

14 INITIAL TEST PROGRAM AND INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA

14.1 Introduction

This chapter of the safety evaluation report (SER) documents the U.S. Nuclear Regulatory Commission (NRC or Commission) staff (hereafter referred to as the staff) review of Chapter 14, “Initial Plant Test Program and Inspections, Tests, Analyses, and Acceptance Criteria,” of the NuScale Power, LLC (hereafter referred to as the applicant) Design Certification Application (DCA), Part 2, “Final Safety Analysis Report (FSAR),” Revision 2. For SER Section 14.2, “Initial Plant Test Program – Design Certification and New License Applicants,” the staff’s review also includes additional changes to DCA Part 2, Tier 2 Section 14.2, “Initial Plant Test Program,” provided by NuScale on November 16, 2018, February 5, 2019, and April 2, 2019 (Agencywide Documents Access and Management System (ADAMS) Accession Nos. ML18320A189, ML19036A969, and ML19092A448).

14.2 Initial Plant Test Program - Design Certification and New License Applicants

14.2.1 Generic Guidelines for Initial Test Programs

14.2.1.1 Introduction

The applicant for an operating license (OL) under Title 10 of the Code of Federal Regulations (10 CFR) Part 50, “Domestic Licensing of Production and Utilization Facilities,” or a combined license (COL) under 10 CFR Part 52, “Licenses, Certifications, and Approvals for Nuclear Power Plants,” is responsible for ensuring that a suitable initial (preoperational and startup) test program will be conducted for the facility. The initial test program (ITP) includes system and component tests; monitoring of structures, systems, and component (SSCs) performance; and inspection and surveillance test activities for plant SSCs. An ITP satisfying these objectives should provide the necessary assurance that the facility can be operated in accordance with design requirements and in a manner that will not endanger the health and safety of the public.

Initial startup testing consists of equipment performance tests completed during and after fuel loading. These performance tests are normally completed during fuel loading, precritical, initial criticality, low-power, and power ascension phases to confirm the design basis and demonstrate, to the extent practical, that the plant will operate in accordance with the design and can respond to anticipated transients and postulated accidents as specified in the FSAR.

The ITP is designed to demonstrate the performance of SSCs and integrated plant design features that will be used during normal facility operations, as well as the performance of standby systems and features that must function to maintain the plant in a safe condition in the event of malfunctions or accidents. The startup tests are sequenced so that plant safety is never entirely dependent on the performance of untested SSCs.

Regulatory Guide (RG) 1.68, Revision 4, “Initial Test Programs for Nuclear Power Plants,” dated June 2013, describes the general scope and depth of the ITP acceptable to the NRC staff for light-water-cooled nuclear power plants. Additionally, NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR [Light Water Reactor]

Edition,” Section 14.2, “Initial Test Program,” Revision 3, dated March 2007, provides guidance to the NRC staff for the review of a proposed ITP. For small modular reactor designs, SECY-11-0024, “Use of Risk Insights to Enhance the Safety Focus of Small Modular Reactor Reviews,” dated February 18, 2011, requested Commission approval of the staff’s recommendation to develop a risk-informed and integrated framework for the review of the integral pressurized-water reactor (iPWR) designs. On May 11, 2011, the Commission approved staff’s approach and provided additional direction (ADAMS Accession No. ML111320551). In response, the NRC staff subsequently developed a design specific review standard (DSRS) for the NuScale design. The NuScale DSRS Section 14.2, “Initial Plant Test Program – Design Certification and New License Applicants,” dated July 11, 2016, provides guidance to the NRC staff for review of the proposed NuScale initial test program.

Section 14.2 of the DSRS notes that there is no requirement for a design certification (DC) applicant to provide an ITP submittal under 10 CFR Part 52, Subpart B, “Standard Design Certifications.” However, the staff has reviewed the test abstracts provided by previous DC applicants for completeness and suitability for development of an ITP by a COL applicant against the guidance in the Standard Review Plan Section 14.2 and RG 1.68.

14.2.1.2 Summary of Application

DCA Part 2, Tier 1: No Tier 1 information is provided in the NuScale DCA Part 2 for this program.

DCA Part 2, Tier 2: The applicant provided a Tier 2 program description in DCA Part 2, Tier 2 Section 14.2.1, “Summary of Initial Test Program and Objectives,” which is summarized here in part:

The Initial Test Program (ITP) consists of a series of preoperational and startup tests. Preoperational testing is conducted following completion of construction testing but prior to fuel load. Completion of preoperational testing is necessary to ensure the overall plant is ready for fuel loading and startup testing of a NuScale Power Module (NPM).

ITAAC: There are no inspections, tests, analyses, and acceptance criteria (ITAAC) for this area of review.

Technical Specifications: There are no technical specifications (TS) for this area of review.

Technical Reports: There are no technical reports for this area of review.

14.2.1.3 Regulatory Basis

The following NRC regulations contain the relevant requirements for this review:

- 10 CFR 50.34(b)(6)(iii), which requires the applicant to provide plans for preoperational testing and initial operations.
- 10 CFR 30.53(c), as it relates to testing radiation detection and monitoring instruments.

- Criterion XI, “Test Control,” of Appendix B, “Quality Assurance Criteria for Nuclear Power Plants and Fuel Reprocessing Plants,” to 10 CFR Part 50, as it relates to test programs established to ensure that SSCs will perform satisfactorily in service.
- Section III.A.4 of Appendix J, “Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors,” to 10 CFR Part 50, as it relates to the preoperational leakage testing of the primary reactor containment and related systems and components penetrating the primary containment pressure boundary.
- 10 CFR 50.43(e)(1)(i), which states that an application for a design certification that proposes nuclear reactor designs which differ significantly from light-water reactor designs that were licensed before 1997, or use simplified, inherent, passive, or other innovative means to accomplish their safety functions 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.
- 10 CFR 52.47(c)(2), which requires that 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 Section 52.47 must provide an essentially complete nuclear power reactor design and must meet the requirements of 10 CFR 50.43(e).
- 10 CFR 52.79(a)(28), which requires COL applicants to provide plans for preoperational testing and initial operations.

Additionally, the guidance in DSRS Section 14.2 lists acceptance criteria adequate to meet the above requirements, as well as review interfaces with other DSRS sections.

14.2.1.4 Technical Evaluation

The applicant provided the technical information associated with the ITP in DCA Part 2, Tier 2, Section 14.2, “Initial Plant Test Program,” dated November 16, 2018, February 5, 2019, and April 2, 2019 (ADAMS Accession Nos. ML18320A189, ML19036A969, and ML19092A448). This information applies to the preoperational testing phase, as well as the initial startup testing phase. Preoperational testing consists of tests conducted following completion of construction and construction-related inspections and tests, but before fuel loading. Preoperational testing demonstrates the capability of the plant systems to meet relevant performance requirements. Startup tests, which begin with initial fuel loading, demonstrate the capability of the integrated plant to meet performance requirements. The staff reviewed the NuScale ITP in accordance with the guidance in the RG 1.68. In DCA Part 2, Tier 2, Section 14.2, the applicant described the NuScale ITP, which consists of preoperational and initial startup tests.

For each phase of the ITP, a design certification applicant should define organizational responsibilities, provide administrative controls for the development of the test program, and provide test abstracts, which include the objectives of each test, as well as a summary of prerequisites, test methods, and specific acceptance criteria. These test abstracts should address the criteria outlined in RG 1.68 and, specific to the NuScale application, DSRS Section 14.2. The DSRS also states that the applicant should describe how it considered the use of reactor operating and testing experience, the trial use of plant operating and emergency procedures, and conformance with applicable RGs. Conformance of a proposed test program to the above guidelines provides reasonable assurance that the facility can be operated in

accordance with its design criteria and in a manner that will not endanger public health and safety.

The staff noted that the applicant provided the proper administrative test attributes, consistent with the DSRS, in the areas of organization and staffing, conformance with RGs, test procedure control, utilization of reactor operating and testing experience, use of plant operating and emergency procedures, and test program scheduling and sequencing. In addition, the applicant provided individual test descriptions, test performance requirements, and acceptance criteria for each preoperational and startup test.

14.2.1.4.1 Initial Test Program Objectives

The staff reviewed the preoperational and initial startup testing objectives as described in DCA Part 2, Tier 2, Section 14.2 against the guidance in RG 1.68 and DSRS Section 14.2. Consistent with this guidance, the staff noted that the applicant's proposed test program provided controls to: (1) provide assurance that SSCs operate in accordance with their design; (2) provide assurance that construction and installation of equipment in the facility has been completed in accordance with the design; (3) demonstrate, to the extent practical, the validity of analytical models used to predict plant responses to anticipated transients and postulated accidents, as well as the correctness and conservatism of assumptions used in those models; (4) familiarize the plant's operating and technical staff with the operation of the facility; (5) perform testing, to the extent practical, using the plant conditions that simulate the actual operating, abnormal operating occurrences, and emergency conditions to which the SSCs may be subjected; (6) verify, to the extent practical, by trial use that the facility operating, surveillance, and emergency procedures are adequate; (7) verify that system interfaces and component interactions are in accordance with the design; and (8) complete and document the ITP testing required to satisfy preoperational and startup testing requirements, thus providing reasonable assurance that the plant can be brought safely to its rated power and can be safely operated during sustained power operations.

Consistent with guidance, in the preoperational and startup testing phase description, the staff noted that the applicant's testing is performed on those SSCs that are: (1) relied upon for safe shutdown and cooldown of the NPM under normal conditions for maintaining a safe condition for an extended shutdown period; (2) relied upon for safe shutdown and cooldown of the NPM under transient and postulated accident conditions and for maintaining a safe condition for an extended shutdown period following such conditions; (3) relied upon for establishing conformance with safety limits or limiting conditions for operation that are included in the TS; (4) assumed to function or for which credit is taken in the accident analysis as described in DCA Part 2, Tier 2, Chapter 15; (5) used to process, store, control, or limit the release of radioactive materials; (6) relied upon to maintain their structural integrity during normal operation, anticipated transients, simulated test parameters, and design basis event conditions to avoid damage to safety-related SSCs; and (7) identified as risk-significant in the probabilistic risk assessment.

Based on the discussion above, in the initial startup testing phase description and test abstracts, the staff noted that the applicant provided controls consistent with guidance to ensure: (1) a safe core loading, (2) a safe and orderly approach to initial criticality, and (3) the plant's ability to meet test acceptance criteria during low-power and power ascension testing based on sufficient testing.

14.2.1.4.2 Organizational Staffing Responsibilities

Section 14.2 of the DSRS states that the COL applicant is responsible for providing a detailed description of management organizations and staff responsibilities, authorities, and qualifications. As such, in DCA Part 2, Tier 2, Section 14.2.2, "Organization and Staffing," the applicant provided COL Item 14.2-1, which states, "A COL applicant that references the NuScale Power Plant design certification will describe the site-specific organizations that manage, supervise, or execute the Initial Test Program, including the associated training requirements." The staff finds this consistent with the guidance in DSRS Section 14.2 as the COL item indicates that the COL holder will implement an adequate organization and staffing when testing is conducted.

14.2.1.4.3 Initial Test Program Test Procedures

The staff reviewed the methodology submitted by the applicant that will be used to develop, review, and approve individual test procedures to ensure that they are consistent with relevant guidance in RG 1.68 and DSRS Section 14.2 or propose to meet the regulatory requirements in a different way. Section 14.2 of the DSRS specifies that the applicant should provide a summary description of the general guidance to control ITP activities. This description should include administrative controls that will be used to develop, review, and approve individual test procedures; coordination with organizations involved in the test program; participation of plant operating and technical staff; and review, evaluation, and approval of test results.

In DCA Part 2, Tier 2, Section 14.2.3.1, "Initial Test Program Procedures," the staff noted that the applicant provided general guidance for the development and review of test specifications and procedures. Specifically, the DCA states that the preoperational and startup testing procedures will contain the following administrative controls: (1) test procedure format; (2) application, to the extent practical, of normal plant operating procedures, emergency operating procedures, and surveillance procedures in support of test procedure development; (3) test procedure review and approval; and (4) test procedure change and revision. Further, the DCA states that the content of the procedures will address objectives, detailed step-by-step instructions specifying how testing is to be performed, special precautions, test instrumentation, test equipment calibration, initial test conditions, methods to direct and control test performance, acceptance criteria by which testing is evaluated, test prerequisites, identification of the data to be collected and method of documentation, actions to take if unanticipated errors or malfunctions occur while testing, remedial actions to take if acceptance criteria are not satisfied, and actions to take if an unexpected or unanalyzed condition occurs. Additionally, DCA Part 2, Tier 2, Section 14.2.3.4, "Generic Component Testing," discusses procedures to be developed for generic component testing, which is generally executed after a system's transfer from the construction organization to the startup organization.

DCA Part 2, Tier 2, Section 14.2.3.2, "Graded Approach to Testing," outlines the graded approach to testing, consistent with the requirements of General Design Criterion 1, "Quality Standards and Records," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50. It requires, in part, that SSCs important to safety shall be tested to quality standards commensurate with the importance of the safety functions to be performed. The NuScale subject matter experts identified all functions of each system during the SSC classification process and compared them to safety functional requirements as described in DCA Part 2, Tier 2 Section 17.4, "Reliability Assurance Program." As noted in the test abstracts

in DCA Part 2, Tier 2 Section 14.2.12, "Individual Test Descriptions," the testable functions contain a safety and risk categorization.

The guidance in RG 1.68 and DSRS Section 14.2 describe certain tests that should be included in the ITP, such as first-of-a-kind (FOAK) tests, which are new, unique, or special tests used to verify design features that the NRC has not previously reviewed. As such, DCA Part 2, Tier 2, Section 14.2.3.3, "Testing of First-of-a-Kind Design Features," highlights the four FOAK tests, and refers to Table 14.2-110, "ITP Testing of New Design Features," which summarizes of the ITP testing for new design features.

The staff finds that the general test specifications and test procedure guidelines specified in DCA Part 2 Tier 2, Section 14.2.3, "Test Procedures," are acceptable for the design certification because the specifications and guidelines are consistent with RG 1.68 and DSRS Section 14.2. Because plant-specific design information will be needed, the staff concludes that it is acceptable to defer responsibility for the development of detailed preoperational and startup test specifications and test procedures to the COL holder.

14.2.1.4.4 Initial Test Program's Conformance with Regulatory Guides

The staff reviewed the methodology used by the applicant to verify that the ITP is consistent with the guidance in the RGs. Section 14.2 of the DSRS states, in part, that the applicant should establish and describe an ITP that is consistent with the regulatory positions outlined in RG 1.68 and identifies supplemental RGs that provide more detailed information pertaining to the testing. Appendix A to RG 1.68 references a set of supplemental RGs that provide additional guidance for particular tests during the preoperational and initial startup phases. The supplemental RGs contain additional information to help determine if performance of the tests in the proposed manner will accomplish the objectives of certain plant tests.

In DCA Part 2, Tier 2, Section 14.2.7, "Test Programs Conformance with Regulatory Guides," the applicant listed the RGs used in the development of the NuScale ITP. In addition, DCA Part 2, Tier 2, Table 1.9-2, "Conformance with Regulatory Guides," lists the RGs applicable to the NuScale design. The staff reviewed this table to ensure that the applicable RGs were included in the development of the ITP. In cases where the applicant determined that RGs did not apply to the NuScale design, or where the applicant proposed a deviation from the guidance in the RGs, the staff review found that the applicant's proposed testing scope was acceptable to meet the applicable regulatory guidance.

The staff reviewed the list of RGs that the applicant had determined are not applicable to the NuScale design which include the following:

- RG 1.9, Revision 4, "Application and Testing of Safety-Related Diesel Generators in Nuclear Power Plants," issued March 2007
- RG 1.52, Revision 4, "Design, Inspection, and Testing Criteria for Air Filtration and Adsorption Units of Post-Accident Engineered-Safety-Feature Atmosphere Cleanup Systems in Light-Water- Cooled Nuclear Power Plants," issued September 2012
- RG 1.79.1, "Initial Test Program of Emergency Core Cooling Systems for New Boiling-Water Reactors," issued October 2013

- RG 1.160, Revision 3, “Monitoring the Effectiveness of Maintenance at Nuclear Power Plants,” issued May 2012

The staff determined that RGs 1.9 and 1.52 do not apply to the NuScale design certification because the NuScale design does not require or include safety-related emergency diesel generators. RG 1.79.1 does not apply to the NuScale design as it is specific to boiling water reactors, while RG 1.160 does not apply as it contains guidance for meeting requirements that are the responsibility of the COL applicant. Thus, the staff concludes that those RGs do not apply to the NuScale design certification.

Based on the above review, the staff finds that the NuScale ITP adequately conforms to the general scope and depth of test programs, as described in RG 1.68, and also conforms to the test program regulatory positions stated in DSRS Section 14.2. In addition, the staff finds that the applicant has adequately justified the categorization of certain RGs as inapplicable to the NuScale DC review.

14.2.1.4.5 Use of Reactor Operating and Testing Experience in the Development of the Initial Test Program

The staff reviewed the methodology submitted by the applicant to include reactor operating and testing experience in the development of the ITP. Section 14.2 of the DSRS and RG 1.68 state that the applicant should describe how it used the operating and testing experiences of other facilities in the development of the ITP.

In DCA Part 2, Tier 2, Section 14.2.8, “Utilization of Reactor Operating and Testing Experience in Test Program Development,” the staff noted that the applicant considered the use of operational and testing experience gained from previous pressurized water reactor plant designs,¹ as well as operating and testing experience obtained from NRC licensee event reports, NRC generic communications, and Institute of Nuclear Power Operations issuances. The applicant stated that the administrative procedures control the review of reactor operating experience and its incorporation in the ITP. In DCA Part 2, Tier 2, Section 14.2.4, “Conduct of the Test Program,” the staff noted that the COL applicant will be responsible for providing test specifications and test procedures for preoperational and startup tests for review by the NRC and for the preparation of the Startup Administration Manual, which will contain the processes and standards that govern the activities associated with the plant ITP. COL Item 14.2-2 ensures that a COL applicant that references the NuScale Power Plant design certification is responsible for the development of the Startup Administration Manual which will contain the administrative procedures and requirements that control the activities associated with the ITP.

The staff finds that the applicant provided adequate controls for the use of reactor operating and testing experience as described in RG 1.68 and DSRS Section 14.2. However, development of ITP test procedures will require detailed plant-specific design information review by the COL holder, and thus, the staff concludes that it is acceptable to defer the review of the use of operating and testing experience to the COL applicant.

¹ COL Item 14.2-3 states, in part, “a COL applicant that references the NuScale Power Plant design certification will identify the specific operator training to be conducted during low-power testing related to the resolution of TMI [Three Mile Island] Action Plan Item I.G.1.”

14.2.1.4.6 Trial Use of Plant Operating Procedures, Emergency Procedures, and Surveillance Procedures

The staff reviewed the proposed trial use of plant operating, emergency, and surveillance procedures during the performance of the ITP. Section 14.2 of the DSRS states that the applicant should incorporate plant operating, emergency, and surveillance procedures into the test program, or otherwise verify these procedures through use, to the extent practicable, during the ITP.

In DCA Part 2, Tier 2, Section 14.2.9, "Trial Use of Plant Operating Procedures, Emergency Procedures, and Surveillance Procedures," the staff noted that the applicant included provisions to ensure that the plant's normal, surveillance, abnormal, and emergency operating procedures will be, to the extent practical, developed, trial tested, and corrected throughout the preoperational and initial startup tests.

A COL applicant that references the NuScale Power Plant design certification is responsible for the development of the Startup Administration Manual which will contain the administrative procedures and requirements that control the activities associated with the ITP. The COL applicant should provide a milestone for completing the Startup Administrative Manual and making it available for NRC inspection (COL Item 14.2-2).

The staff also notes that the COL applicant's quality assurance controls should ensure that procedures are appropriate and include quantitative or qualitative acceptance criteria for determining that important activities have been satisfactorily accomplished.

Based on the above review, the staff finds that NuScale's approach is acceptable to develop, trial test and correct the plant's normal, surveillance, abnormal, and emergency operating procedures throughout the preoperational and initial startup tests, to the extent practical, during preoperational and initial startup test activities.

14.2.1.4.7 Initial Fuel Loading and Initial Criticality

The staff reviewed the measures provided by the applicant for use during initial fuel loading and initial criticality. RG 1.68 and DSRS Section 14.2 provide general guidance on the conduct of the ITP after the completion of preoperational testing. As stated in the regulatory guidance, initial fuel loading and precritical tests ensure that: (1) initial core loading is safe; (2) provisions are in place to maintain a shutdown margin; and (3) the facility is in a final state of readiness to achieve criticality and to perform low-power testing.

In DCA Part 2, Tier 2, Section 14.2.10, "Initial Fuel Loading, and Initial Criticality," the applicant included provisions for prefuel load checks, initial fuel loading, precriticality, and initial criticality in accordance with RG 1.68 and DSRS Section 14.2. The staff noted that these provisions included TS compliance, proper verification of boron concentration limits, calibration and testing of nuclear instrumentation, shutdown margin verifications at predetermined intervals, and control rod functionality tests. These controls are consistent with the regulatory positions in RG 1.68 and are therefore acceptable to the staff.

Based on the above review, the staff concludes that the ITP adequately addresses the initial fuel loading and initial criticality testing by meeting the associated guidance in RG 1.68 and DSRS Section 14.2.

14.2.1.4.8 Initial Test Program Schedule and Sequence

The staff reviewed the methodology submitted by the applicant that will be used to develop the ITP schedule and sequence. RG 1.68 and DSRS Section 14.2 discuss the guidelines for test program schedule and sequence, specifically, stating that the applicant should develop a schedule for conducting each major phase of the ITP and that the schedule should establish that the safety of the plant will not depend on the performance of untested SSCs.

The staff noted that in DCA Part 2, Tier 2, Section 14.2.11, "Test Program Schedule and Sequence," the applicant provided measures for conducting each major phase of the ITP relative to the initial fuel load. The DCA states that the COL applicant will provide a schedule showing the timetable for the generation, review, and approval of procedures, as well as the actual testing and analysis of the results. The applicant also stated that approved test procedures will be available to the staff no later than 60 days before their intended use.

The staff reviewed the controls that will be implemented during the preoperational and initial startup testing phases. The staff found that the applicant provided general controls to ensure that during the preoperational testing phase, testing is performed as systems and equipment availability allows. Additionally, the staff noted that applicant stated that test sequencing is accomplished as early in the test program as feasible and that the safety of the plant is not dependent on the performance of untested systems, components, or features.

Based on the above review, the staff finds that the information provided by the applicant is consistent with the guidance contained in RG 1.68 and DSRS Section 14.2. Since the COL applicant is designated as responsible for the test program schedule, the staff finds that it is acceptable to defer the detailed test program schedule and sequence to the COL stage. The COL applicant should provide a milestone for completing the detailed testing schedule and make it available to the NRC (COL Item 14.2-4).

14.2.1.4.9 Individual Test Descriptions

The individual test abstracts are provided in Tables 14.2-1 through 14.2-108 of DCA Part 2, Tier 2, Section 14.2. Each abstract identifies each test by title and gives the test objectives, prerequisites, test methods, and acceptance criteria. These test abstracts will be utilized in the development of detailed preoperational and startup test procedures. Based on an October 24, 2018, public meeting regarding the scope of the NuScale ITP review at the DC stage (ADAMS Accession No. ML18313A201), the staff determined that approximately 60 test abstracts will be reviewed. As there is no requirement in 10 CFR 52.47 for the ITP to be reviewed at the DC stage, the staff have limited the review to those portions of the ITP discussed during the October 24, 2018, public meeting, and the remainder of the test abstracts will be reviewed at the COL stage. In accordance with RG 1.68 and DSRS 14.2, the staff confirmed that the following test abstracts contained in Table 14.2-1 are adequate with the exception of 14.2-47 which is the subject of open item 03.09.06-1. Since NuScale's response to the staff's review of these test abstracts included proposed markups to DCA Part 2, Tier 2 provided in letters dated November 16, 2018, February 5, 2019, and April 2, 2019, the staff is tracking the incorporation of the proposed changes in these letters into a future revision of the DCA as **Confirmatory Item 14.2-1**.

Table 14.2-1 NuScale Section 14.2 Test Abstracts Reviewed at the DC Stage

Abstract	Test Title
Table 14.2-4	Pool Surge Control System Test #4
Table 14.2-5	Ultimate Heat Sink #5
Table 14.2-9	Auxiliary Boiler System Test #9
Table 14.2-18	Control Room Habitability System Test #18
Table 14.2-19	Normal Control Room HVAC [Heating, Ventilation, and Air Conditioning] System Test #19
Table 14.2-20	Reactor Building HVAC System Test #20
Table 14.2-24	Balance-of-Plant Drains Test #24
Table 14.2-25	Fire Protection Systems Test #25
Table 14.2-33	Turbine Generator Test #33
Table 14.2-35	Liquid Radioactive Waste System Test #35
Table 14.2-36	Gaseous Radioactive Waste System Test #36
Table 14.2-38	Chemical and Volume Control System Test #38
Table 14.2-41	Containment Evacuation System Test #41
Table 14.2-42	Containment Flooding and Drain System Test #42
Table 14.2-43	Containment System Test #43
Table 14.2-44	Control Rod Drive System Flow-Induced Vibration Test #44
Table 14.2-45	Reactor Vessel Internals Flow-Induced Vibration Test #45
Table 14.2-46	Reactor Coolant System Test #46
Table 14.2-47	Emergency Core Cooling System Test #47
Table 14.2-48	Decay Heat Removal System Test #48
Table 14.2-51	Fuel Handling Equipment System Test #51
Table 14.2-52	Reactor Building Cranes Test #52
Table 14.2-60	Plant Lighting System Test #60
Table 14.2-63	Module Protection System Test #63
Table 14.2-66	Safety Display and Indication Test #66
Table 14.2-68	Communication System Test #68
Table 14.2-70	Hot Functional Testing Test #70
Table 14.2-72	Steam Generator Flow-Induced Vibration Test #72
Table 14.2-73	Security Access Control Test #73
Table 14.2-74	Security Detection and Alarm Test #74
Table 14.2-76	Initial Fuel Load Test (Test #76)
Table 14.2-77	Reactor Coolant System Flow Measurement Test (Test #77)
Table 14.2-78	NuScale Power Module Temperature Test (Test #78)
Table 14.2-79	Primary and Secondary System Chemistry Test (Test #79)
Table 14.2-80	Control Rod Drive System – Manual Operation, Rod Speed, and Rod Position Indication Test (Test #80)
Table 14.2-81	Control Rod Assembly Drop Time Test (Test #81)
Table 14.2-81a	Control Rod Assembly Ambient Temperature Full-Height Drop Time Test #81A
Table 14.2-82	Pressurizer Spray Bypass Flow Test (Test #82)
Table 14.2-83	Initial Criticality Test (Test #83)
Table 14.2-84	Post-Critical Reactivity Computer Checkout Test (Test #84)
Table 14.2-86	Determination of Zero-Power Physics Testing Range Test (Test #86)
Table 14.2-87	All Rods Out Boron Endpoint Determination Test (Test #87)

Abstract	Test Title
Table 14.2-88	Isothermal Temperature Coefficient Measurement Test (Test #88)
Table 14.2-89	Bank Worth Measurement Test (Test #89)
Table 14.2-91	Core Power Distribution Map Test (Test #91)
Table 14.2-92	Neutron Monitoring System Power Range Flux Calibration Test (Test #92)
Table 14.2-93	Reactor Coolant System Temperature Instrument Calibration Test (Test #93)
Table 14.2-94	Reactor Coolant System Flow Calibration Test (Test #94)
Table 14.2-95	Radiation Shield Survey Test (Test #95)
Table 14.2-96	Reactor Building Ventilation System Capability (Test #96)
Table 14.2-97	Thermal Expansion Test (Test #97)
Table 14.2-98	Control Rod Assembly Misalignment (Test #98)
Table 14.2-99	Steam Generator Level Control Test (Test #99)
Table 14.2-100	Ramp Change in Load Demand (Test #100)
Table 14.2-101	Step Change in Load Demand Test (Test #101)
Table 14.2-102	Loss of Feedwater Heater Test (Test #102)
Table 14.2-103	100 Percent Load Rejection Test (Test #103)
Table 14.2-104	Reactor Trip from 100 Percent Power Test (Test #104)
Table 14.2-105	Island Mode Test for NuScale Power Module #1 (Test #105)
Table 14.2-106	Island Mode Test for Multiple NuScale Power Modules (Test #106)
Table 14.2-108	NuScale Power Module Vibration Test (Test #108)

The staff confirmed that each of the test abstracts identified above from NuScale DCA Part 2 Tier 2, Section 14.2, contains the necessary prerequisites, acceptance criteria, and test methods to satisfy the guidance in DSRS Section 14.2 and RG 1.68 for the DC review.

Although the NRC is approving only the test abstracts listed in the table above, the staff notes that additional test abstracts that are not being reviewed by the NRC at this stage are included in DCA Part 2, Tier 2, Section 14.2.12. Test abstracts not listed in the table above are not approved by the staff, do not have issue finality, and must be addressed by any COL applicant. If the staff approves this design certification, the staff intends to recommend that the Commission include language in the proposed rule clarifying that the test abstracts in Table 14.2-2 are outside the scope of the certified design. Table 14.2-2 lists the tests that were not evaluated by the staff at the DC stage and must be reviewed at the COL stage

Table 14.2-2 NuScale Section 14.2 Test Abstracts Not Reviewed at the DC Stage

Abstract	Test Title
Table 14.2-1	Spent Fuel Pool Cooling System Test #1
Table 14.2-2	Pool Cleanup System Test #2
Table 14.2-3	Reactor Pool Cooling System Test #3
Table 14.2-6	Pool Leak Detection System Test #6
Table 14.2-7	Reactor Component Cooling Water System Test #7
Table 14.2-8	Chilled Water System Test #8
Table 14.2-10	Circulating Water System Test #10
Table 14.2-11	Site Cooling Water System Test #11

Abstract	Test Title
Table 14.2-12 ²	Potable Water System Test #12
Table 14.2-13	Utility Water System Test #13
Table 14.2-14	Demineralized Water System Test #14
Table 14.2-15	Nitrogen Distribution System Test #15
Table 14.2-16	Service Air System Test #16
Table 14.2-17	Instrument Air System Test #17
Table 14.2-21	Radioactive Waste Building HVAC System Test #21
Table 14.2-22	Turbine Building HVAC System Test #22
Table 14.2-23	Radioactive Waste Drain System Test #23
Table 14.2-26	Fire Detection System Test #26
Table 14.2-27	Main Steam System Test #27
Table 14.2-28	Feedwater System Test #28
Table 14.2-29	Feedwater Treatment System Test #29
Table 14.2-30	Condensate Polishing System Test #30
Table 14.2-31	Feedwater Heater Vents and Drains System Test #31
Table 14.2-32	Condenser Air Removal System Test #32
Table 14.2-34	Turbine Oil Storage System Test #34
Table 14.2-37	Solid Radioactive Waste System Test #37
Table 14.2-39	Boron Addition System Test #39
Table 14.2-40	Module Heatup System Test #40
Table 14.2-49	In-core Instrumentation System Test #49
Table 14.2-50	Module Assembly Equipment Test #50
Table 14.2-53	Process Sampling System Test #53
Table 14.2-54	13.8kV [kilovolt] and Switchyard System Test #54
Table 14.2-55	Medium Voltage AC [alternating current] Electrical Distribution System Test #55
Table 14.2-56	Low Voltage AC Electrical Distribution System Test #56
Table 14.2-57	Highly Reliable DC [direct current] Power System Test #57
Table 14.2-58	Normal DC Power System Test #58
Table 14.2-59	Backup Power Supply System Test #59
Table 14.2-61	Module Control System Test #61
Table 14.2-62	Plant Control System Test #62
Table 14.2-64	Plant Protection System Test #64
Table 14.2-65	Neutron Monitoring System Test #65
Table 14.2-67	Fixed-Area Radiation Monitoring System Test #67
Table 14.2-69 ³	Seismic Monitoring System Test #69
Table 14.2-71	Module Assembly Equipment Bolting Test #71
Table 14.2-75	Initial Fuel Loading Precritical Test #75
Table 14.2-85	Low-Power Test Sequence Test #85
Table 14.2-90	Power Ascension Test #90
Table 14.2-107	Remote Shutdown Workstation Test #107

² COL Item 14.2-5 states “a COL Applicant that references the NuScale Power Plant design certification will provide a test abstract for the potable water system pre-operational testing.

³ COL Item 14.2-6 states “a COL Applicant that references the NuScale Power Plant design certification will provide a test abstract for the SMS pre-operational testing.

14.2.1.5 Open Items

The topic in Table 14.2-3 has been identified as an Open Item within the test abstracts:

Table 14.2-3: Section 14.2 Open Items

Item No.	Description	DCD Tier 2 Section
03.09.06-1	<p>Based on an audit, the NRC staff determined that NuScale had not provided sufficient information necessary to demonstrate the safety features of the emergency core cooling system (ECCS) valves as required by 10 CFR 52.47(c)(2) and 10 CFR 50.43(e). Therefore, the NRC staff audit report concluded that NuScale had not demonstrated the capability and reliability of the ECCS valves to perform their safety functions to support the NuScale DCA. In an enclosure to the audit report, the staff provided a detailed list of the remaining items to be addressed regarding the demonstration of the design of the ECCS valves. Following completion of the ECCS valve design audit, the staff discussed the audit findings with NuScale to determine the most efficient method to address the follow-up items for the demonstration of the design of the NuScale ECCS valves to support the completion of the NRC review of the NuScale DCA. On September 21, 2018, NuScale submitted its response (ADAMS Accession No. ML18264A312) to the ECCS valve audit report, including ECCS Valve Design Demonstration Testing plans, to resolve the findings from the NRC audit of the ECCS valve design. The NRC staff finds the NuScale response to the ECCS valve audit report to provide an acceptable approach to address the ECCS valve audit findings. The staff will confirm that the testing conforms to the ECCS Valve Design Demonstration Testing plans as described in the ECCS valve audit report. Therefore, the NRC staff will track the resolution of this issue as Open Item 03.09.06-1. This open item impacts Test 14.2-47. Additional discussion of this issue can be found in Section 3.9.6 of this SER.</p>	3.9.6

14.2.1.6 Combined License Information Items

Table 1.8-2 lists COL information item numbers and descriptions related to Chapter 14.2, from DCA Part 2, Tier 2.

Table 14.2-4: NuScale Combined License Information Items for Section 14.2

Item No.	Description	DCD Tier 2 Section
COL Item 14.2-1	A COL Applicant that references the NuScale Power Plant design certification will describe the site-specific organizations that manage, supervise, or execute the Initial Test Program, including the associated training requirements.	14.2
COL Item 14.2-2	A COL Applicant that references the NuScale Power Plant design certification is responsible for the development of the Startup Administration Manual that will contain the administrative procedures and requirements that control the activities associated with the Initial Test Program. The COL applicant will provide a milestone for completing the Startup Administrative Manual and making it available for NRC inspection.	14.2
COL Item 14.2-3	A COL Applicant that references the NuScale Power Plant design certification will identify the specific operator training to be conducted during low-power testing related to the resolution of TMI Action Plan Item I.G.1, as described in NUREG-0660, NUREG-0694, and NUREG-0737.	14.2
COL Item 14.2-4	A COL Applicant that references the NuScale Power Plant design certification will provide a schedule for the Initial Test Program.	14.2
COL Item 14.2-5	A COL Applicant that references the NuScale Power Plant design certification will provide a test abstract for the potable water system pre-operational testing.	14.2
COL Item 14.2-6	A COL Applicant that references the NuScale Power Plant design certification will provide a test abstract for the SMS pre-operational testing.	14.2
COL Item 14.2-7	A COL Applicant that references the NuScale Power Plant design certification will select the plant configuration to perform the Island Mode Test (number of NPMs in service).	14.2

14.2.1.7 Conclusion

The staff completed its review of the NuScale ITP at the DC stage in accordance with the requirements of 10 CFR 30.53, 10 CFR 50.43, 10 CFR 52.47, 10 CFR 50.34, 10 CFR 52.79, Section III.A.4 of Appendix J to 10 CFR Part 50, and Criterion XI of Appendix B to 10 CFR Part 50. With the exception of **Open Item 03.09.06-1** and pending the resolution of the confirmatory item discussed above, the staff concludes that the applicant has provided sufficient information in the ITP for the test abstracts indicated in Table 14.2-1 above and adequately

addressed the methods and the applicable guidance in DSRS Section 14.2 and RG 1.68. As previously stated, the test abstracts contained in Table 14.2-2 above were not evaluated as part of the staff's DC ITP review and will need to be reviewed and approved at the COL stage. Except for the tests outlined in Table 14.2-2 and the open items identified in Section 14.2.1.5, the staff concludes that the applicant's ITP is acceptable.