS automatically aligns the components on real or simulated ABS high radiation signal from 6B-AB-RT-0141

List of Acronyms

ABS	Auxiliary Boiler System
AOV	Air Operated Valve
CIV	Containment Isolation Valve
CNTS	Containment System
COL	Combined Operating License
CVCS	Chemical and Volume Control System
DCIP	Division of Construction Oversight and Inspection Programs
DHRS	Decay Heat Removal System
ECCS	Emergency Core Cooling System
ELVS	Low Voltage AC Electrical Distribution System
ESF	Engineered Safety Feature
HF	Human Factors
I&C	Instrumentation and Controls
ITAAC	Inspections, Tests, Analyses and Acceptance Criteria
ITP	Initial Test Program
LOEP	Loss of Electrical Power
MCR	Main Control Room
MPS	Module Protection System
NPM	NuScale Power Module
OOS	Out of Service
RCS	Reactor Coolant System
RHR	Residual Heat Removal
RPV	Reactor Pressure Vessel
RRV	Reactor Recirculation Valve
RTB	Reactor Trip Breaker
RVV	Reactor Vent Valve
Rx	Reactor
S-R	Safety-Related
SSC	Structure, System, and Component