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

June 27, 2019

Mr. Thomas Bergman, Vice President
Regulatory Affairs
NuScale Power LLC
1100 NE Circle Blvd., Suite 200
Corvallis, OR 97330

SUBJECT: NUSCALE POWER, LLC., DESIGN AIRCRAFT IMPACT ASSESSMENT INSPECTION, NUCLEAR REGULATORY COMMISSION INSPECTION REPORT NO. 05200048/2019-202

Mr. Bergman,

From May 6, 2019, through May 9, 2019, the U.S. Nuclear Regulatory Commission (NRC) conducted an inspection of the NuScale Power LLC., (NuScale) design Aircraft Impact Assessment (AIA). The NRC staff performed this inspection at the NuScale Corporate office located in Corvallis, Oregon. The purpose of the inspection was to assess NuScale's compliance with the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.150, "Aircraft impact assessment." The enclosed report presents the results of this inspection.

Based on the inspection samples, the NRC inspection team determined that a Severity Level IV violation of NRC requirements occurred. That violation was evaluated in accordance with the NRC's Enforcement Policy (Section 6.5) and is being dispositioned as non-cited violation (NCV) 05200048/2019-202-01, in accordance with the criteria of paragraph 2.3.2.a, of that policy, which have been satisfied. The NCV, described in detail in the subject inspection report, includes an example of NuScale's failure to identify and incorporate into the design certification application (DCA) those design features and functional capabilities credited in the AIA to show the reactor core remains cooled.

In accordance with 10 CFR 2.390 "Public inspections, exemptions, requests for withholding," of the NRC's "Rules of Practice," a copy of this letter and its enclosures, will be made available electronically for public inspection in the NRC Public Document Room or from the NRC's

Agencywide Document Access and Management System (ADAMS), accessible from the NRC Web site at http://www.nrc.gov/reading-rm/adams.html.

Sincerely,

Kerri A. Kavanagh, Chief **/RA/**
Quality Assurance Vendor Inspection Branch
Division Inspection Programs and Regional Support
Office of Nuclear Reactor Regulation

Docket No.: 05200048
EPID I-2019-202-0003

Enclosure:
Inspection Report No. 05200048/2019-202

SUBJECT: NUSCALE POWER, LLC., DESIGN AIRCRAFT IMPACT ASSESSMENT INSPECTION, NUCLEAR REGULATORY COMMISSION INSPECTION REPORT NO. 05200048/2019-202 Dated: June 27, 2019

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U.S. NUCLEAR REGULATORY COMMISSION
OFFICE OF NUCLEAR REACTOR REGULATION
DIVISION OF INSPECTION AND REGIONAL SUPPORT
AIRCRAFT IMPACT ASSESSMENT INSPECTION REPORT

Docket No.:	05200048
Report No.:	05200048/2019-202
Inspection Location:	1100 NE Circle Blvd., Suite 200 Corvallis, Oregon 97330
Contact:	Mr. Cyrus Afshar Supervisor, Regulatory Affairs cafshar@nuscalepower.com (541) 360-0609
Nuclear Industry Activities:	NuScale Power LLC. has completed its aircraft impact assessment of the design certification to comply with the U.S. Nuclear Regulatory Commission requirements in Title 10 of the Code of Federal Regulations Section 50.150, "Aircraft impact assessment."
Inspection Dates:	May 6-9, 2019
Inspectors:	Greg Galletti, Team Leader, NRR/DIRS/IQVB Odunayo Ayegbusi, NRO/DSRA/SPRA Ata Istar, NRO/DEI/SEB Ryan Nolan, NRO/DSRA/SPSB Pravin Patel, NRO/DEI/SEB Robert Vettori, NRO/DSRA/SPRA
Approved by:	Kerri A. Kavanagh, Chief Quality Assurance Vendor Inspection Branch Division Inspection Programs and Regional Support Office of Nuclear Reactor Regulation

Enclosure

EXECUTIVE SUMMARY

The U.S. Nuclear Regulatory Commission (NRC) conducted this inspection to verify that NuScale Power LLC., (NuScale) had implemented the provisions of Title 10 of the *Code of Federal Regulations* (10 CFR) 50.150, "Aircraft impact assessment," (10 CFR 50.150) and performed a design-specific assessment of the effects on the facility of the impact of a large commercial aircraft.

The NRC conducted the inspection at the NuScale Corporate office in Corvallis, Oregon on May 6-9, 2019.

The following served as the basis for the NRC inspection:

- 10 CFR 50.150

During this inspection, the NRC inspection team implemented Inspection Procedure (IP) 37804, "Aircraft Impact Assessment," dated February 9, 2012.

This inspection was performed to verify that NuScale's aircraft impact assessment (AIA) of the NuScale reactor design complies with the requirements of 10 CFR 50.150. The Nuclear Energy Institute (NEI) 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," Revision 8, dated April 2011, has been endorsed by the NRC in Regulatory Guide (RG) 1.217, "Guidance for the Assessment of Beyond-Design-Basis Aircraft Impacts," as one means of performing an AIA acceptable to the NRC. NuScale utilized NEI 07-13, Revision 8, with no exceptions, to perform its AIA.

For the implementation of this inspection, the NRC inspection team used Revision 2 of NuScale's design certification application (DCA). The results of the inspection are summarized below.

Systems-Loss Assessment

The NRC inspection team concluded, with one exception, that the systems-loss assessment performed by NuScale for the AIA is consistent with the regulatory requirements of 10 CFR 50.150. As documented in Section 1.b of this inspection report, the NRC inspection team identified one non-cited violation (NCV) regarding NuScale's failure to adequately identify and incorporate into the DCA those design features and functional capabilities credited in the AIA to show the reactor core remains cooled.

Fire Damage Assessment

The NRC inspection team concluded the fire damage assessment performed by NuScale for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

Structural Damage Assessment

The NRC inspection team found that the structural damage assessment performed by NuScale for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

Documentation and Quality Assessment

The NRC inspection team concluded that, with the exception of the NCV documented in Section 1.b of this inspection report, the documentation and quality assessment performed by NuScale for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

REPORT DETAILS

1. Systems-Loss Assessment

a. Inspection Scope

The NRC inspection team verified that the aircraft impact assessment (AIA) adequately addressed a system-loss assessment consistent with the requirements of 10 CFR 50.150. Specifically, the NRC inspection team determined that the systems-loss assessment included:

- verification of the location of those structures, systems, and components (SSCs) that provide core cooling or containment isolation, and spent fuel pool (SFP) integrity to determine the potential for damage by aircraft impact;

- verification that those SSCs would be capable of performing their intended function given the established structural, shock, and fire damage footprints and the rule sets and assumptions provided in Nuclear Energy Institute (NEI) 07-13, "Methodology for Performing Aircraft Impact Assessments for New Plant Designs," Revision 8, dated April 2011 (NEI 07-13);

- verification that NuScale addressed accident initiators, such as a breach of the reactor coolant system (RCS) or the failure of the reactor to trip, that could result from damage caused by an aircraft impact; and

- verification that success paths for core cooling exist.

The NRC inspection team also discussed the systems-loss assessment with NuScale's management and technical staff. The attachment to this inspection report lists the documents reviewed and the staff interviewed by the NRC inspection team.

b. Observations and Findings

b.1 Determination of the location of credited SSCs

The NRC inspection team reviewed NuScale's selection of SSCs needed to prevent fuel damage in the core and the documented spatial configuration of those SSCs. NuScale indicated that its objective in adding key design features to address the AIA rule was to maintain core cooling, intact containment, and spent fuel pool integrity. Therefore, SSCs needed to provide for active spent fuel pool cooling were not reviewed by the NRC inspection team.

The NRC inspection team compared the descriptions of SSCs in the assessment to those in the Final Safety Analysis Report (FSAR) and the probabilistic risk analysis (PRA) and reviewed whether the scope of SSCs treated in the assessment was complete and consistent with those needed to satisfy the core cooling success criteria in the PRA. The NRC inspection team used equipment location data and drawings from the general arrangement drawings to confirm that the locations of equipment documented in the assessment were accurate.

The NRC inspection team found that NuScale failed to perform a design-specific assessment in portions of the AIA, consistent with 10 CFR 50.150 subpart (a)(1)

which states, in part, that the applicant shall identify and incorporate into the design those design features and functional capabilities to show that, with reduced use of operator actions: (i) The reactor core remains cooled. Specially, the NuScale systems-loss assessment identifies the emergency core cooling system (ECCS) as a safety-related system available to provide heat removal from the reactor pressure vessel for at least 72 hours and credits in its conclusions that core cooling is maintained by the ECCS. The ECCS was not identified as, nor considered, a key design feature in Chapter 19.5 of the FSAR, as required by 10 CFR 50.150(a)(1).

This issue was identified as severity level IV violation for NuScale's failure to adequately address core cooling within the systems-loss assessment portion of the AIA and is being dispositioned as a non-cited violation (NCV) 05200048/2019-202-01 in accordance with the NRC's Enforcement Policy, Section 2.3.2.a. In response to the issue, NuScale created condition reports CR-0519-65527 and CR-0519-65535, dated May 9, 2019, to immediately address this concern. Subsequent to the inspection, the NRC inspection team reviewed draft revisions to the NuScale FSAR, Revision 2, and EE-F010-3912, "NuScale Design Phase 2 AIA Heat Removal Report," Revision 1, that further clarifies that the DHRS system is credited as the only system needed to provide adequate core cooling for the entire time duration of the analysis. The NRC inspection team determined that those draft revisions to the FSAR and AIA Heat Removal Report that specifically credit only the DHRS are acceptable to address the concern. However, NuScale should review the concern for potential extent of condition beyond the example cited in the NCV and appropriately document any potential action in NuScale's corrective action program.

b.2 Determination of the state of SSCs in the aircraft impact scenarios

The NRC inspection team reviewed the AIA to determine whether NuScale had correctly applied the rules and assumptions given in NEI 07-13 for the loss of SSCs. Specifically, the NRC inspection team reviewed the SSCs that NuScale had identified in the AIA as remaining functional in each scenario and verified that the basis used to conclude that these SSCs will survive the conditions created by an aircraft impact is consistent with the rules and assumptions given in NEI 07-13. For example, for each at power strike scenario, the NRC inspection team verified that a decay heat removal pathway exists using the decay heat removal system (DHRS). For all strike scenarios, the NRC inspection team verified that necessary support SSCs, such as containment isolation valves and the ultimate heat sink, were available. The NRC inspection team determined that the potential effect of structural, shock, or fire damage will not prevent the core cooling equipment and the credited systems from remaining capable of performing their intended function following an aircraft impact.

b.3 Determination of accident conditions

The NRC inspection team verified that NuScale used appropriate assumptions and scenarios to determine accident conditions. These assumptions were consistent with NEI 07-13 and include:

- NuScale's success criteria and the scenario analysis that addresses initial plant states of 100 percent power and cold shutdown;

- the analysis takes no credit for the availability of offsite power;

- the consideration of the possibility of an anticipated transient without scram (ATWS); and

- NuScale has considered the influence of containment status on the operability of other equipment.

Specifically, the NRC inspection team reviewed NuScale's treatment of the following potential accident conditions:

Loss of Coolant Accident (LOCA) inside containment

The NRC inspection team reviewed NuScale's assessment of a LOCA inside the containment to determine if the containment is adequately protected such that it could not be impacted by an aircraft. The NRC inspection team determined that the assessment adequately demonstrated that neither shock damage nor physical damage to the containment vessel would occur and, as such, verified that a LOCA inside containment would not occur.

LOCA outside containment

The NRC inspection team reviewed NuScale's assessment of a LOCA outside containment to determine if piping outside of primary containment that is connected to the reactor coolant pressure boundary, above grade level, is protected from structural damage. The NRC inspection team used plan and elevation drawings of the reactor building (RXB) to confirm that NuScale's assessment effectively determined that the applicable piping and isolation valves are adequately protected from structural damage.

ATWS

The NRC inspection team reviewed the AIA to determine if NuScale adequately assessed the potential for any damage scenarios that could affect the ability to trip the reactor. The NRC inspection team verified that an ATWS was not a viable outcome from an aircraft impact because the equipment necessary to maintain the reactor shutdown is outside the damage footprint areas or a loss of power to the equipment will induce a reactor trip.

Flooding

The NRC inspection team reviewed the AIA to determine if NuScale adequately assessed the potential for flooding from a large water source as described in NEI 07-13. The assessment stated that there are no pipe breaks which would cause flooding of the RXB from an aircraft impact. The NRC inspection team verified that any potential large water source was either not vulnerable nor was bounded by the internal flooding analysis.

Loss of Decay Heat Removal-Shutdown

The NRC inspection team reviewed the AIA to determine if NuScale adequately assessed the potential for a loss of decay heat removal event when the reactor is shutdown. The NRC inspection team reviewed the assumptions used in the analysis and verified that applicable assumptions were consistent with guidance in NEI 07-13.

During refueling the lower portion of the containment and reactor vessels will be completely submerged in the protected RXB pool. Therefore, core cooling is maintained during shutdown conditions.b.4 Identification of Success Paths

The NRC inspection team reviewed the AIA to determine if NuScale had a success path for core cooling. The NRC inspection team reviewed the information documented in Chapter 19 of the FSAR, Revision 2, and verified that the core cooling methods identified by NuScale are shown as success paths for avoiding core damage.

c. Conclusions

The NRC inspection team concluded that the system-loss assessment performed by NuScale for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

2. Fire Damage Assessment

a. Inspection Scope

The NRC inspection team verified that the AIA adequately assesses fire-damage consistent with the requirements of 10 CFR 50.150 to ensure that plant SSCs maintain key safety functions (core cooling, containment, spent fuel cooling, and spent fuel pool integrity). Specifically, the NRC inspection team verified that the fire damage assessment included:

- identification and incorporation of the necessary design features and functional capabilities;
- a realistic and design-specific assessment;
- a description of key design features credited in the AIA that are consistent with those documented in the FSAR;
- an assessment that damage footprints include the effects from the spread of fire damage through existing connected compartments and through new compartment connections due to overpressure; and
- a verification that the SSCs credited for safe shutdown following aircraft impact scenarios remain free from physical and fire damage.

The NRC inspection team also discussed the fire damage assessment with NuScale's management and technical staff. The attachment to this inspection report lists the documents reviewed and the staff interviewed by the NRC inspection team.

b. Observations and Findings

b.1 Fire-Damage Footprint Assessment

The NRC inspection team verified NuScale's method that led NuScale to conclude that NuScale's structural design prevented fire from being a hazard to internal equipment. Specifically, the NRC inspection team verified that there was no fire damage caused by aircraft impact in the vicinity of essential SSCs needed to

maintain reactor core and SFP cooling. The NRC inspection team verified consistency between the FSAR and AIA to assure that design features credited in the AIA are described in the FSAR.

The NRC inspection team assessed NuScale's preventative measures and credited protections to exterior openings. Specifically, the NRC inspection team verified that NuScale's assessment of credited structural design features, including concrete barriers and 3-hour 5 pounds per square inch differential barriers located at the perimeter of the RXB, adequately prevented damage from propagating to the interior regions.

b.2 Fire Damage Effects on SSCs

The NRC inspection team reviewed the AIA to determine if NuScale assessed the fire damage effects on SSCs; however, since there were no fire damage areas in the vicinity of essential SSCs needed to maintain reactor core and SFP cooling, the NRC inspection team verified NuScale's preventative measures and credited protections as described in Section 2.b.1, "Fire-Damage Footprint Assessment." of this report.

c. Conclusions

The NRC inspection team concluded that the fire damage assessment performed by NuScale for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

3. Structural Damage Assessment

a. Inspection Scope

The NRC inspection team verified that the AIA was sufficiently rigorous and realistically evaluated a design-specific structural damage analysis of the effects of the impact of a large, commercial aircraft on the facility consistent with the requirements of 10 CFR 50.150: Specifically, the NRC inspection team verified that the structural damage assessment included:

- adequate information found in plant documentation including plant arrangement drawings displaying locations of major equipment and plant elevation drawings documenting the relative heights of various buildings;
- civil-structural drawings that provide wall thicknesses, reinforcement details, and material specifications;
- general structural analysis considerations such as design inputs, analysis parameters and assumptions, computer codes, methods used for structural analyses and results to evaluate whether NuScale adequately analyzed the effects of, and damage to structures resulting from, global and local aircraft impact loads;
- SFP impact analyses to evaluate whether NuScale addressed the criteria in section 2.5 of NEI 07-13; and
- structural damage footprint assessments to evaluate whether NuScale adequately assessed the containment and other reinforced concrete buildings containing

essential SSCs for maintaining reactor core cooling using the damage rule sets in Section 3.3 of NEI 07-13.

The NRC inspection team also discussed the structural damage assessment with NuScale's management and technical staff. The attachment to this inspection report lists the documents reviewed and the staff interviewed by the NRC inspection team.

b. Observations and Findings

b.1 Structural Assessment Document Review

The NRC inspection team reviewed NuScale's structural assessment design inputs, including plant arrangement drawings, plant elevation drawings, civil-structural drawings, and material specifications. The NRC inspection team verified that the plant arrangement drawings display the locations of major equipment (e.g., RXB crane), and the plant elevation drawings identified the relative heights of various buildings.

b.2 General Structural Analysis

NuScale's AIA evaluated 19 structural analysis cases in accordance with NEI 07-13. The analyses performed for the RXB and stainless steel RXB pool liner confirmed that the liner would remain intact and that the RXB would not be perforated.

The NRC inspection team verified that NuScale used appropriate design inputs including the structural analysis parameters and assumptions, type of finite elements used in each analysis, material models considered, boundary conditions and extent of model, initial conditions, and time duration of the analysis. In addition, the NRC inspection team verified that NuScale adequately documented and justified the structural design input for a sampling of analyses and adequately analyzed the effects of, and damage to structures resulting from, local and global loading arising from an aircraft impact.

The NRC inspection team verified that NuScale properly modeled the reinforcing bars as sub-elements embedded within the concrete elements at the appropriate locations and RXB pool including liner.

The NRC inspection team verified that all potential aircraft impact scenarios were considered in the structural analyses. The NRC inspection team reviewed a sample of the structural damage impact scenario analyses and verified that NuScale properly applied the NRC-supplied forcing function and missile-target interaction to the appropriate structural damage impact scenarios. In addition, the NRC inspection team reviewed the assumptions used in the structural damage analyses and verified that NuScale adequately documented the technical basis and assumptions used in the analyses.

The NRC inspection team reviewed a sample of structural damage analyses and verified that NuScale used the correct failure criteria. As part of the review, the NRC inspection team reviewed the various material properties used in the structural analyses, including concrete strength of 5,000 pounds per square inch (psi) (34.5

MPa) and 7,000 psi (48.3 MPa) used for the structural element of RXB. Conservatively, the analyses did not credit Dynamic Increase Factor (DIF) allowed by NEI 07-13.

b.3 RXB Specific Impact Assessment

The NRC inspection team reviewed the RXB impact analyses to evaluate whether NuScale met the sufficiency criteria in NEI 07-13, Section 2.5.

The NRC inspection team reviewed the structural damage assessment as it relates to local loading on the RXB structure and verified that NuScale conducted the following activities in accordance with NEI 07-13, Section 2.1:

- documented and cross-checked the aircraft engine parameters used in the analysis against NRC-specified parameters;
- properly applied the various local loading formulas referenced in NEI 07-13, Subsection 2.1.2, to arrive at the degree of local damage and the wall thickness required to prevent perforation of the target; and
- used the formulas cited in NEI 07-13.

The NRC inspection team reviewed the structural damage assessment as it relates to global loading effects on the RXB structure. The NRC inspection team verified that the following activities were conducted in accordance with NEI 07-13, Section 2.2:

- documentation and use of the application of the force time-history analysis method and cross-checking it for its equivalency to the NRC-specified force time-history;
- documentation of the application of the missile-target interaction analysis method and cross-checking it for its equivalency to the NRC-specified force-time history;
- the missile-target interaction analysis method reasonably captured the mass distribution of the missile when a "reverse-engineering" approach was used to determine the missile-target interaction from the force-time history; and
- for the application of the force time-history analysis method, NuScale properly used and adequately documented the NRC-specified spatial distribution of the impact force in the analyses.

The NRC inspection team reviewed a sample of documents for material characterization and failure criteria related to the structural damage assessment and verified that the following analysis activities were conducted in accordance with NEI 07-13, Section 2.3:

- application of the ANACAP-U concrete constitutive model consisting of material properties and the equations used to model the nonlinear behavior of

both steel and reinforced concrete materials in the analyses. The model parameters used are adequately documented and consistent with the material properties and equations documented in NEI 07-13, Section 2.3;

- application of the ductile failure strain limits specified in NEI 07-13, Subsection 2.3.2, for the various materials used in the analyses;

- the concrete structural failure criteria used in the analyses are appropriately documented and consistent with the criteria specified in NEI 07-13, Subsection 2.3.3;
- application and documentation of the material models specified in NEI 07-13, Subsection 2.3.4; and

- application and documentation of the structural integrity failure criteria specified in NEI 07-13, Subsection 2.3.5.

The NRC inspection team reviewed the major assumptions applied to the containment and SFP related structural analyses and verified that the following activities were conducted in accordance with NEI 07-13, Section 2.4:

- missile-target interaction analysis model properly assumed that the aircraft impact was perpendicular to the centerline of the containment;

- missile-target interaction analysis model properly assumed takeoff weight such that the missile-target interaction model is equivalent to the NRC-specified force time-history;

- containment regions containing critical penetrations received an appropriate level of special consideration;

- SFP analyses properly assumed that both the engine and the aircraft fuselage strike were perpendicular to and at the mid-point of the SFP wall;

- assessment of potential aircraft impact at other locations that could result in greater consequences; and

- NuScale did not take credit for RXB pool water inventory in its analyses, except for the case number 19 for the integrity of the RXB crane.

The NRC inspection team reviewed the RXB including SFP related structural analyses and verified NuScale's conclusion that the damage imparted to the RXB walls would not result in leakage of the RXB pool water. Thus, the integrity of the RXB of pool water is maintained, consistent with the sufficiency criteria of NEI 07-13, Subsection 2.5.2.

b.4 Structural Damage Footprint Assessment

The NuScale AIA evaluated a total of 19 different impact scenarios in accordance with NEI 07-13. The NRC inspection team reviewed all of the impact scenarios associated with structural performance.

The NRC inspection team reviewed the structural damage footprint analyses to evaluate whether the following items of interest related to the damage rule sets identified in NEI 07-13, Section 3, "Heat Removal Capability," have been met. These items of interest include:

- structures of concern that contain SSCs have been identified;
- a systematic evaluation of susceptible damage was conducted and adequately documented; and
- assumptions used to determine elevations of concern have been addressed and adequately documented.

The NRC inspection team verified that the structural damage rule sets for RXB and including SFP structures were appropriately assessed consistent with the guidance in NEI 07-13, Subsection 3.3.1. The NRC inspection team verified that the following activities were conducted in the analyses:

- various impact points have been investigated and documented in order to define the damage footprint;
- structural damage rule sets regarding perforations were appropriately developed;
- shock damage was evaluated in the structural damage footprints and these evaluations have been adequately documented;
- the guidance in NEI 07-13, Table 3-3, was used to define the shock damage footprints and was adequately documented; and
- shock effects impacting seismic separation between buildings has been adequately assessed and documented.

c. Conclusions

The NRC inspection team concluded that the structural damage assessment performed by NuScale for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

4. AIA Documentation and Quality Assessment

a. Inspection Scope

The NRC inspection team verified that the NuScale performed a quality assessment to ensure the AIA was documented and maintained consistent with the requirements of 10 CFR 50.150. The NRC inspection team confirmed that:

- NuScale adequately documented the quality assessment consistent with NEI 07-13, Section 5.1; and

- NuScale adequately established standards and measures to establish the validity of the assessment and supporting calculations.

b. Observations and Findings

The NRC inspection team reviewed ECR-F101-64992, "Aircraft Impact Assessment for DCA Inspection," dated March 26, 2019, the administrative controls governing the design change process, and reviewed a sample of completed design change requests to verify that any effects of design changes on key design features credited in the AIA were adequately identified and evaluated.

The NRC inspection team reviewed TeraGrande, a dynamic finite element software application used for structural analyses during the AIA, to verify that NuScale had validated and benchmarked the codes for the applications assessed, consistent with Appendix C of NEI 07-13. The NRC inspection team determined that NuScale had adequately documented the validation activities as described in report TeraGrande Version 2.0-13905, "Verification and Validation of TeraGrande Version 2.0-13905," dated August 2015.

c. Conclusions

The NRC inspection team concluded that, with the exception of NCV 05200048/2019-202-01, documented in Section 1.b of this inspection report, the documentation and quality assessment performed by NuScale for the AIA is consistent with the regulatory requirements of 10 CFR 50.150.

5. Entrance and Exit Meetings

On May 6, 2019, the NRC inspection team discussed the scope of the inspection with Mr. Dale Atkinson, NuScale Chief Operating Officer/Chief Nuclear Officer (COO/CNO) and other representatives from NuScale. On May 9, 2019, the NRC inspection team presented the inspection results and observations during an exit meeting with Mr. Dale Atkinson, NuScale COO/CNO and representatives from NuScale.

ATTACHMENT

1. PERSONS CONTACTED

Name	Affiliation	Entrance	Exit	Interviewed
Greg Galletti	NRC	X	X	
Ryan Nolan	NRC	X	X	
Ata Istar	NRC	X	X	
Pravin Patel	NRC	X	X	
Robert Vettori	NRC	X	X	
Odunayo Ayegbusi	NRC	X	X	
Dale Atkinson	NuScale	X	X	
Thomas Bergman	NuScale	X	X	X
Cyrus Afsar	NuScale	X	X	
Eric Kjolsing	Structural Integrity	X	X	X
Josh Parker	NuScale	X	X	X
Liz English	NuScale	X		
Amber Berger	NuScale	X	X	X
Andrew Williamson	Jensen Hughes	X	X	X
Elisa Fairbanks	NuScale	X	X	
Brandon Hanson	NuScale	X		
Evren Ulku	NuScale	X	X	X
David Ethington	NuScale	X		
Gary Hayner	Jensen Hughes	X	X	X
Wayne Masse	NuScale	X	X	X
Zachary Rad	NuScale	X		X
Robert Gamble	NuScale	X		
Mike Melton	NuScale	X	X	X
Randy James	Structural Solutions	X	X	X
Marty Bryan	NuScale	X	X	
Brian Mocello	NuScale		X	
Gary Becker	NuScale			X
Cindy Williams	NuScale			X

1. Inspection Procedures Used

Inspection Procedure 37804, “Aircraft Impact Assessment,” dated February 9, 2012

2. List of Items Opened, Closed, and Discussed

Item Number	Status	Type	Description
05200048/2019-202-01	CLOSED	NCV	10 CFR 50.150(a)(1)

3. Documents Reviewed

Systems-Loss Assessment

- EE-F010-3912, “NuScale Design Phase 2 AIA Heat Removal Report,” Revision 1, dated April 25, 2019
- EE-F010-1545, “Aircraft Impact Mitigation Design Decision,” Revision 2, dated June 15, 2015
- -E-P-NR-14002-P-SGI, “Aircraft Impact Assessment Report Volume II: Heat Removal,” Revision 1, dated April 2017
- -E-P-NR-14001-P, “Probabilistic Risk Assessment Summary Report,” Revision 0, dated January 2015
- ARP1400-K-X-FS-14002-NP, “Design Control Document Tier 2,” Revision 1, dated March 2017

Fire Damage Assessment

- Report No. 1500925.402, “Aircraft Impact Assessment for NuScale NP-12 Plant Design,” Revision 2, dated April 2019
- 1GWH1L008-RPT-001, “NuScale Design Phase 3 AIA Heat Removal Report,” Revision 0
- -E-P-NR-14002-P-SGI, "Aircraft Impact Assessment Report Volume II: Heat Removal," Revision 1, dated April 2017
- Design Control Document, Revision 1, dated March 2017
- DCA Quadrant Color Code (tool aid showing safety divisions)

Structural Damage Assessment

Reports

- Report No.: 1801179.402, “Mesh Sensitivity Impact Analysis Using TeraGrande Report,” Revision 0
- Report No.: ER-F010-3948, “Verification and Validation of TeraGrande Version 2.0-13905,” Revision 0

Drawings

- Drawing No.: NP12-00-F012-S-A5-1711-S01 thru S18, “RXB Equipment Door Arrangement and Details,” Revision 5

- Drawing No.: NP12-00-F010-S-CD-1897-651, “RXB Structural Drawing, SHT1,” Revision 5
- Drawing No.: NP12-00-F010-S-CD-1697-S32, “RXB Structural Concrete Drawing SHT32,” Revision 5
- Drawing No.: NP12-00-F010-S-CD-1697-S43, “RXB Structural Concrete Drawing SHT43,” Revision 5
- Drawing No.: NP12-00-F010-S-CD-1697-S50, “RXB Structural Concrete Drawing SHT50,” Revision 5
- Drawing No.: NP12-00-F010-S-CD-1697-S53, “RXB Structural Concrete Drawing SHT53,” Revision 5
- Drawing No.: NP12-00-F010-S-CD-1697-S56, “RXB Structural Drawing SHT56,” Revision 5

Quality Assessment

- ECR-F010-64992, “Aircraft Impact Assessment for DCA Inspection,” dated March 26, 2019
- ER-F010-3669, “Aircraft Impact Assessment for NuScale NP-12 Plant Design,” Revision 1, dated April 30, 2019
- EP-0603-12984, “Methods for Protection of Safeguards Information,” Revision 4
- EP-0703-1417, “Owner Acceptance Review and Approval of Supplier Deliverables,” Revision 11, dated January 11, 2019
- EP-0703-1417-F01, “Supplier Deliverable Review Form”
- TeraGrande Version 2.0-13905, “Verification and Validation of TeraGrande Version 2.0-13905,” dated August 2015
- S1-0119-65496, “January 2019 Surveillance of Jensen Hughes SGI Facility,” Revision 0, dated January 3, 2019
- DI-1417-53076, “Owner Acceptance Review Documented Instructions,” Revision 0
- SW-0918-61550, “Aircraft Impact Assessment Reconciliation Structural,” Revision 2
- SW-0918-61549, “Aircraft Impact Assessment Reconciliation Heat Removal,” Revision 0

Task orders

- CO-1215-19693 TO05, “Task Order- Time and Material,” Revision 0
- CO-0713-4326, TO16, “Task Order- Time and Material,” Revision 0
- CO-0713-4326, TO16, “Task Order-Revision,” Revision 1
- CO-0713-4326 TO16, “Task Order Revision,” Revision 2
- CO-0713-4326 TO16, “Task Order Revision,” Revision 3

4. ACRONYMS USED:

ADAMS	Agencywide Documents Access and Management System
AIA	aircraft impact assessment
ATWS	anticipated transient without scram
CFR	*Code of Federal Regulations*
COO/CNO	Chief Operating Officer/Chief Nuclear Officer
DCA	design certification application
DCIP	Division of Construction Inspection and Operational Programs
DHRS	decay heat removal system

DIF	Dynamic Increase Factor
ECCS	emergency core cooling system
FSAR	Final Safety Analysis Report
IP	inspection procedure
NuScale	NuScale Power LLC.
LOCA	loss of coolant accident
NCV	non-cited violation
NEI	Nuclear Energy Institute
NRC	(U.S.) Nuclear Regulatory Commission
NRO	Office of New Reactors
PRA	probabilistic risk analysis
PSI	pounds per square inch
IQVB	Quality Vendor Inspection Branch
RBX	reactor building
RCS	reactor coolant system
RG	regulatory guide
SGI	safeguards information
SFP	spent fuel pool
SSC	systems, structures, and components
UHS	ultimate heat sink
U.S.	United States (of America)