RAIO-0218-58728

February 19, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
One White Flint North
11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 149 (eRAI No. 8955) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 149 (eRAI No. 8955)," dated August 05, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 149 (eRAI No.8955)," dated November 02, 2017

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) supplemental response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's supplemental response to the following RAI Question from NRC eRAI No. 8955:

- 03.09.06-16

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8955

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 8955

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NuScale Power™

Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 8955
Date of RAI Issue: 08/05/2017

NRC Question No.: 03.09.06-16

D. NuScale FSAR Tier 2, Section 3.9.6.5, “Relief Requests and Alternative Authorizations to the OM Code,” states that no relief requests to the ASME OM Code are anticipated for the NuScale Power Plant design. Section 3.9.6.5 states that the NuScale Power Plant consists of up to 12 NPMs licensed under a single operating license. Section 3.9.6.5 indicates that the NuScale definition of Modes of Operation (see NuScale Design Certification Application, Part 4, “Generic Technical Specifications,” Table 1.1-1, “Modes”) differ from those defined in the ASME OM Code. References to a Mode called transition are specified in other locations of the IST program description in NuScale FSAR Tier 2. NuScale FSAR Tier 2, Table 3.9-15 on page 3.9-66 states that in cases where the performance of a valve full-stroke exercise test is limited to transitions (defined in NuScale technical specifications as the reactor mode when the reactivity condition is less than 0.95 keff) or refueling outages, a table footnote is provided which justifies this determination. The ASME OM Code does not define a plant condition of transition in determining the specified IST intervals.

Describe the plans to satisfy requirements to perform the preservice and inservice testing specified in the ASME OM Code without requests for relief or alternatives to the ASME OM Code in light of the differences in terminology and operating conditions for the NuScale Power Plant design. For example, define the use of the term transition as part of the IST program, and describe the plan to request relief from or an alternative to the ASME OM Code in accordance with 10 CFR 50.55a(z) regarding use of this term. In addition, clarify the proposed COL Item 3.9-5 in response to this request.

NuScale Response:

A public meeting was held on January 9, 2018 to discuss the NRC's feedback on NuScale's response to eRAIs 8952, 8954, 8955, 8956, 8957, and 8958. The resulting changes to FSAR Section 3.9.6 from this discussion are:

Section 3.9.6.2 was revised to clarify the operability testing performed on hydraulic operated valves (HOVs) and emergency core cooling system (ECCS) valves.

Section 3.9.6.5.1 was revised to include a relief request to reconcile "cold shutdown" as defined by the OM Code and the equivalent Mode defined by the NuScale Technical Specifications. COL Item 3.9-7 is deleted as a result because the COL applicant that references the NuScale Power Plant will have "cold shutdown" reconciled by this section.

Section 3.9.6.5.2 includes an Alternative Authorization for specific application of the ASME OM-2017 Code in accordance with 10 CFR 50.55a(z).

Section 3.6.6 was revised to re-establish Augmented Testing Requirements. Twelve valves are included in this program. Eight valves perform nonsafety backup to a safety related function (backup main steam isolation valves (MSIVs), backup main steam isolation bypass valves (MSIBVs), feedwater regulating valves (FWRVs), and backup feedwater check valves). The functions of these valves are described in Section 15.0.0.6.6. These eight valves were previously listed in the inservice testing (IST) Plan, but are moved to the Augmented Test Program because they do not meet the definition in ISTA-1100. Four valves were previously included as requiring augmented testing, these are the first isolation valves after the containment isolation valves (CIVs) in each chemical and volume control system (CVCS) line. These valves provide the NRC Quality Group C/D and Seismic I/III classification break. These are nonsafety-related valves that have augmented quality requirements. Four additional valves were removed from the original Augmented Test Program. These were two check valves and two excess flow check valves installed in the reactor coolant system (RCS). These valves are nonsafety-related and have only a beyond design basis event function. These valves are RCS-CKV-0323, RCS-CKV-0332, RCS-CKV-0333, and RCS-CKV-400.

COL Item 3.9-8 applicability changed from HOV to power-operated valve (POV).

Table 3.9.15 was revised to include the eight non-code class valves that perform as a backup to a safety-related function, and the four Class 3 valves that are nonsafety but have augmented quality requirements.

Table 3.9.16 was revised to move the eight non-code valves to the Augmented Test table, and additional editorial changes were made to the Notes section.

Table 3.9-17 is a new table for Augmented Test Requirements and includes twelve valves as described above.

Editorial corrections were made as discussed in the public meeting.

Impact on DCA:

Tier 2 FSAR Section 3.9.6 has been revised as described in the response above and as shown in the markup provided in this response.

RAI 01-61, RAI 02.04.13-1, RAI 03.04.02-1, RAI 03.04.02-2, RAI 03.04.02-3, RAI 03.05.01.04-1, RAI 03.05.02-2, RAI 03.06.02-15, RAI 03.06.03-11, RAI 03.07.01-2, RAI 03.07.01-3, RAI 03.07.02-8, RAI 03.07.02-12, RAI 03.09.02-15, RAI 03.09.02-48, RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-6, RAI 03.09.06-16, RAI 03.09.06-16S1, RAI 03.09.06-27, RAI 03.11-8, RAI 03.11-14, RAI 03.13-3, RAI 05.04.02.01-13, RAI 05.04.02.01-14, RAI 06.04-1, RAI 09.01.02-4, RAI 09.01.05-3, RAI 09.01.05-6, RAI 09.03.02-3, RAI 09.03.02-4, RAI 09.03.02-5, RAI 09.03.02-6, RAI 09.03.02-8, RAI 10.02-1, RAI 10.02-2, RAI 10.03.06-1, RAI 10.04.06-1, RAI 10.04.06-2, RAI 10.04.06-3, RAI 10.04.10-2, RAI 13.01.01-1, RAI 13.01.01-1S1, RAI 13.02.02-1, RAI 13.03-4, RAI 13.05.02.01-2, RAI 13.05.02.01-2S1, RAI 13.05.02.01-3, RAI 13.05.02.01-3S1, RAI 13.05.02.01-4, RAI 13.05.02.01-4S1, RAI 19-31

Table 1.8-2: Combined License Information Items

Item No.	Description of COL Information Item	Section
COL Item 1.1-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will identify the site-specific plant location.	1.1
COL Item 1.1-2:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will provide the schedules for completion of construction and commercial operation of each power module.	1.1
COL Item 1.4-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will identify the prime agents or contractors for the construction and operation of the nuclear power plant.	1.4
COL Item 1.7-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will provide site-specific diagrams and legends, as applicable.	1.7
COL Item 1.7-2:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will list additional site-specific piping and instrumentation diagrams~~P&IDs~~ and legends as applicable.	1.7
COL Item 1.8-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will provide a list of departures from the certified design.	1.8
COL Item 1.9-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will review and address the conformance with regulatory criteria in effect six months before the docket date of the COL application for the site-specific portions and operational aspects of the facility design.	1.9
COL Item 1.10-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will evaluate the potential hazards resulting from construction activities of the new NuScale facility to the safety-related and risk significant structures, systems, and components of existing operating unit(s) and newly constructed operating unit(s) at the co-located site per 10 CFR 52.79(a)(31). The evaluation will include identification of ~~any~~ management and administrative controls necessary to eliminate or mitigate the consequences of potential hazards and demonstration that the limiting conditions for operation of an operating unit would not be exceeded. This COL item is not applicable for construction activities (build-out of the facility) at an individual NuScale Power Plant with operating NuScale Power Modules.	1.10
COL Item 2.0-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will demonstrate that site-specific characteristics are bounded by the design parameters specified in Table 2.0-1. If site-specific values are not bounded by the values in Table 2.0-1, the COL applicant will demonstrate the acceptability of the site-specific values in the appropriate sections of its combined license application.	2.0
COL Item 2.1-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will describe the site geographic and demographic characteristics.	2.1
COL Item 2.2-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will describe nearby industrial, transportation, and military facilities. The COL applicant will demonstrate that the design is acceptable for each potential accident, or provide site-specific design alternatives.	2.2
COL Item 2.3-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will describe the site-specific meteorological characteristics for Section 2.3.1 through Section 2.3.5, as applicable.	2.3
COL Item 2.4-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will investigate and describe the site-specific hydrologic characteristics for Section 2.4.1 through Section 2.4.14, as applicable.	2.4

Table 1.8-2: Combined License Information Items (Continued)

Item No.	Description of COL Information Item	Section
COL Item 3.9-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will provide the applicable test procedures before the start of testing and will submit the test and inspection results from the comprehensive vibration assessment program for the NuScale Power Module, in accordance with Regulatory Guide 1.20.	3.9
COL Item 3.9-2:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will develop design specifications and design reports in accordance with the requirements outlined under American Society of Mechanical Engineers Boiler and Pressure Vessel Code, Section III (Reference 3.9-1). A COL applicant will address any known issues through the reactor vessel internals reliability programs (i.e. Comprehensive Vibration Assessment Program, steam generator programs, etc.) in regards to known aging degradation mechanisms such as those addressed in Section 4.5.2.1.	3.9
COL Item 3.9-3:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will provide a summary of reactor core support structure ~~maximum total stress,~~ASME service level stresses, deformation, and cumulative usage factor values for each component and each operating condition in conformance with ASME Boiler and Pressure Vessel Code Section III Subsection NG.	3.9
COL Item 3.9-4:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will submit a Preservice Testing program for valves as required by 10 CFR 50.55a.	3.9
COL Item 3.9-5:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will establish an Inservice Testing program in accordance with ASME OM Code and 10 CFR 50.55a.	3.9
COL Item 3.9-6:	~~A COL Applicant that references the NuScale Power Plant design certification will identify any site-specific valves and provide inservice testing in accordance with the latest endorsed ASME Code with addenda of the ASME OM Code incorporated by reference by 10 CFR 50.55a 18 months prior to the date for initial fuel load.~~A COL applicant that references the NuScale Power Plant design certification will identify any site-specific valves, implementation milestones, and the applicable ASME OM Code (and ASME OM Code Cases) for the preservice and inservice testing programs. These programs are to be consistent with the requirements in the latest edition and addenda of the OM Code incorporated by reference in 10 CFR 50.55a in accordance with the time period specified in 10 CFR 50.55a before the scheduled initial fuel load (or the optional ASME Code Cases listed in Regulatory Guide 1.192 incorporated by reference in 10 CFR 50.55a).	3.9
COL Item 3.9-7:	~~Where the NuScale definition of Modes of Operation differ from those defined in the ASME OM Code, an Alternative may be provided to reconcile the terminology. A COL Applicant that reference the NuScale Power Plant design certification will generate any relief request(s) needed as part of the Inservice Testing Program Document.~~Not Used.	~~3.9~~
COL Item 3.9-8:	A COL applicant that references the NuScale Power Plant design certification will develop specific test procedures to allow detection and monitoring of power-operated valve assembly performance sufficient to satisfy periodic verification design basis capability requirements.	3.9
COL Item 3.9-9:	A COL applicant that references the NuScale Power Plant design certification will develop specific test procedures to allow detection and monitoring of emergency core cooling system valve assembly performance sufficient to satisfy periodic verification of design basis capability requirements.	3.9
COL Item 3.9-10:	A COL applicant that references the NuScale Power Plant design certification will verify that evaluations are performed during the detailed design of the main steam lines, using acoustic resonance screening criteria and additional calculations as necessary (e.g., Strouhal number) to determine if there is a concern. The methodology contained in "NuScale Comprehensive Vibration Assessment Program Technical Report," TR-0716-50439 is acceptable for this purpose. The COL applicant will update Section 3.9.2.1.1.3 to describe the results of this evaluation.	3.9
COL Item 3.10-1:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will develop and maintain a site-specific seismic and dynamic qualification program.	3.10
COL Item 3.10-2:	A COL ~~Applicant~~applicant that references the NuScale Power Plant design certification will develop the equipment qualification database and ensure equipment qualification record files are created for the structures, systems, and components that require seismic qualification.	3.10

Section 3.9.2 provides the dynamic analyses of the RVI design under steady-state and operational transient conditions, and the proposed program for pre-operational and startup testing of flow-induced vibration and acoustic resonance.

Structural integrity evaluation for the structural design adequacy and ability, with no loss of safety function, of the reactor vessel internals (RVI) to withstand the loads from breaches in high energy pressure boundaries in combination with the safe shutdown earthquake is provided in Section 3.9.3.

3.9.6 Functional Design, Qualification, and Inservice Testing Programs for Pumps, Valves, and Dynamic Restraints

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

This section describes the functional design~~,~~ and qualification provisions for preservice testing (PST) and inservice testing (IST) ~~program for ASME BPVC Code, Section III Class 1, Class 2, Class 3, and non-safety-related and non-ASME valves that have been added to the IST program as having an important function and augmented quality requirements. The NuScale Power Plant standard design does not have any pumps or dynamic restraints which perform a specific function identified in the ASME OM Code (OM-2012) Subsection ISTA-1100 (Reference 3.9-3).~~of safety-related valves that are designated as Class 1, 2, or 3 under Section III of the ASME BPV Code and meet the requirements of the OM Code, Subsection ISTA-1100. This also includes valves not categorized as ASME BPV Code Class 1, 2, or 3 that have a safety-related function. Inservice testing of ASME Code Class 1, 2, and 3 valves is performed in accordance with the ASME Operation and Maintenance (OM) Code and applicable addenda, as endorsed by 10 CFR 50.55a(f), or where relief has been granted by the NRC in accordance with 10 CFR 50.55a(f).

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

~~The provisions and programs described here verify that components in the IST program are in a state of operational readiness to perform their intended functions throughout the life of the plant.~~Testing requirements for pumps, valves, and dynamic restraints are specified in the ASME OM Code (Reference 3.9-3). The ASME OM-2012 Code Edition was used to develop the inservice testing plan for the NuScale Power Plant design certification. The NuScale inservice testing plan includes augmented testing for a limited number of valves not constructed to the ASME Code that are relied on in some safety analyses (see Table 3.9-17). The plan also considers the guidance provided in NUREG-1482, Revision 2.

RAI 03.09.06-16S1

Pursuant to 10 CFR 50.55a(z), the ASME OM-2017 Code Edition, Mandatory Appendix IV was used as an alternative to OM-2012 to develop inservice operability testing as described in Section 3.9.6.3.2 and Table 3.9-16. Mandatory Appendix IV provides an acceptable level of quality and safety by utilizing established code requirements for testing to demonstrate that valves can perform their safety function at design basis conditions.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

~~The IST of valves is performed in accordance with the ASME OM Code, as required by 10 CFR 50.55a(f). In addition, the program also considers the guidance provided in RG 1.192~~

~~and NUREG-1482 ASME OM Code, Subsection ISTC defines the functional testing requirements for valves.~~ASME OM Code, Subsection ISTC specifies requirements for functional testing of valves. The functional tests are required for valves that have an active safety-related function.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

~~In addition to the valves that meet the criteria of ISTA-1100, valves identified by the Design Reliability Assurance Program (DRAP) as augmented quality are included in an augmented IST program, also described in this section.~~The NuScale inservice test plan includes augmented testing of valves that provide a nonsafety backup of a safety-related function, such as establishing decay heat removal system boundary, main steam isolation, or feedwater isolation.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

The NuScale Power Plant does not have any pumps or dynamic restraints which perform a specific function identified in the ASME OM Code Subsection ISTA-1100 (Reference 3.9-3).

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

~~The following GDC apply to this section~~

- ~~GDC 1 requires, in part, that structures, systems, and components (SSC), which include pumps, valves, and dynamic restraints be designed, fabricated, erected, constructed, and inspected to quality standards commensurate with the importance of the safety functions they perform.~~
- ~~GDC 2 requires, in part, that components be designed to withstand the effects of severe natural phenomena, combined with appropriate effects of normal and accident conditions, without a loss of capability to perform their safety functions~~
- ~~GDC 4 requires, in part, that components be designed to accommodate the effects of, and be compatible with, the environmental conditions associated with normal operation, maintenance, testing, and postulated accidents as described in Section 3.11. In addition, the NuScale Power Plant design applies the leak-before-break methodology to eliminate the dynamic effects of pipe rupture, as described in Section 3.6.3.~~
- ~~GDC 14 requires that the reactor coolant pressure boundary (RCPB) be designed with an extremely low probability of abnormal leakage, rapidly propagating failure, and gross rupture.~~
- ~~GDC 15 requires that the reactor coolant system (RCS) be designed with sufficient margin of safety so that the design conditions of the RCPB are not exceeded during conditions of normal operation, including AOOs.~~
- ~~GDC 37 requires that the emergency core cooling system be designed to permit periodic functional testing to ensure leak-tight integrity and performance of the active components. The tests verify the operability and performance of the active components in accordance with the ASME OM Code.~~
- ~~GDC 43 requires the containment atmospheric cleanup system to have functional testing to verify leak tightness. The NuScale Power Plant design does not have a containment atmospheric cleanup system.~~

~~construction, and testing safety-related pumps, valves, and dynamic restraints~~Access requirements have been incorporated into the engineering design and construction documents, as specified by 10 CFR 50.55a(f)(3). The quality assurance requirements for the design, fabrication, construction, and testing of safety-related valves is controlled by the plant Quality Assurance program as described in Chapter 17. These requirements are in accordance with 10 CFR 50 Appendix B.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

3.9.6.2 Inservice Testing ~~Program for~~ of Pumps

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

~~The NuScale Power Plant design does not have any pumps which perform a specific function identified in ASME OM Code Subsection ISTA-1100.~~Pumps that meet the criteria of ISTA-1100 are subject to the inservice testing requirements of ISTB. The NuScale Power Plant design contains no safety-related pumps and no nonsafety-related pumps that meet the criteria of ISTA-1100. Therefore, the NuScale inservice test plan does not include any pumps.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

3.9.6.3 Inservice Testing ~~Program for~~of Valves

Valves that meet the criteria of ISTA-1100 are subject to the inservice testing requirements of ISTC. The valves that are subject to inservice testing include those valves that perform a specific function in shutting down the reactor to a safe shutdown condition, in maintaining a safe shutdown condition, or in mitigating the consequences of an accident. Inservice testing of valves verifies the operational readiness including actuating, leakage, and position verification. Pressure relief devices subject to inservice testing are those used for protecting systems or portions of systems that perform a function in shutting down the reactor to a safe shutdown condition, in maintaining a safe shutdown condition, or in mitigating the consequences of an accident.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

The NuScale inservice test plan includes valves classified as ASME Code Class 1, Class 2, and Class 3 valves that meet the criteria of ISTA 1100. The NuScale inservice test plan also includes augmented testing of valves that provide a nonsafety backup of a safety related function. The NuScale inservice valve test plan is summarized in Table 3.9-16 and includes information regarding the scope of the valve preservice and inservice testing plan, valve functions, valve categories, and test frequencies. Augmented testing of valves is summarized in Table 3.9-17. The NuScale inservice test plan adheres to the requirements of ASME OM, Subsection ISTC. Lessons learned from operating experience at nuclear power plants were used in the development of the inservice testing plan. NRC Generic Letters, NUREG-1482, industry, and utility guidelines were considered in developing the inservice test plan and are reflected in the requirements identified in Table 3.9-16. The testing of power-operated valves uses guidance from NRC Regulatory Issue Summary (RIS) 2000-03 and the Joint Owners Group (JOG) on air-operated valve (AOV) testing. The lessons learned from this guidance are reflected in

the inservice testing plan and valve qualification testing requirements for both AOVs and hydraulic-operated valves (HOVs).

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

Inservice testing may incorporate the use of nonintrusive techniques to periodically assess performance and degradation of selected check valves. The ASME OM ISTC requires that safety-related check valves be exercise tested in both the open and closed direction, regardless of the safety function position. Safety-related power-operated valves that have an active function require an exercise test and an operability test. The operability test verifies that the valve can perform its intended safety function and can be either a dynamic test (with flow and differential pressure) or a static test. Operability testing is discussed in Section 3.9.6.3.2 (3).

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

The NuScale design does not use safety-related:

- motor operated valves,
- manual valves, or
- valves that are actuated by an energy source capable of only one operation, such as a rupture disk or explosively actuated valve.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

A valve test program will be developed and administered by the COL applicant and based on the inservice test plan outlined in this subsection.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

~~The NuScale Power Plant IST program applies to valves classified as ASME Code Class 1, Class 2, or Class 3 valves and non-ASME valves that meet the criteria of ISTA-1100. The IST valve program is summarized in Table 3.9-15 through Table 3.9-23. Table 3.9-15 and Table 3.9-16 include information regarding scope of the valve program, valve functions, valve categories, and test frequencies.~~

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

~~Valves are exercised at the frequency identified in Table 3.9-17 through Table 3.9-23 to affirm their continued availability for service. If a valve fails its surveillance test or exceeds degradation criteria, corrective actions are taken. Periodic Verification of power operated valves will be performed in accordance with the ASME OM Code and the requirements of 10CFR50.55a.~~

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

~~Grouping of valves for analysis or testing in accord with the ASME OM Code is done by valve type, model, and size. The population of each group is made up of valves from all installed NPM. The NuScale IST plan consists of 564 total valves (for 12 NPMs) divided into 15 valve groups. This results in 47 valves per NPM for a NuScale 12-module facility.~~

RAI 03.09.06-27

- reactor coolant pressure boundary isolation.
- containment isolation.
- limiting seat leakage. Seat leakage is limited to a specific maximum amount when required to meet the safety-related function.
- remote position indication.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

Valve safety functions and valve characteristics were used to determine ASME inservice testing categories. The following criteria are used in assigning the ASME OM Code categories to the NuScale valves.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

Category A - valves with safety-related seat leakage requirements (valves for which seat leakage is limited to a specific maximum amount in the closed position for fulfillment of their required function)

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

Category B - valves requiring inservice testing, but without safety-related seat leakage requirements (valves for which seat leakage in the closed position is inconsequential for fulfillment of the required function)

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, 03.09.06-16S1

Category C - safety-related, self-actuated valves, such as check valves and pressure relief devices, and valves that are self-actuating in response to some system characteristic, such as pressure (relief valves) or flow direction (check valves) for fulfillment of the required function.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

The NuScale design does not utilize any Category D valves.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

3.9.6.3.2 ~~Inservice Testing Program for Power-Operated Valves Other Than MOVs~~Valve Testing

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

Valve testing is specified in ASME OM ISTC, Mandatory Appendices I, II and IV. Five types of inservice tests have been identified for the NuScale Power Plant.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

(1) Valve Position Verification Tests

Valves that are included in the inservice testing plan that have position indication will be observed locally or by a change in system parameter (flow, pressure, etc.) during valve exercising to verify proper operation of the position

indication. The frequency for this position indication test is once every two years, unless otherwise justified.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

(2) Valve Leakage Tests

Valves with safety-related seat leakage limits will be tested to verify their seat leakage is within limits. These valves include:

- Containment Isolation - valves that provide isolation for fluid penetrations into the containment and must meet the requirements of 10 CFR 50 Appendix J.
- Decay Heat Removal System (DHRS) Boundary - active secondary system valves that close to establish the DHRS boundary so closed-loop, natural circulation heat removal can be established between the decay heat removal condensers and the steam generators.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

Containment Isolation

Containment isolation valves (CIVs) are leak tested in accordance with 10 CFR 50, Appendix J and ISTC-3620. These valves are tested individually as a part of the Type C testing. Containment leak rate testing is discussed in Section 6.2.6 and in Technical Report TR-1116-51962, "NuScale Containment Leakage Integrity Assurance" (Reference 3.9-6). Containment isolation valves referenced in the NuScale inservice test plan shall meet the corrective action requirements of the ASME OM ISTC if the CIV fails to meet its leakage criteria (See Table 3.9-16).

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

Decay Heat Removal System Boundary

The DHRS boundary is established when the active secondary system CIVs (SSCIVs) close automatically to isolate steam lines and feedwater lines to create a natural circulation flow path. Backup SSCIVs provide a nonsafety backup to a safety-related function to isolate steam lines and feed lines and to establish the decay heat removal system boundary. Both the SSCIVs and backup SSCIVs have a specific leakage criteria to fulfill their required function as specified in ISTA-1100. The leakage criteria are selected to maintain DHRS inventory within acceptable limits. SSCIVs and backup SSCIVs are leak tested in accordance with ISTC-3630 (See Table 3.9-16 and Table 3.9-17).

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

Pressure Isolation Valves

Pressure isolation valves that provide isolation between high- and low-pressure systems are not used in the NuScale design. Instead, eight

exercise test may satisfy this requirement if the exercise test removes actuator power from the valve.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

The fail-safe test is identified as a separate test in Table 3.9-16 for clarity; however, the fail-safe and exercise test may be the same inservice test.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

Valves that operate during normal plant operation at a frequency that satisfies the exercising requirement do not have to have an additional exercise test provided that the observations (and measurements) required of inservice testing are made and recorded at the required frequency specified by ISTC and that fail-safe requirements have been met.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

Power-Operated Valve (POV) Operability Tests - Lessons learned from operating experience at nuclear power plants were used in developing the NuScale design. The results are a simplified design that relies on passive safety systems and far fewer components than in a typical inservice testing plan. The active safety functions of the highly safety significant valves in the NuScale inservice test plan include containment isolation and emergency core cooling.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, 03.09.06-16S1

High safety significant POV groups for the NuScale Power Plant include ECCS reactor recirculation valves and the reactor vent valves, and certain small actuator containment isolation HOVs. Risk significant components are identified pursuant to Section 19.1, Probability Risk Assessment, which evaluates the NuScale Power Module for full power, low power, and shutdown modes of operation for both internal and external events.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

Operability testing to ensure that NuScale power-operated valves perform their intended safety function(s) when called upon shall consider NRC RIS 2000-03 and OM Mandatory Appendix IV (OM-2017). The requirements for OM Mandatory Appendix IV are applied to both AOVs and HOVs. Lessons learned and recommendations from the AOV Joint Owners Group are considered in the development of the specific on-site operability test procedures for all NuScale POVs.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

NuScale HOV operability testing will contain the following attributes:

RAI 03.09.06-16S1

- fail safe, exercise test, and stroke time measurement

RAI 03.09.06-16S1

- verifying of the integrity of the nitrogen cylinder via visual inspection

- recording of as-found and as-left nitrogen pressure and temperatures when performing stroke time measurements
- comparing of nitrogen pressure and temperature with the previous valve tests to determine cylinder leakage rate over the test period
- testing the two redundant, fail-safe hydraulic vent paths on each valve separately to ensure that each vent path is fully functional
- measuring and trending obturator torque periodically to verify and monitor valve friction degradation

RAI 03.09.06-16S1

- leakage testing, as required (Appendix J Type B, Type C, DHR boundary)

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

NuScale ECCS valve operability testing contains the following attributes:

RAI 03.09.06-16S1

- fail safe, exercise test, and stroke time measurement during NuScale Power Module (NPM) shutdown

RAI 03.09.06-16S1

- testing or inspection to ensure minimum flow capacity Cv(min) is confirmed
- testing of the inadvertent block valve function
- testing of any ECCS valve not opened during exercise testing during NPM shutdown to demonstrate that the valve will open on low RCS pressure while the trip valve remains energized (closed)

RAI 03.09.06-16S1

- leakage testing, as required for Appendix J Type B for pilot valves

RAI 03.09.06-16S1

- leak testing, owner specified leakage requirement for main valve and block valve pursuant to Mandatory Appendix I

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

COL Item 3.9-8: A COL applicant that references the NuScale Power Plant design certification will develop specific test procedures to allow detection and monitoring of power-operated valve assembly performance sufficient to satisfy periodic verification design basis capability requirements.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

COL Item 3.9-9: A COL applicant that references the NuScale Power Plant design certification will develop specific test procedures to allow detection and monitoring of emergency core cooling system valve assembly performance sufficient to satisfy periodic verification of design basis capability requirements.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

(4) Check Valve Tests

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

Check Valve Exercise Tests - Check valves identified with specific safety-related functions to transfer closed or maintain close are periodically tested.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

There are no check valves with an open safety function in the NuScale design.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

There are four check valves per NPM in the NuScale inservice test plan. They are all normally closed, nozzle check valves in the feedwater line. Valves FW-CKV-1002/2002 are safety-related and are located outboard of the FWIVs in the same valve body. Valves FW-CKV-1007/2007 are nonsafety-related, perform a backup function, and are located in the feedwater header in the Reactor Building. All four valves close rapidly on a feedwater line breach to preserve DHRS inventory until the FWIV and the feedwater regulating valve close.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

These valves are grouped together when applying the criteria of ASME OM Code Mandatory Appendix II. The valves are tested during cold shutdown as detailed in Table 3.9-16. The backup feedwater check valves, FW-CKV-1007/2007 have augmented test requirements specified in Table 3.9-17.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

ISTC requires that check valves be exercised to both the open and closed positions regardless of their safety function position. The exercise test is intended to show that the check valve will open in response to flow and close when the flow is stopped. In all cases, the open exercise test is in the nonsafety function position. Sufficient flow shall be provided to demonstrate that the valve obturator fully opens. This test may be performed during normal operation in accordance with ISTC-3550, Valves in Regular Use. During the closed exercise test, valve obturator position is verified by direct measurements using nonintrusive devices or by other positive means (i.e., seat leakage or other system parameters). The acceptance criteria for assessing individual valve performance is based on full open (achieving design minimum flowrates) and valve closure verification using backflow tests. Valves that cannot be verified using a flow test may use other means to exercise the valve to the open and closed position as described in ISTC.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

The NuScale check valve test frequencies are identified in Table 3.9-16. The ASME Code requires that check valves be exercise tested quarterly. However, when it is not practical to exercise the valve during plant operation, a check valve can be tested less frequently. If quarterly exercise testing of a check valve is not practical, then exercise testing is performed during cold shutdowns no more often than quarterly. If cold shutdown testing is not practical, then check valve exercise testing shall be performed each refueling cycle. Other means of

- ~~FW regulating valves consisting of two valves per NPM (24 valves total)~~
- ~~backup main steam isolation valves (MSIV) consisting of two valves per NPM (24 valves total)~~
- ~~backup MS isolation bypass valves consisting of two valves per NPM (24 valves total).~~

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

~~Testing and assessment of active hydraulic-operated valves (HOVs) is in accordance with ASME OM Code (Reference 3.9-3) Subsection ISTC. There are five groups of HOVs as follows:~~

- ~~2-inch containment isolation valves consisting of 16 valves per NPM (192 valves total)~~
- ~~feedwater isolation valves, consisting of two valves per NPM (24 valves total)~~
- ~~MSIVs consisting of two valves per NPM (24 valves total)~~
- ~~MS isolation bypass valves consisting of two valves per NPM (24 valves total)~~
- ~~DHRS actuation valves consisting of four valves per NPM (48 valves total)~~

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

3.9.6.3.3 ~~Inservice Testing Program for Check Valves~~Valve Disassembly and Inspection

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

There are two check valves per NPM in the NuScale inservice testing plan and two check valves that require augmented tests. These valves are normally closed, nozzle check valves located in the feedwater system. The safety-related feedwater check valves (FW-CKV-1002/2002) are located in the FWIV body and can be leak tested to satisfy the closed exercise test (Table 3.9-16). The nonsafety-related backup feedwater check valves (FW-CKV-1007/2007) are located in the RXB in the feedwater header (Table 3.9-17). Valve disassembly and inspection may be required if nonintrusive techniques do not prove to be reliable. The check valve group is the two safety-related nozzle check valves in each NPM (24 check valves total for 12 NPMs).

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

Disassembly and inspection of other types of valves is performed based on information from qualification testing, inservice testing, or other program requirements, such as:

- NuScale PRA importance measures.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

- historical performance of power-operated valves (identify valve types which experience unacceptable degradation in service.)
- basic design of valves including the use of components subject to aging and requiring periodic replacement.
- analysis of valve test results during valve qualification tests.

identify the applicable code requirements, describe alternative testing methods and explain why compliance is impractical. The request will provide a specific schedule for implementation of the relief request and justify the request for relief from the ASME OM Code.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16

In the event that any ASME OM Code Cases are implemented as part of the inservice testing plan, they shall either be previously accepted by Regulatory Guide 1.192 as incorporated by reference in 10 CFR 50.55a, or be submitted as a separate alternative authorization pursuant to 10 CFR 50.55a(z).

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

~~No relief requests to the ASME OM Code are anticipated for the NuScale Power Plant design.~~ The following relief requests and alternative authorization to the ASME OM code are required for the NuScale Power Plant design.

RAI 03.09.06-16S1

3.9.6.5.1 Cold Shutdown Definition Relief Request

RAI 03.09.06-16S1

REQUIREMENT — ISTC-3520, Exercising Requirements, refers to full-stroke exercise testing at cold shutdowns if testing during operation at power is not practical.

RAI 03.09.06-16S1

ALTERNATIVE — NuScale Mode 3 “safe shutdown with all reactor coolant temperatures < 200 °F” meets the definition of “cold shutdown outage” as defined in the OM-2017 Code ISTA-2000.

RAI 03.09.06-16S1

BASIS FOR RELIEF — The NuScale Technical Specifications do not have a Mode defined as “cold shutdown” as utilized in the OM Code. The term “cold shutdown” is used in this subsection for clarity with OM Code requirements. NuScale Power Plant modes of operation differ from other pressurized water reactor standard technical specifications. Mode 3 “safe shutdown” reactivity condition is $k_{eff} < 0.99$ and all reactor coolant temperatures < 420 °F. Containment and containment isolation operability is required at temperatures ≥ 200 °F. To meet the intent of the ASME OM-2017 Code definition for “cold shutdown outage, safe shutdown with reactor coolant temperatures < 200 °F” is an equivalent condition where the NPM is stable, important safety systems are not required, and cold shutdown testing can commence per OM Code requirements.

RAI 03.09.06-16S1

"Refueling outage" as defined in OM Code ISTA-2000 is Mode 5, "refueling" in the NuScale Technical Specifications. The term "refueling" is used in this section.

RAI 03.09.06-16S1

~~For the purpose of the ISI Program, a Plant or Unit is what is defined by a "single" license issued by the governing regulatory authority. A plant or unit may consist of multiple "reactors" as long as the reactors are defined in a single license. The NuScale Power Plant consists of up to 12 NuScale Power Modules (NPMs) licensed under a single operating License. Therefore, a single IST program is used and is adjusted as each new NPM train is constructed and exposed to nuclear heat. This approach may be submitted as an Alternative to the Code upon development of the IST Program.~~

RAI 03.09.06-16S1

3.9.6.5.2 ASME OM Code Version Alternate Authorization

RAI 03.09.06-16S1

REQUIREMENT The ASME OM-2012 Code Edition was used to develop the inservice testing plan for the NuScale Power Plant design certification.

RAI 03.09.06-16S1

ALTERNATIVE Portions of the ASME OM-2017 Code Edition,

RAI 03.09.06-16S1

SCOPE Pursuant to 10 CFR 50.55a(z), ISTA-2000 and Mandatory Appendix IV of the ASME OM-2017 Code Edition are utilized to clarify inservice test requirements for the NuScale design.

RAI 03.09.06-16S1

ISTA-2000 was utilized in developing the cold shutdown definition relief request (subsection 3.9.6.5.1). ISTA 2000 introduces definitions for "cold shutdown outage" and "refueling outage" that clarify the intent of "cold shutdown" and "refueling" as utilized in the OM Code.

RAI 03.09.06-16S1

Mandatory Appendix IV was used as an alternative to OM-2012 to develop inservice operability testing as described in subsection 3.9.6.3.2 and Table 3.9-16.

Mandatory Appendix IV is referenced to provide an acceptable level of quality and safety by utilizing established code requirements for testing to demonstrate that valves can perform their safety function at design basis conditions.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

COL Item 3.9-7: ~~Where the NuScale definition of Modes of Operation differ from those defined in the ASME OM Code, an Alternative may be provided to reconcile the terminology. A COL applicant that reference the NuScale Power Plant design certification will generate any relief request(s) needed as part of the Inservice Testing Program Document.~~Not Used.

3.9.6.6 Augmented Valve Testing Program

RAI 03.09.06-16S1

Components not required by ASME OM Code, Subsection ISTA-1100, but with augmented quality requirements similar to ISTA-1100 are included in an augmented inservice testing program. These components either provide nonsafety backup to a safety-related function or are nonsafety related valves that provide an augmented quality function. These components will be tested to the intent of the OM Code commensurate with their augmented requirements. The valve augmented test requirements are presented in Table 3.9-17 and include valves in the chemical and volume control system, condensate and feedwater system, and the main steam system.

RAI 03.09.06-26

~~Components not required by ASME OM Code, Subsection ISTA-1100, but with augmented quality requirements similar to ISTA-1100 are included in an augmented inservice testing program. These components were identified by the DRAP.~~

RAI 03.09.06-26

~~The DRAP process identifies functions requiring augmented quality requirements to provide greater assurance that the supporting components will perform their intended function when called upon. The DRAP considered the GDC and other select 10 CFR 50 regulations to identify safety significant functions. The augmented quality components identified as part of the DRAP process were reviewed for inservice test applicability. Those components meeting the definition of ISTA-1100 were included in the IST program. Components not meeting ISTA-1100 but having augmented requirements for the nonsafety-related functions are included in the augmented IST program. These components will be tested to the intent of the OM Code commensurate with their augmented requirements. The augmented IST plan is presented in Table 3.9-24 through Table 3.9-26 and includes valves in the following systems:~~

RAI 03.09.06-26

- ~~chemical and volume control system~~
- ~~condensate and feedwater system~~
- ~~reactor coolant system~~

RAI 03.09.06-26

~~Testing and assessment of valves within the augmented IST program meet the intent of Subsection ISTC. The NuScale augmented IST Plan includes 96 total valves (8 valves per NPM) divided into four valve groups as follows:~~

- ~~two CVCS Class 3 boundary active pneumatically operated valves per NPM (24 valves total)~~
- ~~two CVCS Class 3 boundary nozzle check valves per NPM (24 valves total)~~
- ~~one RCS nozzle check valve inside containment (excess flow valve installed in reverse) per NPM (12 valves total)~~
- ~~three RCS excess flow check valves inside containment per NPM (36 valves total)~~

3.9.7 References

3.9-1 American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, 2013 Edition No Addenda, Section III, "Rules for Construction of Nuclear Facility Components" and applicable addenda, New York, NY.

3.9-2 American Society of Mechanical Engineers, Boiler and Pressure Vessel Code, 2013 Edition No Addenda, Section XI, "Rules for Inservice Inspection of Nuclear Facility Components," New York, NY.

3.9-3 American Society of Mechanical Engineers, OM-2012 "Standards and Guides for Operation and Maintenance of Nuclear Power Plants," New York, NY, 2012.

3.9-4 American Society of Mechanical Engineers, QME-1-2007 Edition, "Qualification of Active Mechanical Equipment Used in Nuclear Power Plants," 2007 Edition, New York, NY.

3.9-5 NuScale Power, LLC, "Comprehensive Vibration Assessment Program (CVAP) Technical Report," TR-0716-50439.

RAI 03.09.06-16S1

3.9-6 NuScale Power, LLC, "NuScale Containment Leakage Integrity Assurance Technical Report," TR-1116-51962.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

Table 3.9-15: Active Valve List

Valve No.	Description	ASME Class	Function[1]
ASME Class 1, 2, and 3			
Chemical and Volume Control System			
CVC-AOV-0001	CVCS Discharge Isolation Valve	3	5
CVC-CKV-0054	CVCS Injection Check Valve	3	5
CVC-CKV-0057	Pressurizer Spray Check Valve	3	5
CVC-SV-0079	RPV High Point Degasification Isolation Valve	3	5
CVC-AOV-0101	Demineralized Water Supply Isolation Valve	3	3
CVC-AOV-0119	Demineralized Water Supply Isolation Valve	3	3
Containment System			
CVC-ISV-0323	Pressurizer Spray Outboard Containment Isolation Valve	1	1, 2, 3, 4
CVC-ISV-0325	Pressurizer Spray Inboard Containment Isolation Valve	1	1, 2, 3, 4
CVC-ISV-0329	Chemical and Volume Control System Injection Outboard Containment Isolation Valve	1	1, 2, 3, 4
CVC-ISV-0331	Chemical and Volume Control System Injection Inboard Containment Isolation Valve	1	1, 2, 3, 4
CVC-ISV-0334	Chemical and Volume Control System Discharge Inboard Containment Isolation Valve	1	1, 2, 3, 4
CVC-ISV-0336	Chemical and Volume Control System Discharge Outboard Containment Isolation Valve	1	1, 2, 3, 4
CVC-ISV-0401	RPV High Point Degasification Inboard Containment Isolation Valve	1	1, 2, 3, 4
CVC-ISV-0403	RPV High Point Degasification Outboard Containment Isolation Valve	1	1, 2, 3, 4
CE-ISV-0101	Containment Evacuation Inboard Containment Isolation Valve	2	2, 3, 4
CE-ISV-0102	Containment Evacuation Outboard Containment Isolation Valve	2	2, 3, 4
CFD-ISV-0129	Containment Flooding & Drain Outboard Containment Isolation Valve	2	2, 3, 4
CFD-ISV-0130	Containment Flooding & Drain Inboard Containment Isolation Valve	2	2, 3, 4
RCCW-ISV-0184	Reactor Component Cooling Water Inlet Outboard Containment Isolation Valve	2	2, 3, 4
RCCW-ISV-0185	Reactor Component Cooling Water Inlet Inboard Containment Isolation Valve	2	2, 3, 4
RCCW-ISV-0190	Reactor Component Cooling Water Outlet Inboard Containment Isolation Valve	2	2, 3, 4
RCCW-ISV-0191	Reactor Component Cooling Water Outlet Outboard Containment Isolation Valve	2	2, 3, 4
FW-ISV-1003	Feedwater Isolation Valve	2	2, 3, 4
FW-ISV-2003	Feedwater Isolation Valve	2	2, 3, 4
FW-CKV-1002	Feedwater Isolation Check Valve	2	3
FW-CKV-2002	Feedwater Isolation Check Valve	2	3
MS-ISV-1005	Main Steam Isolation Valve	2	2, 3, 4
MS-ISV-2005	Main Steam Isolation Valve	2	2, 3, 4
MS-ISV-1006	Main Steam Isolation Bypass Valve	2	2, 3, 4
MS-ISV-2006	Main Steam Isolation Bypass Valve	2	2, 3, 4
Decay Heat Removal System			
DHR-HOV-1002A	Decay Heat Removal System Actuation Valve	2	3, 4
DHR-HOV-1002B	Decay Heat Removal System Actuation Valve	2	3, 4
DHR-HOV-2002A	Decay Heat Removal System Actuation Valve	2	3, 4
DHR-HOV-2002B	Decay Heat Removal System Actuation Valve	2	3, 4
Emergency Core Cooling System[2]			
ECC-HOV-0101A	Reactor Vent Valve A	1	1, 3, 4

Table 3.9-15: Active Valve List (Continued)

Valve No.	Description	ASME Class	Function[1]
ECC-HOV-0101B	Reactor Vent Valve B	1	1, 3, 4
ECC-HOV-0101C	Reactor Vent Valve C	1	1, 3, 4
ECC-HOV-0104A	Reactor Recirculation Valve A	1	1, 3, 4
ECC-HOV-0104B	Reactor Recirculation Valve B	1	1, 3, 4
Safety and Relief Valves			
RCS-PSV-0003A	Reactor Safety Valve A	1	1, 3
RCS-PSV-0003B	Reactor Safety Valve B	1	1, 3
SGS-PSV-1002	Steam Generator System Thermal Relief Valve	2	2
SGS-PSV-2002	Steam Generator System Thermal Relief Valve	2	2
Non-Code Class Valves			
Condensate and Feedwater System			
FW-FCV-1006	Feedwater Regulating Valve	NC	6
FW-FCV-2006	Feedwater Regulating Valve	NC	6
FW-CKV-1007	Backup Feedwater Check Valve	NC	6
FW-CKV-2007	Backup Feedwater Check Valve	NC	6
Main Steam System			
MS-AOV-1003	Backup Main Steam Isolation Valve	NC	6
MS-AOV-2003	Backup Main Steam Isolation Valve	NC	6
MS-AOV-1004	Backup Main Steam Isolation Bypass Valve	NC	6
MS-AOV-2004	Backup Main Steam Isolation Bypass Valve	NC	6

1 - Function 1 - Reactor coolant pressure boundary
2 - Containment isolation
3 - Accident mitigation
4 - Safe shutdown
5- Nonsafety related, but provide an augmented quality function
6- Nonsafety backup to a safety-related function (Section 15.0.0.6.6)

2 - Trip and reset valves are included with each RVV and RRV.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1, RAI 06.02.04-5S1

Table 3.9-16: Valve Inservice Test Requirements per ASME OM Code

Valve No.	Description	Valve / Actuator[1]	Position	Augmented Function(s)[2]	ASME Class / IST Category	IST Type and Frequency[3]	Valve Group[4]	Notes
Chemical and Volume Control System								
CVC-AOV-0101	Demineralized Water Supply Isolation Valve	BALL Remote AO	Closed	Active Boron Dilution Prevention	Class 3 Category B	Position Verification Test/2 Years Exercise Full Stroke/Quarterly Failsafe Test/Quarterly Operability Test	1	5, 16
CVC-AOV-0119	Demineralized Water Supply Isolation Valve	BALL Remote AO	Closed	Active Boron Dilution Prevention	Class 3 Category B	Position Verification Test/2 Years Exercise Full Stroke/Quarterly Failsafe Test/Quarterly Operability Test	1	5, 16
Containment System								
CVC-ISV-0323	Pressurizer Spray Outboard Containment Isolation Valve	BALL Remote HO	Closed	Active Reactor Coolant Pressure Boundary Containment Isolation	Class 1 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/ Quarterly Containment Isolation Leak Test Operability Test	2	6, 16
CVC-ISV-0325	Pressurizer Spray Inboard Containment Isolation Valve	BALL Remote HO	Closed	Active Reactor Coolant Pressure Boundary Containment Isolation	Class 1 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/ Quarterly Containment Isolation Leak Test Operability Test	2	6, 16
CVC-ISV-0329	Chemical and Volume Control System Injection Outboard Containment Isolation Valve	BALL Remote HO	Closed	Active Reactor Coolant Pressure Boundary Containment Isolation	Class 1 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/Cold Shutdown Containment Isolation Leak Test Operability Test	2	6, 16
CVC-ISV-0331	Chemical and Volume Control System Injection Inboard Containment Isolation Valve	BALL Remote HO	Closed	Active Reactor Coolant Pressure Boundary Containment Isolation	Class 1 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/ Quarterly Containment Isolation Leak Test Operability Test	2	6, 16

Table 3.9-16: Valve Inservice Test Requirements per ASME OM Code (Continued)

Valve No.	Description	Valve / Actuator[1]	Position	Augmented Function(s)[2]	ASME Class / IST Category	IST Type and Frequency[3]	Valve Group[4]	Notes
CVC-ISV-0334	Chemical and Volume Control System Discharge Inboard Containment Isolation Valve	BALL Remote HO	Closed	Active Reactor Coolant Pressure Boundary Containment Isolation	Class 1 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/Cold Shutdown Containment Isolation Leak Test Operability Test	2	6, 16
CVC-ISV-0336	Chemical and Volume Control System Discharge Outboard Containment Isolation Valve	BALL Remote HO	Closed	Active Reactor Coolant Pressure Boundary Containment Isolation	Class 1 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/ Quarterly Containment Isolation Leak Test Operability Test	2	6, 16
CVC-ISV-0401	RPV High Point Degasification Inboard Containment Isolation Valve	BALL Remote HO	Closed	Active Reactor Coolant Pressure Boundary Containment Isolation	Class 1 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/ Quarterly Containment Isolation Leak Test Operability Test	2	6, 16
CVC-ISV-0403	RPV High Point Degasification Outboard Containment Isolation Valve	BALL Remote HO	Closed	Active Reactor Coolant Pressure Boundary Containment Isolation	Class 1 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/ Quarterly Containment Isolation Leak Test Operability Test	2	6, 16
CE-ISV-0101	Containment Evacuation Inboard Containment Isolation Valve	BALL Remote HO	Closed	Active Containment Isolation	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/Cold Shutdown Containment Isolation Leak Test Operability Test	2	6, 16
CE-ISV-0102	Containment Evacuation Outboard Containment Isolation Valve	BALL Remote HO	Closed	Active Containment Isolation	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/ Quarterly Containment Isolation Leak Test Operability Test	2	6, 16
CFD-ISV-0129	Containment Flooding & Drain Outboard Containment Isolation Valve	BALL Remote HO	Closed	Active Containment Isolation	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/ Quarterly Containment Isolation Leak Test Operability Test	2	6, 16

Table 3.9-16: Valve Inservice Test Requirements per ASME OM Code (Continued)

Valve No.	Description	Valve / Actuator[1]	Position	Augmented Function(s)[2]	ASME Class / IST Category	IST Type and Frequency[3]	Valve Group[4]	Notes
CFD-ISV-0130	Containment Flooding & Drain Inboard Containment Isolation Valve	BALL Remote HO	Closed	Active Containment Isolation	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/ Quarterly Failsafe Test/ Quarterly Containment Isolation Leak Test Operability Test	2	6, 16
RCCW-ISV-0184	Reactor Component Cooling Water Inlet Outboard Containment Isolation Valve	BALL Remote HO	Closed	Active Containment Isolation	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Containment Isolation Leak Test Operability Test	2	6, 7, 16
RCCW-ISV-0185	Reactor Component Cooling Water Inlet Inboard Containment Isolation Valve	BALL Remote HO	Closed	Active Containment Isolation	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Containment Isolation Leak Test Operability Test	2	6, 7, 16
RCCW-ISV-0190	Reactor Component Cooling Water Outlet Inboard Containment Isolation Valve	BALL Remote HO	Closed	Active Containment Isolation	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Containment Isolation Leak Test Operability Test	2	6, 7, 16
RCCW-ISV-0191	Reactor Component Cooling Water Outlet Outboard Containment Isolation Valve	BALL Remote HO	Closed	Active Containment Isolation	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Containment Isolation Leak Test Operability Test	2	6, 7, 16
FW-ISV-1003	Feedwater Isolation Valve	BALL Remote HO	Closed	Active Feedwater Isolation Containment Isolation Decay Heat Removal Boundary	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test Operability Test	3	8, 15, 16
FW-ISV-2003	Feedwater Isolation Valve	BALL Remote HO	Closed	Active Feedwater Isolation Containment Isolation Decay Heat Removal Boundary	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test Operability Test	3	8, 15, 16

Table 3.9-16: Valve Inservice Test Requirements per ASME OM Code (Continued)

Valve No.	Description	Valve / Actuator[1]	Position	Augmented Function(s)[2]	ASME Class / IST Category	IST Type and Frequency[3]	Valve Group[4]	Notes
FW-CKV-1002	Feedwater Check Valve	NOZZLE CHECK	Closed	Active Feedwater Isolation Decay Heat Removal Boundary	Class 2 Category C	Check Exercise/ Refueling	5	9
FW-CKV-2002	Feedwater Check Valve	NOZZLE CHECK	Closed	Active Feedwater Isolation Decay Heat Removal Boundary	Class 2 Category C	Check Exercise/ Refueling	5	9
MS-ISV-1005	Main Steam Isolation Valve	BALL Remote HO	Closed	Active Steam Line Isolation Containment Isolation Decay Heat Removal Boundary	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test Operability Test	3	10, 15, 16
MS-ISV-2005	Main Steam Isolation Valve	BALL Remote HO	Closed	Active Steam Line Isolation Containment Isolation Decay Heat Removal Boundary	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test Operability Test	3	10, 15, 16
MS-ISV-1006	Main Steam Isolation Bypass Valve	BALL Remote HO	Closed	Active Steam Line Isolation Containment Isolation Decay Heat Removal Boundary	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test Operability Test	2	10, 15, 16
MS-ISV-2006	Main Steam Isolation Bypass Valve	BALL Remote HO	Closed	Active Steam Line Isolation Containment Isolation Decay Heat Removal Boundary	Class 2 Category A	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test Operability Test	2	10, 15, 16
Decay Heat Removal System								
DHR-HOV-1002A	Decay Heat Removal System Actuation Valve	BALL Remote HO	Open	Active Decay Heat Removal	Class 2 Category B	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Test	3	11, 16
DHR-HOV-1002B	Decay Heat Removal System Actuation Valve	BALL Remote HO	Open	Active Decay Heat Removal	Class 2 Category B	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Test	3	11, 16

Table 3.9-16: Valve Inservice Test Requirements per ASME OM Code (Continued)

Valve No.	Description	Valve / Actuator[1]	Position	Augmented Function(s)[2]	ASME Class / IST Category	IST Type and Frequency[3]	Valve Group[4]	Notes
DHR-HOV-2002A	Decay Heat Removal System Actuation Valve	BALL Remote HO	Open	Active Decay Heat Removal	Class 2 Category B	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Test	3	11, 16
DHR-HOV-2002B	Decay Heat Removal System Actuation Valve	BALL Remote HO	Open	Active Decay Heat Removal	Class 2 Category B	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Test	3	11, 16
Emergency Core Cooling System								
ECC-HOV-0101A	Reactor Vent Valve A	GLOBE Remote HO	Open/ Closed	Active Core Cooling Recirculation Path Reactor Coolant Pressure Boundary LTOP	Class 1 Category BC	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Test	4	12, 16 Vent valves also perform the LTOP function.
ECC-HOV-0101B	Reactor Vent Valve B	GLOBE Remote HO	Open/ Closed	Active Core Cooling Recirculation Path Reactor Coolant Pressure Boundary LTOP	Class 1 Category BC	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Test	4	12, 16
ECC-HOV-0101C	Reactor Vent Valve C	GLOBE Remote HO	Open/ Closed	Active Core Cooling Recirculation Path Reactor Coolant Pressure Boundary LTOP	Class 1 Category BC	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Test	4	12, 16
ECC-HOV-0104A	Reactor Recirculation Valve A	GLOBE Remote HO	Open/ Closed	Active Core Cooling Recirculation Path Reactor Coolant Pressure Boundary	Class 1 Category BC	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Test	4	12, 16
ECC-HOV-0104B	Reactor Recirculation Valve B	GLOBE Remote HO	Open/ Closed	Active Core Cooling Recirculation Path Reactor Coolant Pressure Boundary	Class 1 Category BC	Position Verification Test/2 Years Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Test	4	12, 16

Table 3.9-16: Valve Inservice Test Requirements per ASME OM Code (Continued)

Valve No.	Description	Valve / Actuator[1]	Position	Augmented Function(s)[2]	ASME Class / IST Category	IST Type and Frequency[3]	Valve Group[4]	Notes
Safety and Relief Valves								
RCS-PSV-0003A	Reactor Safety Valve A	SAFETY Pilot Operated Self Actuating	Open/ Closed	Overpressure Protection Reactor Coolant Pressure Boundary	Class 1 Category BC	Position Verification Test, 2 Years (alternated) Class 1 Safety Valve Test/ 5 Years and 20% in 2 Years	6	13
RCS-PSV-0003B	Reactor Safety Valve B	SAFETY Pilot Operated Self Actuating	Open/ Closed	Overpressure Protection Reactor Coolant Pressure Boundary	Class 1 Category BC	Position Verification Test, 2 Years (alternated) Class 1 Safety Valve Test/ 5 Years and 20% in 2 Years	6	13
SGS-PSV-1002	Steam Generator System Thermal Relief Valve	PRESSURE RELIEF Self Actuating	Open/ Closed	Thermal Overpressure Protection Steam Generator System Pressure Boundary Containment Isolation Decay Heat Removal Boundary	Class 2 Category AC	Class 2/3 Relief Valve Test/ 10 Years and 20% in 4 Years	7	14
SGS-PSV-2002	Steam Generator System Thermal Relief Valve	PRESSURE RELIEF Self Actuating	Open/ Closed	Thermal Overpressure Protection Steam Generator System Pressure Boundary Containment Isolation Decay Heat Removal Boundary	Class 2 Category AC	Class 2/3 Relief Valve Test/ 10 Years and 20% in 4 Years	7	14

Notes:

1. AO air operated
   CIV containment isolation valve
   CNV containment vessel
   CVCS chemical and volume control system
   DHRS decay heat removal system
   DWS demineralized water system
   ECCS emergency core cooling system
   FCV feedwater check valve
   FWIV feedwater isolation valve
   FWRV feedwater regulating valve
   HO hydraulic operated
   LRWS liquid radioactive waste system
   LTOP low temperature overpressure protection
   MCR main control room
   MPS module protection system
   MSIV main steam isolation valve
   MSIBV main steam isolation bypass valve
   NPM NuScale Power Module
   PORV power operated relief valve
   PSCIV primary system CIV
   RCCW reactor component cooling water
   RPV reactor pressure vessel
   RRV reactor recirculation valve
   RVV reactor vent valve

SG steam generator SSCIV secondary system CIV

2. The NuScale design does not use safety-related electric power to mitigate accidents or for the safe shutdown of the NuScale Power Module; therefore, all valves listed as having an active safety function have an active-to-failed function to transfer to its safe position on loss of motive power. Valves with an active function are tested by observing the operation of the actuator upon loss of valve actuating power.

3. Cold Shutdown Outage as defined in ISTA-2000 is Mode 3, safe shutdown, with all reactor coolant temperatures < 200 °F. The term "cold shutdown" is used throughout Section 3.9.6 for clarity with the OM Code requirements (Section 3.9.6.5.1).

4. Valve Groups: Valves are grouped as required by OM Mandatory Appendices I, II and IV. Pressure Relief Devices (Mandatory Appendix I) are grouped by valve type, valve function, and Code class. Check valves (Mandatory Appendix II) are grouped by valve type and valve size. POVs (Mandatory Appendix IV-OM-2017) are grouped by actuator type, obturator type, valve size, and safety significance.

Mandatory Appendix	Group No.	Valve
IV	1	AOV, BALL, LSS
IV	2	HOV [small actuator type], BALL, HSS (CVCS only) and LSS
IV	3	HOV [large actuator type], BALL, LSS
IV	4	PORV, Globe, HSS
II	5	NOZZLE CHECK valve, 4-inch, normally closed
I	6	Class 1 SAFETY valve
I	7	Class 2 PRESSURE RELIEF valve

5. CVCS Makeup and Module Isolation Valves (Section 9.3.4.2.2): These two safety-related, air operated valves are in series in the common DWS/LRWS makeup line to the CVCS makeup pumps. The valves close automatically on an MPS signal to mitigate an inadvertent boron dilution event.

6. Primary System Containment Isolation Valves (Section 6.2.4.2.2, Figure 6.2-5): PSCIVs are HO to open, nitrogen gas to close. These valves are located on nozzle penetrations on the CNV head and are intended to satisfy the requirements of GDC 55 and 56. All PSCIVs are designed with two valve actuators installed in a single valve body that is welded directly to the CNV nozzle safe-end. The valves close automatically on an MPS signal or loss of power to isolate containment and preserve RCS inventory. When the valve is deenergized, parallel hydraulic vent paths open, allowing fluid to vent from the valve actuator. This allows the nitrogen gas cylinder to overcome hydraulic pressure and to close the valve. The nitrogen cylinder is sealed and its pressure monitored by plant instrumentation, with alarms and indication available in the MCR. The exercise test and operability test (Note 16) shall determine the state of the nitrogen cylinder (pressure, temperature), the state of the obturator (stroke time, diagnostics), and the state of each hydraulic vent path (by testing each vent path individually). These valves have a test insert that allows 10 CFR 50 Appendix J, Type C testing locally in the direction of containment accident pressure.

7. The RCCW CIVs (Section 6.2.4.2.2) cannot be full stroked during normal operation because this will interrupt cooling flow the CRDMs. The CRDMs operate in the containment vacuum and depend on RCCW cooling for heat removal. Interrupting cooling flow to the CRDMs can cause overheating and lead to a possible rod drop.

8. Feedwater Isolation Valves (Section 6.2.4.2.2, Figure 6.2-6b): FWIVs are HO to open, nitrogen gas to close. These valves are located on two nozzle penetrations on the CNV head and are intended to satisfy the requirements of GDC 57. The FWIV is designed with the actuator installed inboard and a feedwater check valve installed outboard in the same valve body. The valve is welded directly to the CNV nozzle safe-end. The valves close automatically on a MPS signal or loss of power to isolate the feedwater line and preserve DHRS inventory. When the valve is deenergized, parallel hydraulic vent paths open, allowing fluid to vent from the valve actuator. This allows the nitrogen gas cylinder to overcome hydraulic pressure and close the valve. The nitrogen cylinder is sealed and its pressure monitored by plant instrumentation, with alarms and indication available in the MCR. The exercise test and operability test (Note 19) shall determine the state of the nitrogen cylinder (pressure, temperature), the state of the obturator (stroke time, diagnostics), and the state of each hydraulic vent path (by testing each vent path individually). These valves have a test insert that allows Technical

Specification leakage testing (Note 15) locally in the direction of DHRS pressure. These valves cannot be full-stroke or part stroke exercised during plant operation because closing the valves interrupts feedwater flow resulting in possible steam generator level transients and may initiate a turbine or NPM trip.

9. Feedwater Check Valves (Section 6.2.4.2.1, Figure 6.2-6b): The feedwater check valves are credited for rapidly acting to the safety function position (closed) to preserve DHRS inventory on a loss of feedwater. The FCVs are normally closed nozzle check valves. The FWIV is credited with providing the primary DHRS/feedwater boundary and has specific leakage criteria. The FCV maintains the DHRS boundary until the FWIV is fully closed and therefore, has no specific leakage criteria. The FCV is located in the same valve body as the FWIV and is located outboard of the two (FWIV located nearest the CNV). These valves cannot be full-stroke or part stroke exercised closed during plant operation because closing the valves interrupts feedwater flow resulting in possible steam generator level transients and may initiate a turbine or NPM trip. The FWIV/FCV body is equipped with a test insert that allows leakage testing following system shutdown. The closed exercised test will be performed at cold shutdown with a leak test to verify the valve is fully closed. Normal feedwater operation will satisfy the open exercise (nonsafety direction) for these valves pursuant to ISTC-3550, Valves in Regular Use, at a frequency that satisfies requirements of the OM Code by periodically measuring FW flow to confirm the valve obturator is fully open.

10. Main Steam Isolation Valves and Bypass (Section 6.2.4.2.2, Figure 6.2-6a): MSIVs and MSIBVs are HO to open, nitrogen gas to close. These valves located on the two main steam nozzle penetrations on the CNV head and are intended to satisfy the requirements of GDC 57. One actuator is located in a single valve body that is welded to a ASME Class 2 pipe. The valves close automatically on a MPS signal or loss of power to isolate the main stream line and preserve DHRS inventory (the MSIBV is normally closed). When the valve is deenergized, parallel hydraulic vent paths open allowing fluid to vent from the valve actuator. This allows the nitrogen gas cylinder to overcome hydraulic pressure and close the valve. The nitrogen cylinder is sealed and its pressure monitored by plant instrumentation, with alarms and indication available in the MCR. The exercise test and operability test (Note 16) shall determine the state of the nitrogen cylinder (pressure, temperature), the state of the obturator (stroke time, diagnostics), and the state of each hydraulic vent path (by testing each vent path individually). These valves have a test insert that allows leakage testing (Note 15) locally in the direction of steam flow and DHRS isolation. These valves cannot be full-stroke or part stroke exercised during plant operation because closing the valves interrupts steam flow resulting in possible steam generator pressure and level transients and may initiate a turbine or NPM trip.

11. Decay Heat Removal System Actuation Valves (Section 5.4.3.2.1): DHRS actuation valves are HO to close, nitrogen gas to open. These valves are located on two closed loops outside the CNV and are intended to satisfy the requirements of GDC 57. There are two valves in parallel in each loop, four valves total. Either valve is designed to fulfill the system safety function requirement. The valves open automatically on a MPS signal or loss of power to initiate decay heat removal circulation through the DHRS condenser and corresponding SG. When the valve is deenergized, parallel hydraulic vent paths open allowing fluid to vent from the valve actuator. This allows the nitrogen gas cylinder to overcome hydraulic pressure and open the valve. The nitrogen cylinder is sealed and its pressure monitored by plant instrumentation, with alarms and indication available in the MCR. The exercise test and operability test (Note 16) shall determine the state of the nitrogen cylinder (pressure, temperature), the state of the obturator (stroke time, diagnostics), and the state of each hydraulic vent path (by testing each vent path individually). These valves cannot be full-stroke or part stroke exercised during plant operation because opening the valves would unnecessarily subject the SG nozzles to thermal transients from the decay heat condenser condensate flow.

12. Emergency Core Cooling Valves (Section 6.3.2.2, Figure 6.3-3): The ECCS RRVs and RVVs are PORVs that each consist of a main valve, a trip pilot, a reset pilot and an inadvertent actuation block. These components are considered as one valve assembly and are exercised tested as a unit during cold shutdown. However, operability testing per Note 16 may be performed separately to provide additional diagnostic information to assess valve performance. These valves cannot be full or partial stroke exercised during plant operation because cycling a valve opens an RCS vent path resulting in a potential loss of core cooling. The active safety function of the valves is to open and remain open when actuated. The closed safety function to support the reactor coolant pressure boundary is passive. The reset pilot is a nonsafety function and is not inservice tested as part of the ASME OM Code IST program. The trip valve is tested during failsafe and exercise testing.

    RRVs and RVVs do not have specific leakage criteria. Seat tightness will be in accord with the requirements of the OM Code Mandatory Appendix I. ECCS valve seat leakage will be RCS unidentified leakage and must meet Technical Specification surveillance criteria. The owner's seat tightness criteria should be in accordance with the methods prescribed in OM Mandatory Appendix I, Table I-8220-1. The associated pilot valve bodies form part of the reactor coolant and containment boundaries and are subject to 10 CFR 50 Appendix J Type B testing.

ISTC-5110 Power Operated Relief Valves - RRVs and RVVs have attributes of both power operated valves (ISTC-5100) and relief valves (ISTC-5240). Operability testing per Note 16 includes a functional test of the inadvertent actuation block at normal RCS pressure to confirm that the ECCS valve does not open. Testing also includes an operational test to demonstrate that the valves not exercise tested will open on low RCS pressure even though the trip valves remain energized (closed).

13. Reactor Safety Valves (Section 5.1.3.5): These valves are not exercised for inservice testing; their position indication components are tested by local inspection without valve exercise. RSVs do not have specific leakage criteria. Seat tightness will be in accord with the requirements of the OM Code Mandatory Appendix I. Any RSV seat leakage will be RCS unidentified leakage and must meet Technical Specification surveillance criteria. Owner's as-left seat tightness criteria shall be no observed leakage utilizing the methods prescribed in OM Mandatory Appendix I, Table I-8220-1.

14. Steam Generator System Thermal Relief Valves (Section 5.4.1.2): These thermal relief valves are located inside containment on each SG system feedwater header.

15. All secondary systems containment isolation valves close to complete the decay heat removal system boundary. All of these valves have specific leakage criteria and are tested per NuScale Technical Specification surveillance test (Technical Specification SR 3.7.1.2 and SR 3.7.2.2).

16. These valves are subject to operability testing per the requirements of 10 CFR 50.55a. The test frequencies are to be established in accordance with the intent ASME OM Code - 2017, Mandatory Appendix IV. The approach detailed in Mandatory Appendix IV shall be applied to both AOVs and HOVs.

    OM Mandatory Appendix IV and this Plan address the attributes of a successful POV program as delineated in NRC Regulatory Issue Summary (RIS) 2000-3, "Resolution of Generic Safety Issue 158: Performance of Safety-Related Power Operated Valves Under Design Basis Conditions." See subsection 3.9.6.2.2 (3) for the factors to be considered in the evaluation of operability testing.

RAI 03.09.03-12, RAI 03.09.06-5, RAI 03.09.06-16, RAI 03.09.06-16S1

Table 3.9-17: Chemical and Volume Control System Valves in the Example Inservice Testing Program

Valve Number	Risk Ranking	Size	Code Class	Category	Function	Safety Function Position	Test Parameters and Schedule				Remarks
							Leak Test	Exercise Test	Fail Safe Test	Position Verification Test	
GROUP 1: Ball valve / air operated											
CVC-AOV-0101	Low	2	3	B	A	C	N/A	MT/3MO	FC/3MO	PIT/2YR	Boron dilution prevention
CVC-AOV-0119	Low	2	3	B	A	C	N/A	MT/3MO	FC/3MO	PIT/2YR	Boron dilution prevention

RAI 03.09.06-16S1

Table 3.9-17: Valve Augmented Requirements

Valve No.	Description	Valve / Actuator[1]	Position	Augmented Function(s)[2]	IST Category	IST Type[3]	Notes
Chemical Volume and Control System							
CVC-AOV-0339	CVCS Discharge Isolation Valve	GLOBE Remote AO	Closed	Active Containment Isolation	Category A	Position Verification Test Exercise Full Stroke Failsafe Test Operability Leak Test	9
CVC-CKV-0353	CVCS Injection Check Valve	NOZZLE CHECK	Closed	Active Containment Isolation	Category A/C	Check Exercise/ Refueling	8, 9
CVC-CKV-0352	Pressurizer Spray Check Valve	NOZZLE CHECK	Closed	Active Containment Isolation	Category A/C	Check Exercise/ Refueling	8, 9
CVC-AOV-0406	RPV High Point Degasification Isolation Valve	GLOBE Remote AO	Closed	Active Containment Isolation	Category A	Position Verification Test Exercise Full Stroke Failsafe Test Operability Leak Test	9
Condensate and Feedwater System							
FW-FCV-1006	Feedwater Regulating Valve	FCV Remote AO	Closed	Active Feedwater Isolation Containment Isolation Decay Heat Removal Boundary	Category A	Position Verification Test Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test	4, 7
FW-FCV-2006	Feedwater Regulating Valve	FCV Remote AO	Closed	Active Feedwater Isolation Containment Isolation Decay Heat Removal Boundary	Category A	Position Verification Test Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test	4, 7
FW-CKV-1007	Backup Feedwater Check Valve	Nozzle Check	Closed	Active Decay Heat Removal Boundary	Category C	Check Exercise/ Refueling	5
FW-CKV-2007	Backup Feedwater Check Valve	Nozzle Check	Closed	Active Decay Heat Removal Boundary	Category C	Check Exercise/ Refueling	5
Main Steam System							

Table 3.9-17: Valve Augmented Requirements (Continued)

Valve No.	Description	Valve / Actuator[1]	Position	Augmented Function(s)[2]	IST Category	IST Type[3]	Notes
MS-AOV-1003	Backup Main Steam Isolation Valve	GATE Remote AO	Closed	Active Steam Line Isolation Containment Isolation Decay Heat Removal Boundary	Category A	Position Verification Test Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test	6,7
MS-AOV-2003	Backup Main Steam Isolation Valve	GATE Remote AO	Closed	Active Steam Line Isolation Containment Isolation Decay Heat Removal Boundary	Category A	Position Verification Test Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test	6,7
MS-AOV-1004	Backup Main Steam Isolation Bypass Valve	GATE Remote AO	Closed	Active Steam Line Isolation Containment Isolation Decay Heat Removal Boundary	Category A	Position Verification Test Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test	6,7
MS-AOV-2004	Backup Main Steam Isolation Bypass Valve	GATE Remote AO	Closed	Active Steam Line Isolation Containment Isolation Decay Heat Removal Boundary	Category A	Position Verification Test Exercise Full Stroke/Cold Shutdown Failsafe Test/Cold Shutdown Operability Leak Test	6,7

Notes:

1. AO air operated; DHRS decay heat removal system; FCV feedwater check valve; FWIV feedwater isolation valve; FWRV feedwater regulating valve; MSIV main steam isolation valve; MSIBV main steam isolation bypass valve; NPM NuScale Power Module; CVCS chemical volume and control; RPV reactor pressure vessel

2. Valves with augmented test requirements either provide a nonsafety backup to a safety-related function or are nonsafety-related that provide an augmented quality function. The NuScale design does not use safety-related electric power to mitigate accidents or for the safe shutdown of the NuScale Power Module; therefore, all valves listed have an active-to-failed function to transfer to its backup position on loss of motive power. Valves with an active function are tested by observing the operation of the actuator upon loss of valve actuating power.

3. Cold Shutdown Outage as defined in ASME OM-2017 ISTA-2000 is Mode 3, safe shutdown, with all reactor coolant temperatures < 200 °F. The term "cold shutdown" is used throughout Section 3.9.6 for clarity with the OM Code requirements (Section 3.9.6.5.1).

4. Feedwater Regulating Valves (Section 10.4.7.2.2): The FWRVs are nonsafety-related, not risk-significant backup isolation valves to the safety-related FWIVs and are credited in safety analysis. These valves have the same design pressure and temperature as the RCS. These valves cannot be full-stroke or part-stroke exercised during plant operation because closing the valves interrupts feedwater flow, resulting in possible steam generator level transients, and may initiate a turbine or NPM trip.

5. Backup Feedwater Check Valves (Section 10.4.7.2.2): The backup feedwater check valves are nonsafety-related, not risk-significant backup check valves to the safety-related FCV and are credited in safety analysis. These valves are credited for rapid acting to the safety function position (closed) to preserve DHRS inventory on a loss of feedwater. The backup FCVs are normally closed, nozzle check valves. The FWRV is credited with providing the backup DHRS/feedwater boundary and has specific leakage criteria. The backup FCV maintains the DHRS boundary until the FWRV is fully closed and, therefore, has no specific leakage criteria. These valves cannot be full-stroke or part-stroke exercised closed during plant operation because closing the valves interrupts feedwater flow, resulting in possible steam generator level transients, and may initiate a turbine or NPM trip. The nozzle check design is a spring-to-close design. Nonintrusive testing can be used to verify valve closure during plant shutdown or during cold shutdown. Normal feedwater operation satisfies the open exercise (nonsafety direction) for these valves pursuant to ISTC-3550, Valves in Regular Use, at a frequency that satisfies requirements of the OM Code by periodically measuring FW flow and pressure to confirm the valves are fully open.
6. Backup Main Steam Isolation Valves and Bypass (Section 10.3.2.2): The backup MSIVs and MSIBVs are nonsafety-related, not risk significant backup isolation valves to the safety-related MSIVs and MSIBVs and are credited in safety analysis. These valves have the same design pressure and temperature as the RCS. These valves cannot be full-stroke or part stroke exercised during plant operation because closing the valves would interrupt steam flow resulting in possible steam generator pressure and level transients and may initiate a turbine or NPM trip.
7. All secondary systems containment backup isolation valves close to complete the decay heat removal system boundary. All of these valves have specific leakage criteria and are tested per NuScale Technical Specification surveillance test (Technical Specification SR 3.7.1.2 and SR 3.7.2.2).
8. Backup CVCS Check Valves: The backup CVCS check valves are normally closed, nozzle check valves. These valves cannot be full- stroke or part-stroke exercised closed during plant operation because system flow must be reversed to demonstrate valve closure. The nozzle check design is a spring-to-close design. Nonintrusive testing can be used to verify valve closure during plant shutdown. Normal CVCS operation satisfies the open exercise for these valves pursuant to ISTC-3550, Valves in Regular Use, at a frequency that satisfies the owner's requirements for augmented testing by periodically measuring line flow and pressure to confirm the valves are fully open.
9. Backup Containment Isolation Valves: Third isolation valves that provide a nonsafety backup function as defined by Regulatory Guide 1.26 Revision 4, C.2(c) footnote 6 as having “high leaktight integrity.” These valves define the NRC Quality Group C/D and Seismic I/III classification break. The power operated valves receive a nonsafety containment isolation signal.