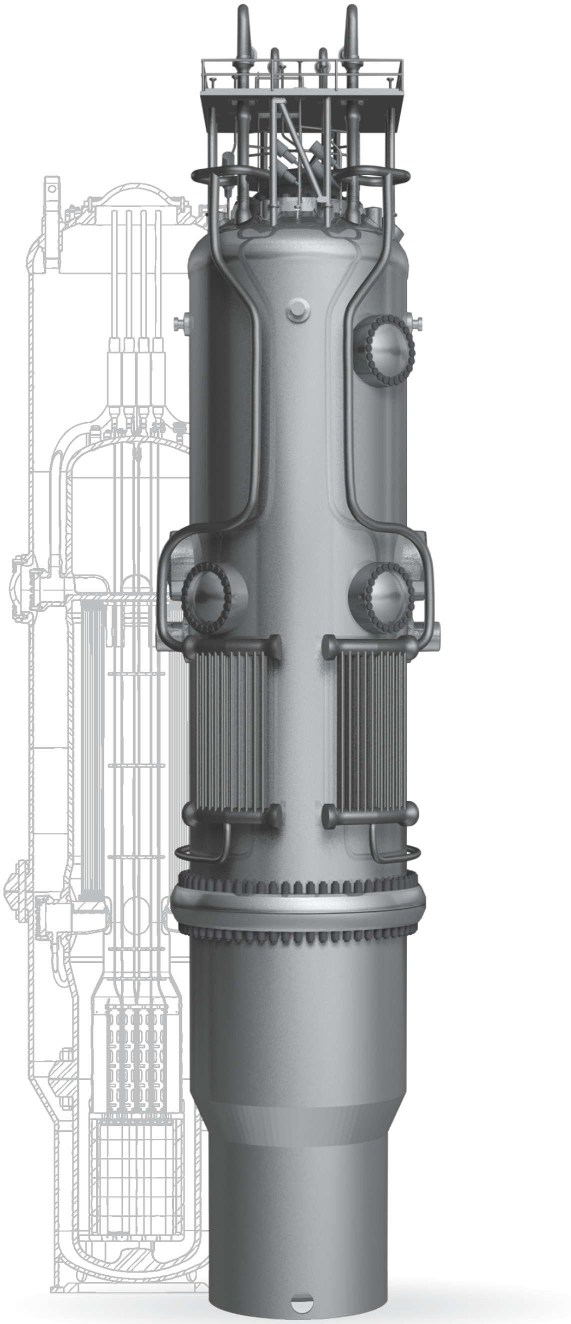

NuScale Standard Plant
Design Certification Application

Certified Design Descriptions and Inspections, Tests, Analyses, & Acceptance Criteria (ITAAC)

PART 2 - TIER 1

Revision 0
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CHAPTER 1 INTRODUCTION

1.0 Introduction

This document presents the Tier 1 information developed for the NuScale, LLC Power Plant. The Tier 1 information is the information that is to be certified through rulemaking and includes the Inspections, Tests, Analyses, and Acceptance Criteria required by 10 CFR 52.47(b)(1).

Tier 1 includes the following information:

- definitions
- general provisions
- design descriptions
- Inspections, Tests, Analyses, and Acceptance Criteria
- site parameters
- interface requirements

The information presented in Tier 1 is consistent with the information presented in Tier 2.

A graded approach is employed relative to the level of design information presented in Tier 1, i.e., the amount of design information presented is proportional to the safety significance of the structures, systems, and components being addressed.

1.1 Definitions

The definitions below apply to terms that may be used in the design descriptions and associated Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC).

Acceptance Criteria refers to the performance, physical condition, or analysis result for structures, systems, and components (SSC), or program that demonstrates that the design commitment is met.

Analysis means a calculation, mathematical computation, or engineering or technical evaluation. Engineering or technical evaluations could include, but are not limited to, comparisons with operating experience or design of similar SSC.

As-built means the physical properties of an SSC following the completion of its installation or construction activities at its final location at the plant site. In cases where it is technically justifiable, determination of physical properties of the as-built SSC may be based on measurements, inspections, or tests that occur prior to installation, provided that subsequent fabrication, handling, installation, and testing do not alter the properties.

ASME Code means Section III of the American Society of Mechanical Engineers (ASME) Boiler and Pressure Vessel Code, unless a different section of the ASME Code is specifically referenced.

ASME Code Data Report means a document that certifies that a component or system is constructed in accordance with the requirements of the ASME Code. This data is recorded on a form approved by the ASME.

Component, as used for reference to ASME Code components, means a vessel, concrete containment, pump, pressure relief valve, line valve, storage tank, piping system, or core support structure that is designed, constructed, and stamped in accordance with the rules of the ASME Code. ASME Code Section III classifies a metal containment as a vessel.

Design Commitment means that portion of the design description that is verified by ITAAC.

Design Description means that portion of the design that is certified. Design descriptions consist of a system description, system description tables, system description figures, and design commitments. System description tables and system description figures are only used when appropriate. The system description is not verified by ITAAC; only the design commitments are verified by ITAAC. System description tables and system description figures are only verified by ITAAC if they are referenced in the ITAAC table.

Inspect or **Inspection** means visual observations, physical examinations, or reviews of records based on visual observation or physical examination that compare (a) the SSC condition to one or more design commitments or (b) the program implementation elements to one or more program commitments, as applicable. Examples include walkdowns, configuration checks, measurements of dimensions, or nondestructive examinations. The terms, inspect and inspection, also apply to the review of Emergency Planning ITAAC requirements to determine whether ITAAC are met.

ITAAC are those Inspections, Tests, Analyses, and Acceptance Criteria identified in the combined license that if met by the licensee are necessary and sufficient to provide reasonable

assurance that the facility has been constructed and will be operated in conformity with the license, the provisions of the Atomic Energy Act, as amended, and the Commission's rules and regulations.

NuScale Power Module (NPM) is a collection of systems, sub-systems, and components that together constitute a modularized, movable, nuclear steam supply system. The NPM is composed of a reactor core, a pressurizer, and two steam generators integrated within a reactor pressure vessel and housed in a compact steel containment vessel.

Reconciliation or **Reconciled** means the identification, assessment, and disposition of differences between an approved design feature and an as-built plant design feature. For ASME Code piping systems, it is the reconciliation of differences between the approved design and the as-built piping system. For structural features, it is the reconciliation of differences between the approved design and the as-built structural feature.

Report, as used in the ITAAC table Acceptance Criteria column, means a document that verifies that the acceptance criteria of the subject ITAAC have been met and references the supporting documentation. The report may be a simple form that consolidates all of the necessary information related to the closure package for supporting successful completion of the ITAAC.

Common or Shared ITAAC means ITAAC that are associated with common or shared SSC and activities that support multiple NPMs. This includes (1) SSC that are common or shared by multiple NPMs, and for which the interface and functional performance requirements between the common or shared SSC and each NPM are identical, or (2) analyses or other generic design and qualification activities that are identical for each NPM (e.g., environmental qualification of equipment). For a multi-module plant, satisfactory completion of a common or shared ITAAC for the lead NPM shall constitute satisfactory completion of the common or shared ITAAC for associated NPMs.

System Description (Tier 1) includes

- a concise description of the system's or structure's safety-related functions, nonsafety-related functions that support safety-related functions, and certain nonsafety risk-significant functions.
- a listing of components required to perform those functions.
- identification of the system safety classification.
- the system components' general locations.

The system description may include system description tables and figures.

Test means actuation or operation, or establishment of specified conditions, to evaluate the performance or integrity of as-built SSC, unless explicitly stated otherwise, to determine whether ITAAC are met.

Tier 1 means the portion of the design-related information contained in the generic Design Control Document that is approved and certified by the design certification rule (Tier 1). The design descriptions, interface requirements, and site parameters are derived from Tier 2 information. Tier 1 includes:

- definitions and general provisions

- design descriptions
- ITAAC
- significant site parameters
- significant interface requirements

Type Test means a test on one or more sample components of the same type and manufacturer to qualify other components of the same type and manufacturer. A type test is not necessarily a test of an as-built SSC.

Top-Level Design Features means the principal performance characteristics and physical attributes that are important to performing the safety-related and certain nonsafety-related functions of the plant.

Module-Specific ITAAC means ITAAC that are associated with SSC that are specific to and support operation of a single, individual NuScale Power Module. Module-specific ITAAC shall be satisfactorily completed for each NuScale Power Module.

1.2 General Provisions

1.2.1 Design Descriptions

Design descriptions pertain only to the structures, systems, and components (SSC) of the standard design and not to their operation and maintenance after fuel load. In the event of an inconsistency between the design descriptions and the Tier 2 information, the design descriptions in Tier 1 shall govern.

Design descriptions consist of system descriptions, system description tables, system description figures, and design commitments. System description tables and system description figures are only used when appropriate. The system description provides a concise description of the top-level design features and performance characteristics of the SSC system functions, safety classification, and general location. The system description only describes those portions of the system or structure that are important to the top-level design features and performance characteristics of the system or structure. Design commitments are provided in numbered paragraphs that are used to develop the Design Commitment column in the Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) table. These commitments address top-level design features and performance characteristics such as:

- seismic classification
- American Society of Mechanical Engineers Code classification
- Class 1E SSC
- equipment to be qualified for harsh environments
- instrumentation and controls equipment to be qualified for other than harsh environments

The absence of discussion or depiction of SSC in the design description shall not be construed as prohibiting a licensee from using such SSC, unless it would prevent SSC from performing a top-level design feature or performance characteristic, or impairing the performance of those functions, as discussed or depicted in the design description.

When the term “operate,” “operates,” or “operation” is used with respect to equipment discussed in the acceptance criteria, it refers to the actuation or control of the equipment.

1.2.2 Interpretation of System Description Tables

Cells with no values in system description tables contain an “N/A” to denote that the cell is “not applicable.”

1.2.3 Interpretation of System Description Figures

Figures are provided for some systems or structures with the amount of information depicted based on their safety significance. These figures may represent a functional diagram, general structural representation, or other general illustration. Unless specified, these figures are not indicative of the scale, location, dimensions, shape, or spatial relationships of as-built SSC. In particular, the as-built attributes of SSC may vary from the

attributes depicted on these figures, provided that the top-level design features discussed in the design description pertaining to the figure are not adversely affected. Valve position indications shown on system description figures do not represent a specific operational state.

The figure legends in Tier 2 Section 1.7 are used to interpret Tier 1 system description figures.

1.2.4 Implementation of Inspections, Tests, Analyses, and Acceptance Criteria

Design commitments, inspections, tests, analyses, and acceptance criteria are provided in ITAAC tables with the following format:

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria

Each commitment in the "Design Commitment" column of the ITAAC tables has one or more associated requirements for inspections, tests or analyses specified in the "Inspections, Tests, Analyses" column.

Inspections, tests, or analyses may be performed by the licensee or by its authorized vendors, contractors, or consultants.

Inspections, tests, or analyses may be

- performed by more than a single individual or group.
- implemented through discrete activities separated by time.
- performed at any time prior to fuel load, including before issuance of the combined license for those ITAAC that do not require as-built equipment.
- performed at a location other than the construction site.

Additionally, inspections, tests, or analyses may be performed as part of other activities such as construction inspections and preoperational testing. Therefore, inspections, tests, or analyses need not be performed as a separate or discrete activity.

If an acceptance criteria does not specify the temperature, pressure, or other conditions under which an inspection or test must be performed, then the inspection or test conditions are not constrained.

For the acceptance criteria, appropriate documentation may be a single document or a collection of documents that show that the stated acceptance criteria are met. Examples of appropriate documentation include:

- design reports
- test reports
- inspection reports
- analysis reports
- evaluation reports

- design and manufacturing procedures
- certified data sheets
- commercial grade dedication procedures and records
- quality assurance records
- calculation notes
- equipment qualification data packages

Conversion or extrapolation of test results from the test conditions to the design conditions may be necessary to satisfy an ITAAC. Suitable justification should be provided for, and applicability of, any necessary conversions or extrapolations of test results necessary to satisfy an ITAAC.

1.2.5 Acronyms and Abbreviations

The acronyms and abbreviations contained in Tier 2 Table 1.1-1 are applicable to Tier 1.

CHAPTER 2 UNIT SPECIFIC STRUCTURES, SYSTEMS, AND COMPONENTS DESIGN DESCRIPTIONS AND INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA

2.0 Unit Specific Systems, Structures, and Components Design Descriptions and Inspections, Tests, Analyses, and Acceptance Criteria

This chapter of Tier 1 provides the structures, systems, and components Design Descriptions and Inspections, Tests, Analyses, and Acceptance Criteria for those structures, systems, and components that are specific to and support operation of a single NuScale Power Module. Unit-specific Inspections, Tests, Analyses, and Acceptance Criteria shall be satisfactorily completed for each NuScale Power Module in a multi-unit plant.

2.1 NuScale Power Module

2.1.1 Design Description

System Description

The scope of this section is the NuScale Power Module (NPM) and its associated systems. The NPM is installed in the reactor pool in the Reactor Building (RXB). Up to 12 NPMs may be installed in the Reactor Building. The systems contained within the boundary of the NPM are the

- reactor coolant system (RCS), including the reactor pressure vessel (RPV), pressurizer, steam generator (SG), reactor vessel internals (RVI), and associated piping and valves.
- control rod drive system (CRDS), including the control rod drive mechanisms (CRDM) with embedded cooling water tubes, cables, and associated cooling water piping. The CRDS also includes instrumentation to provide control rod position indication information.
- containment system (CNTS), including the containment vessel (CNV) and containment isolation valves (CIVs) and associated piping.
- emergency core cooling system (ECCS) valves.
- decay heat removal system (DHRS), including associated piping and valves.

The NPM includes the pressure retaining structures of these systems because they are part of either the reactor coolant pressure boundary (RCPB) or the CNV pressure boundary. Therefore, the mechanical design and arrangement of the piping, CRDS, and NPM valves (emergency core cooling, reactor safety, and containment isolation) are included in this section.

The CRDM pressure housings form the pressure boundary between the environments inside the RPV and the CNV. The CRDM pressure housings consist of the latch housing and the rod travel housing.

The NPM performs the following nonsafety-related, risk-significant functions that is verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The RCS supports the CNTS by supplying the RCPB and a fission product boundary via the RPV and other appurtenances.
- The CRDS supports the RCS by maintaining the pressure boundary of the RPV.
- The SG supports the RCS by suppling part of the RCPB.
- The ECCS supports the RCS by providing a portion of the RCPB for maintaining the RCPB integrity.
- The CNTS supports the RXB by providing a barrier to contain mass, energy, and fission product release from a degradation of the RCPB.
- The ECCS supports the CNTS by providing a portion of the containment boundary for maintaining containment integrity.

- The CNTS supports the DHRS by providing the required pressure boundary for DHR operation.
- The RCS supports the SG by providing physical support for the SG tube supports and for the integral steam and feed plenums.
- The RCS supports the reactor core by the RVI providing mechanical support to orient, position, and seat the fuel assemblies.
- The RCS supports the CRDS by the RPV and the RVI supporting and aligning the control rods.
- The CNTS supports the DHRS by providing structural support for the DHRS piping.
- The CNTS supports the neutron monitoring system by providing structural support for the ex-core detectors.
- The RCS supports the ECCS by providing structural support for the ECCS valves.
- The RCS supports the incore instrumentation system by providing structural support of the in-core instrumentation guide tubes.
- The CNTS supports the CRDS by providing structural support for the CRDMs.
- The CNTS supports the RCS by providing structural support for the RPV.
- The CNTS supports the ECCS by providing structural support of the trip and reset valves for the ECCS reactor vent valves (RVVs) and reactor recirculation valves (RRVs).
- The CNTS supports the RCS by closing the CIVs for pressurizer spray, chemical and volume control system (CVCS) makeup, CVCS letdown, and RPV high point degasification when actuated by module protection system (MPS) for RCS Isolation.
- The CNTS supports the RXB by providing a barrier to contain mass, energy, and fission product release by closure of the CIVs upon containment isolation signal.
- The CNTS supports the DHRS by closing CIVs for main steam valves and feedwater valves when actuated by MPS for DHRS operation.
- The ECCS supports the RCS by opening the ECCS reactor vent valves and RRVs when their respective trip valve is actuated by MPS.
- The DHRS supports the RCS by opening the DHRS actuation valves on a DHRS actuation signal.
- The CNTS supports the MPS by providing electrical penetration assemblies to route instrument cables for MPS actuation through the CNV.

The NPM performs the following nonsafety-related, risk-significant function that is verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The CNTS supports the RXB crane by providing lifting attachment points that the RXB crane can connect to so that the NPM can be lifted.

The NPM performs the following nonsafety-related functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The CNTS supports the SG by providing structural support for the SG piping.
- The CNTS supports the CRDS by providing structural support for the CRDS piping.

- The CNTS supports the RCS by providing structural support for the RCS piping.
- The CNTS supports the feedwater system by providing structural support for the feedwater system piping.

Design Commitments

- The NPM American Society of Mechanical Engineers (ASME) Code Class 1, 2 and 3 piping systems listed in Table 2.1-1 comply with ASME Code Section III requirements.
- The Nuscale Power Module ASME Code Class 1 and 2 components conform to the rules of construction of ASME Code Section III.
- The Nuscale Power Module ASME Code Class CS components conform to the rules of construction of ASME Code Section III.
- Safety-related structures, systems, and components (SSC) are protected against the dynamic and environmental effects associated with postulated failures in high- and moderate-energy piping systems.
- The Nuscale Power Module ASME Code Class 2 piping systems and interconnected equipment nozzles are evaluated for leak-before-break (LBB).
- The RPV beltline material has a Charpy upper-shelf energy of greater than 75 ft-lb.
- The CNV serves as an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment.
- The CIV closure times limit potential releases of radioactivity.
- The length of piping shall be minimized between the containment penetration and the associated outboard CIVs.
- The NPM Class 1E containment electrical penetration assemblies are sized to power their design loads.
- Physical separation exists between the redundant divisions of the MPS Class 1E instrumentation and control current-carrying circuits, and between Class 1E instrumentation and control current-carrying circuits and non-Class 1E instrumentation and current-carrying circuits. The scope of this commitment includes the cables from the NPM disconnect box to the instrument.
- The RPV is provided with surveillance capsule holders to hold a capsule containing RPV material surveillance specimens.
- The CNTS safety-related valves change position under design differential pressure.
- The ECCS safety-related valves change position under design differential pressure.
- The DHRS safety-related valves change position under design differential pressure.
- The RCS safety-related check valves change position under design differential pressure and flow.
- The RCS safety-related excess flow check valves change position under excess flow conditions.
- The CNTS safety-related hydraulic-operated valves fail to their safety-related position on loss of electrical power under design differential pressure.

- The ECCS safety-related RRVs and RVVs fail to their safety-related position on loss of electrical power to their corresponding trip valves under design differential pressure.
- The DHRS safety-related hydraulic-operated valves fail to their safety-related position on loss of electrical power under design differential pressure.
- The CNTS safety-related check valves change position under design differential pressure and flow.
- The CNTS Class 1E containment electrical penetration assemblies are rated to withstand fault currents for the time required to clear the fault from its power source.

2.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.1-4 contains the inspections, tests, and analyses for the NPM.

Table 2.1-1: NuScale Power Module Piping Systems

Piping System Description	ASME Code Section III Class	High/ Moderate Energy	Evaluated for LBB	Length of Containment Piping (ft)
Outside CNV				
RCS injection (charging) line from valves CNT-CVC-ISV-0331 & CNT-CVC-ISV-0329 at CNV nozzle CNV6 to NPM disconnect flange	3	High	No	N/A
RCS pressurizer spray line from valves CNT-CVC-ISV-0325 & CNT-CVC-ISV-0323 at CNV nozzle CNV7 to NPM disconnect flange	3	High	No	N/A
RCS discharge (letdown) line from valves CNT-CVC-ISV-0334 & CNT-CVC-ISV-0336 at CNV nozzle CNV13 to NPM disconnect flange	3	High	No	N/A
RCS reactor high point degasification line from valves CNT-CVC-ISV-0401 & CNT-CVC-ISV-0403 at CNV nozzle CNV14 to NPM disconnect flange	3	High	No	N/A
CNT containment evacuation line from valves CNT-CE-ISV-0101 & CNT-CE-ISV-0102 at CNV nozzle CNV10 to NPM disconnect flange	3	No	No	N/A
CNT flood and drain line from valves CNT-CFD-ISV-0130 & CNT-CFD-ISV-0129 at CNV nozzle CNV11 to NPM disconnect flange	3	No	No	N/A
CRDM cooling water supply line from valves CNT-RCCW-ISV-0185 & CNT-RCCW-ISV-0184 at CNV nozzle CNV12 to NPM disconnect flange	3	No	No	N/A
CRDM cooling water return line from valves CNT-RCCW-ISV-0190 & CNT-RCCW-ISV-0191 at CNV nozzle CNV05 to NPM disconnect flange	3	No	No	N/A
SG #1 feedwater line from valves CNT-FW-ISV-1003 & CNT-FW-CKV-1002 at CNV nozzle CNV1 to NPM disconnect flange	2	High	No	N/A
SG #2 feedwater line from valves CNT-FW-ISV-2003 & CNT-FW-CKV-2002 at CNV nozzle CNV2 to NPM disconnect flange	2	High	No	N/A
SG #1 steam line from CNV nozzle CNV3 to NPM disconnect flange including valves CNT-MS-ISV-1005 & CNT-MS-ISV-1006	2	High	No	4
SG #2 steam line from CNV nozzle CNV4 to NPM disconnect flange including valves CNT-MS-ISV-2005 & CNT-MS-ISV-2006	2	High	No	4
DHRS #1 line from SG #1 steam line to DHRS Passive Condenser A	2	High	No	N/A
DHRS #1 condensate line from DHRS Passive Condenser A to CNV nozzle CNV22	2	High	No	N/A
DHRS #2 line from SG #1 steam line to DHRS Passive Condenser B	2	High	No	N/A
DHRS #2 condensate line from DHRS Passive Condenser B to CNV nozzle CNV23	2	High	No	N/A
Inside CNV				
RCS injection (charging) line from RPV nozzle RPV11 to CNV nozzle CNV6	1	High	No	N/A
RCS pressurizer spray line from RPV nozzles RPV14 and RPV15 to CNV nozzle CNV7	1	High	No	N/A
RCS discharge (letdown) line from RPV nozzle RPV12 to CNV nozzle CNV13	1	High	No	N/A

Table 2.1-1: NuScale Power Module Piping Systems (Continued)

Piping System Description	ASME Code Section III Class	High/ Moderate Energy	Evaluated for LBB	Length of Containment Piping (ft)
RCS reactor high point degasification line from RPV nozzle RPV20 to CNV nozzle CNV14	1	High	No	N/A
CNTS flood and drain line from CNV nozzle CNV11 to open pipe end at bottom of CNV	2	No	No	N/A
CNTS control rod drive mechanism cooling water supply line from CNV nozzle CNV12 to CRDM heat exchangers	2	No	No	N/A
CNTS control rod drive mechanism cooling water return line from CRDM heat exchangers to CNV nozzle CNV5	2	No	No	N/A
CNTS steam generator #1 feedwater line from RPV nozzles RPV3 and RPV5 to CNV nozzle CNV1	2	High	Yes	N/A
CNTS steam generator #2 feedwater line from RPV nozzles RPV4 and RPV6 to CNV nozzle CNV2	2	High	Yes	N/A
CNTS steam generator #1 steam line from RPV nozzles RPV8 and RPV10 to CNV nozzle CNV3	2	High	Yes	N/A
CNTS steam generator #2 steam line from RPV nozzles RPV7 and RPV9 to CNV nozzle CNV4	2	High	Yes	N/A
DHRS #1 condensate line from CNV nozzle CNV22 to SG #1 feedwater line	2	High	No	N/A
DHRS #2 condensate line from CNV nozzle CNV23 to SG #2 feedwater line	2	High	No	N/A

Table 2.1-2: NuScale Power Module Mechanical Equipment

Equipment Name	Equipment Identifier	ASME Code Section III Class	Valve Actuator Type	Containment Isolation Valve
RCS integral RPV/SG/Pressurizer	RPV-VSL-0001	1	N/A	N/A
RVI upper core plate	N/A	CS	N/A	N/A
RVI core barrel	N/A	CS	N/A	N/A
RVI reflector blocks	N/A	CS	N/A	N/A
RVI lower core plate	N/A	CS	N/A	N/A
RVI core support blocks	N/A	CS	N/A	N/A
CNTS containment vessel	CNV-VSL-0001	1	N/A	N/A
RCS reactor safety valve	RCS-PSV-0003A	1	N/A	No
RCS reactor safety valve	RCS-PSV-0003B	1	N/A	No
RCS pressurizer spray check valve	RCS-CKV-0323	1	N/A	No
RCS injection check valve	RCS-CKV-0332	1	N/A	No
RCS discharge excess flow check valve	RCS-CKV-0333	1	N/A	No
RCS high point degasification excess flow check valve	RCS-CKV-0400	1	N/A	No
ECCS reactor vent valve	ECC-HOV-0101A	1	Hydraulic	No
ECCS reactor vent valve trip valve	ECC-SV-0102A	1	Solenoid	Yes
ECCS reactor vent valve reset valve	ECC-SV-0103A	1	Solenoid	Yes
ECCS reactor vent valve	ECC-HOV-0101B	1	Hydraulic	No
ECCS reactor vent valve trip valve	ECC-SV-0102B	1	Solenoid	Yes
ECCS reactor vent valve reset valve	ECC-SV-0103B	1	Solenoid	Yes
ECCS reactor vent valve	ECC-HOV-0101C	1	Hydraulic	No
ECCS reactor vent valve trip valve	ECC-SV-0102C	1	Solenoid	Yes
ECCS reactor vent valve reset valve	ECC-SV-0103C	1	Solenoid	Yes
ECCS reactor recirculation valve	ECC-HOV-0104A	1	Hydraulic	No
ECCS reactor recirculation valve trip valve	ECC-SV-0105A	1	Solenoid	Yes
ECCS reactor recirculation valve reset valve	ECC-SV-0106A	1	Solenoid	Yes
ECCS reactor recirculation valve	ECC-HOV-0104B	1	Hydraulic	No
ECCS reactor recirculation valve trip valve	ECC-SV-0105B	1	Solenoid	Yes
ECCS reactor recirculation valve reset valve	ECC-SV-0106B	1	Solenoid	Yes
ECCS reactor recirculation valve trip valve	ECC-SV-0107	1	Solenoid	Yes
CNTS reactor coolant system injection inboard CIV	CNT-CVC-ISV-0331	1	Electro-hydraulic	Yes
CNTS reactor coolant system injection outboard CIV	CNT-CVC-ISV-0329	1	Electro-hydraulic	Yes
CNTS pressurizer spray inboard CIV	CNT-CVC-ISV-0325	1	Electro-hydraulic	Yes
CNTS pressurizer spray outboard CIV	CNT-CVC-ISV-0323	1	Electro-hydraulic	Yes
CNTS reactor coolant system discharge inboard CIV	CNT-CVC-ISV-0334	1	Electro-hydraulic	Yes
CNTS reactor coolant system discharge outboard CIV	CNT-CVC-ISV-0336	1	Electro-hydraulic	Yes
CNTS reactor pressure vessel high point degasification inboard CIV	CNT-CVC-ISV-0401	1	Electro-hydraulic	Yes
CNTS reactor pressure vessel high point degasification outboard CIV	CNT-CVC-ISV-0403	1	Electro-hydraulic	Yes

Table 2.1-2: NuScale Power Module Mechanical Equipment (Continued)

Equipment Name	Equipment Identifier	ASME Code Section III Class	Valve Actuator Type	Containment Isolation Valve
CNTS containment evacuation inboard CIV	CNT-CE-ISV-0101	1	Electro-hydraulic	Yes
CNTS containment evacuation outboard CIV	CNT-CE-ISV-0102	1	Electro-hydraulic	Yes
CNTS flood and drain inboard CIV	CNT-CFD-ISV-0130	1	Electro-hydraulic	Yes
CNTS flood and drain outboard CIV	CNT-CFD-ISV-0129	1	Electro-hydraulic	Yes
CNTS reactor component cooling water system supply inboard CIV	CNT-RCCW-ISV-0185	1	Electro-hydraulic	Yes
CNTS reactor component cooling water system supply outboard CIV	CNT-RCCW-ISV-0184	1	Electro-hydraulic	Yes
CNTS reactor component cooling water system return inboard CIV	CNT-RCCW-ISV-0190	1	Electro-hydraulic	Yes
CNTS reactor component cooling water system return outboard CIV	CNT-RCCW-ISV-0191	1	Electro-hydraulic	Yes
CNTS control rod drive system pressure relief valve	CRD-RCCW-PSV-0221	2	N/A	Yes
CNTS feedwater #1 CIV	CNT-FW-ISV-1003	2	Electro-hydraulic	Yes
CNTS feedwater line #1 check valve	CNT-FW-CKV-1002	2	N/A	No
CNTS steam generator #1 relief valve	SG-PSV-1002	2	N/A	No
CNTS feedwater #2 CIV	CNT-FW-ISV-2003	2	Electro-hydraulic	Yes
CNTS feedwater line #2 check valve	CNT-FW-CKV-2002	2	N/A	No
CNTS steam generator #2 relief valve	SG-PSV-2002	2	N/A	No
CNTS main steam #1 CIV	CNT-MS-ISV-1005	2	Electro-hydraulic	Yes
CNTS main steam line #1 bypass valve	CNT-MS-ISV-1006	2	Electro-hydraulic	Yes
CNTS main steam #2 CIV	CNT-MS-ISV-2005	2	Electro-hydraulic	Yes
CNTS main steam line #2 bypass valve	CNT-MS-ISV-2006	2	Electro-hydraulic	Yes
DHRS actuation valve	DHR-HOV-1002A	2	Electro-hydraulic	No
DHRS actuation valve	DHR-HOV-1002B	2	Electro-hydraulic	No
DHRS actuation valve	DHR-HOV-2002A	2	Electro-hydraulic	No
DHRS actuation valve	DHR-HOV-2002B	2	Electro-hydraulic	No
DHRS passive condenser	DHR-HX-1005	2	N/A	N/A
DHRS passive condenser	DHR-HX-2005	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-001	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-002	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-003	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-004	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-005	2	N/A	N/A

Table 2.1-2: NuScale Power Module Mechanical Equipment (Continued)

Equipment Name	Equipment Identifier	ASME Code Section III Class	Valve Actuator Type	Containment Isolation Valve
CRDM heat exchanger	CRDS-CRD-006	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-007	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-008	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-009	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-010	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-011	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-012	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-013	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-014	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-015	2	N/A	N/A
CRDM heat exchanger	CRDS-CRD-016	2	N/A	N/A
CRDM cooling water supply flex hose	CRDS-FHS-0101 thru CRDS-FHS-0116	2	N/A	N/A
CRDM cooling water return flex hose	CRDS-FHS-0201 thru CRDS-FHS-0216	2	N/A	N/A
CNTS instrumentation and controls division I electrical penetration	CNV8	1	N/A	N/A
CNTS instrumentation and controls division II electrical penetration	CNV9	1	N/A	N/A
CNTS pressurizer heater power #1 electrical penetration	CNV15	1	N/A	N/A
CNTS pressurizer heater power #2 electrical penetration	CNV16	1	N/A	N/A
CNTS instrumentation and controls channel A electrical penetration	CNV17	1	N/A	N/A
CNTS instrumentation and controls channel B electrical penetration	CNV18	1	N/A	N/A
CNTS instrumentation and controls channel C electrical penetration	CNV19	1	N/A	N/A
CNTS instrumentation and controls channel D electrical penetration	CNV20	1	N/A	N/A
CNTS control rod drive system electrical penetration	CNV37	1	N/A	N/A
CNTS rod position indication group #1 electrical penetration	CNV38	1	N/A	N/A
CNTS rod position indication group #2 electrical penetration	CNV39	1	N/A	N/A
RCS instrumentation and controls channel A electrical penetration	RPV39	1	N/A	N/A
RCS instrumentation and controls channel B electrical penetration	RPV40	1	N/A	N/A
RCS instrumentation and controls channel C electrical penetration	RPV41	1	N/A	N/A
RCS instrumentation and controls channel D electrical penetration	RPV42	1	N/A	N/A

Table 2.1-3: NuScale Power Module Electrical Equipment

Equipment Name	Equipment Identifier	Remotely Operated	Loss of Motive Power Position	CIV Closure Time (sec)
ECCS reactor vent valve trip valve	ECC-SV-0102A	Yes	Open	N/A
ECCS reactor vent valve reset valve	ECC-SV-0103A	Yes	Close	N/A
ECCS reactor vent valve trip valve	ECC-SV-0102B	Yes	Open	N/A
ECCS reactor vent valve reset valve	ECC-SV-0103B	Yes	Close	N/A
ECCS reactor vent valve trip valve	ECC-SV-0102C	Yes	Open	N/A
ECCS reactor vent valve reset valve	ECC-SV-0103C	Yes	Close	N/A
ECCS reactor recirculation valve trip valve	ECC-SV-0105A	Yes	Open	N/A
ECCSreactor recirculation valve reset valve	ECC-SV-0106A	Yes	Close	N/A
ECCS reactor recirculation valve trip valve	ECC-SV-0105B	Yes	Open	N/A
ECCS reactor recirculation valve reset valve	ECC-SV-0106B	Yes	Close	N/A
ECCS reactor recirculation valve trip valve	ECC-SV-0107	Yes	Open	N/A
CNTS reactor coolant system injection inboard CIV	CNT-CVC-ISV-0331	Yes	Closed	< 5
CNTS reactor coolant system injection outboard CIV	CNT-CVC-ISV-0329	Yes	Closed	< 5
CNTS pressurizer spray inboard CIV	CNT-CVC-ISV-0325	Yes	Closed	< 5
CNTS pressurizer spray outboard CIV	CNT-CVC-ISV-0323	Yes	Closed	< 5
CNTS reactor coolant system discharge inboard CIV	CNT-CVC-ISV-0334	Yes	Closed	< 5
CNTS reactor coolant system discharge outboard CIV	CNT-CVC-ISV-0336	Yes	Closed	< 5
CNTS reactor pressure vessel high point degasification inboard CIV	CNT-CVC-ISV-0401	Yes	Closed	< 5
CNTS reactor pressure vessel high point degasification outboard CIV	CNT-CVC-ISV-0403	Yes	Closed	< 5
CNTS containment evacuation inboard CIV	CNT-CE-ISV-0101	Yes	Closed	< 5
CNTS containment evacuation outboard CIV	CNT-CE-ISV-0102	Yes	Closed	< 5
CNTS flood and drain inboard CIV	CNT-CFD-ISV-0130	Yes	Closed	< 5
CNTS flood and drain outboard CIV	CNT-CFD-ISV-0129	Yes	Closed	< 5
CNTS reactor component cooling water system supply inboard CIV	CNT-RCCW-ISV-0185	Yes	Closed	< 5
CNTS reactor component cooling water system supply outboard CIV	CNT-RCCW-ISV-0184	Yes	Closed	< 5
CNTS reactor component cooling water system return inboard CIV	CNT-RCCW-ISV-0190	Yes	Closed	< 5
CNTS reactor component cooling water system return outboard CIV	CNT-RCCW-ISV-0191	Yes	Closed	< 5
CNTS feedwater #1 CIV	CNT-FW-ISV-1003	Yes	Closed	< 5
CNTS feedwater #2 CIV	CNT-FW-ISV-2003	Yes	Closed	< 5
CNTS main steam #1 CIV	CNT-MS-ISV-1005	Yes	Closed	< 5
CNTS main steam line #1 bypass valve	CNT-MS-ISV-1006	Yes	Closed	< 10
CNTS main steam #2 CIV	CNT-MS-ISV-2005	Yes	Closed	< 5
CNTS main steam line #2 bypass valve	CNT-MS-ISV-2006	Yes	Closed	< 10
DHRS actuation valve	DHR-HOV-1002A	Yes	Open	N/A
DHRS actuation valve	DHR-HOV-1002B	Yes	Open	N/A
DHRS actuation valve	DHR-HOV-2002A	Yes	Open	N/A
DHRS actuation valve	DHR-HOV-2002B	Yes	Open	N/A
CNTS instrumentation and controls division I electrical penetration	CNV8	N/A	N/A	N/A

Table 2.1-3: NuScale Power Module Electrical Equipment (Continued)

Equipment Name	Equipment Identifier	Remotely Operated	Loss of Motive Power Position	CIV Closure Time (sec)
CNTS instrumentation and controls division II electrical penetration	CNV9	N/A	N/A	N/A
CNTS pressurizer heater power #1electrical penetration	CNV15	N/A	N/A	N/A
CNTS pressurizer heater power #2 electrical penetration	CNV16	N/A	N/A	N/A
CNTS instrumentation and controls channel A electrical penetration	CNV17	N/A	N/A	N/A
CNTS instrumentation and controls channel B electrical penetration	CNV18	N/A	N/A	N/A
CNTS instrumentation and controls channel C electrical penetration	CNV19	N/A	N/A	N/A
CNTS instrumentation and controls channel D electrical penetration	CNV20	N/A	N/A	N/A
CNTS control rod drive system electrical penetration	CNV37	N/A	N/A	N/A
CNTS rod position indication group #1 electrical penetration	CNV38	N/A	N/A	N/A
CNTS rod position indication group #2 electrical penetration	CNV39	N/A	N/A	N/A
RCS instrumentation and controls channel A electrical penetration	RPV39	N/A	N/A	N/A
RCS instrumentation and controls channel B electrical penetration	RPV40	N/A	N/A	N/A
RCS instrumentation and controls channel C electrical penetration	RPV41	N/A	N/A	N/A
RCS instrumentation and controls channel D electrical penetration	RPV42	N/A	N/A	N/A

Table 2.1-4: NuScale Power Module Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	The NuScale Power Module ASME Code Class 1, 2 and 3 piping systems listed in Table 2.1-1 comply with ASME Code Section III requirements.	An inspection will be performed of the NuScale Power Module ASME Code Class 1, 2 and 3 as-built piping system Design Reports required by ASME Code Section III.	ASME Code Section III Design Reports for the NuScale Power Module ASME Code Class 1, 2 and 3 as-built piping systems listed in Table 2.1-1 meet the requirements of ASME Code Section III, NCA-3550.
2.	The NuScale Power Module ASME Code Class 1 and 2 components conform to the rules of construction of ASME Code Section III.	An inspection will be performed of the NuScale Power Module ASME Code Class 1 and 2 as-built component Data Reports required by ASME Code Section III.	ASME Code Section III Data Reports for the NuScale Power Module ASME Code Class 1 and 2 components listed in Table 2.1-2 and interconnecting piping exist and conclude that the requirements of ASME Code Section III are met.
3.	The NuScale Power Module ASME Code Class CS components conform to the rules of construction of ASME Code Section III.	An inspection will be performed of the NuScale Power Module ASME Code Class CS as-built component Data Reports required by ASME Code Section III.	ASME Code Section III Data Reports for the NuScale Power Module ASME Code Class CS components listed in Table 2.1-2 exist and conclude that the requirements of ASME Code Section III are met.
4.	Safety-related SSC are protected against the dynamic and environmental effects associated with postulated failures in high- and moderate-energy piping systems.	An inspection will be performed of the as-built high- and moderate-energy piping systems and protective features for the safety-related SSC.	Protective features are installed in accordance with the as-built Pipe Break Hazard Analysis Report and safety-related SSC are protected against or qualified to withstand the dynamic and environmental effects associated with postulated failures in high- and moderate-energy piping systems.
5.	The NuScale Power Module ASME Code Class 2 piping systems and interconnected equipment nozzles are evaluated for LBB.	An analysis will be performed of the ASME Code Class 2 as-built piping systems and interconnected equipment nozzles.	The as-built LBB analysis for the ASME Code Class 2 piping systems listed in Table 2.1-1 and interconnected equipment nozzles is bounded by the as-designed LBB analysis.
6.	The RPV beltline material has a Charpy upper-shelf energy of greater than 75 ft-lb.	A vendor test will be performed of the Charpy V-Notch specimen of the RPV beltline material.	An ASME Code Certified Material Test Report exists and concludes that the initial RPV beltline material Charpy upper-shelf energy is greater than 75 ft-lb.
7.	The CNV serves as an essentially leak-tight barrier against the uncontrolled release of radioactivity to the environment.	A leakage test will be performed of the pressure containing or leakage-limiting boundaries, and CIVs.	The leakage rate for local leak rate tests (Type B and Type C) for pressure containing or leakage-limiting boundaries and CIVs meets the requirements of 10 CFR Part 50, Appendix J.
8.	Containment isolation valve closure times limit potential releases of radioactivity.	A test will be performed of the automatic CIVs.	Each CIV listed in Table 2.1-3 travels from the full open to full closed position in less than or equal to the time listed in Table 2.1-3 after receipt of a containment isolation signal.

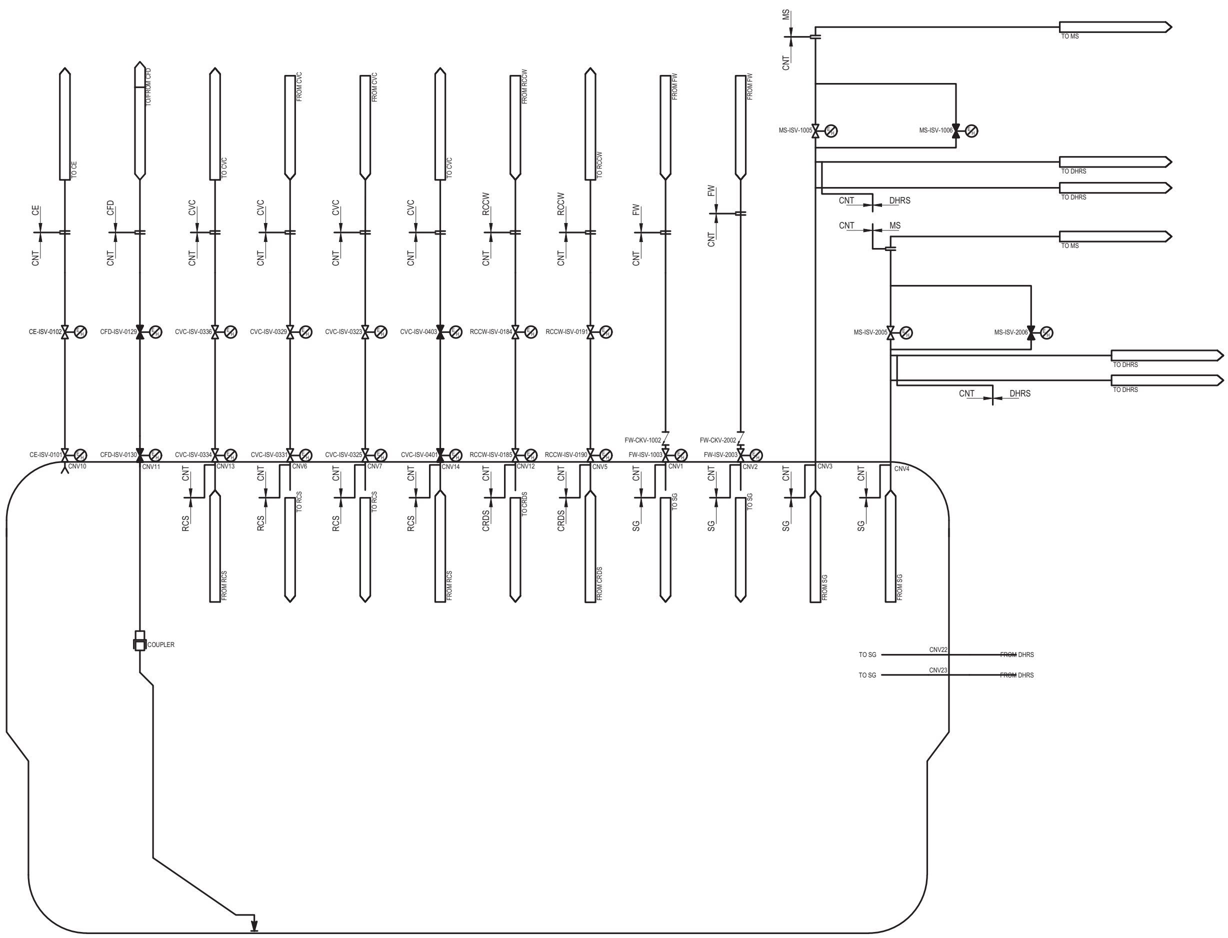
Table 2.1-4: NuScale Power Module Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9.	The length of piping shall be minimized between the containment penetration and the associated outboard CIVs.	An inspection will be performed of the as-built piping between containment penetrations and associated outboard CIVs.	The length of piping between each containment penetration and its associated outboard CIV is less than or equal to the length identified in Table 2.1-1.
10.	The NPM Class 1E containment electrical penetration assemblies are sized to power their design loads.	i. An analysis will be performed of the NPM as-designed Class 1E containment electrical penetration assemblies. ii. An inspection will be performed of NPM Class 1E as-built containment electrical penetration assembly.	i. An electrical rating report exists that defines and identifies the required design electrical rating to power the design loads of each NPM Class 1E containment electrical penetration assembly listed in Table 2.1-3. ii. The electrical rating of each NPM Class 1E containment electrical penetration assembly listed in Table 2.1-3 is greater than or equal to the required design electrical rating as specified in the electrical rating report.
11.	Physical separation exists between the redundant divisions of the MPS Class 1E instrumentation and control current-carrying circuits, and between Class 1E instrumentation and control current-carrying circuits and non-Class 1E instrumentation and current-carrying circuits. The scope of this commitment includes the cables from the NPM disconnect box to the instrument.	An inspection will be performed of the MPS Class 1E as-built instrumentation and control current-carrying circuits.	i. Physical separation between redundant divisions of MPS Class 1E instrumentation and control current-carrying circuits is provided by a minimum separation distance, or by barriers (where the minimum separation distances cannot be maintained), or by a combination of separation distance and barriers. ii. Physical separation between MPS Class 1E instrumentation and control current-carrying circuits and non-Class 1E instrumentation and control current-carrying circuits is provided by a minimum separation distance, or by barriers (where the minimum separation distances cannot be maintained), or by a combination of separation distance and barriers.
12.	The RPV is provided with surveillance capsule holders to hold a capsule containing RPV material surveillance specimens.	An inspection will be performed of the as-built RPV surveillance capsule holders.	Four surveillance capsule holders are installed in the RPV beltline region at approximately 90 degree intervals.
13.	The CNTS safety-related valves change position under design differential pressure.	A test will be performed of the CNTS safety-related valves.	Each CNTS safety-related valve listed in Table 2.1-2 strokes fully open and fully closed by remote operation.
14.	The ECCS safety-related valves change position under design differential pressure.	A test will be performed of the ECCS safety-related valves.	Each ECCS safety-related valve listed in Table 2.1-2 strokes fully open and fully closed by remote operation.
15.	The DHRS safety-related valves change position under design differential pressure.	A test will be performed of the DHRS safety-related valves.	Each DHRS safety-related valve listed in Table 2.1-2 strokes fully open and fully closed by remote operation.

Table 2.1-4: NuScale Power Module Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
16.	The RCS safety-related check valves change position under design differential pressure and flow.	A test will be performed of the RCS safety-related check valves.	Each RCS safety-related check valve listed in Table 2.1-2 strokes fully open and closed under forward and reverse flow conditions, respectively.
17.	The RCS safety-related excess flow check valves change position under excess flow conditions.	A test will be performed of the RCS safety-related excess flow check valves.	Each RCS safety-related excess flow check valve listed in Table 2.1-2 strokes fully closed under excess flow conditions.
18.	The CNTS safety-related hydraulic-operated valves fail to their safety-related position on loss of electrical power under design differential pressure.	A test will be performed of the CNTS safety-related hydraulic-operated valves.	Each CNTS safety-related hydraulic-operated valve listed in Table 2.1-2 fails to its safety-related position on loss of motive power.
19.	The ECCS safety-related RRVs and RVVs fail to their safety-related position on loss of electrical power to their corresponding trip valves under design differential pressure.	A test will be performed of the ECCS safety-related RRVs and RVVs.	Each ECCS safety-related RRV and RVV listed in Table 2.1-2 fails open on loss of electrical power to its corresponding trip valve.
20.	The DHRS safety-related hydraulic-operated valves fail to their safety-related position on loss of electrical power under design differential pressure.	A test will be performed of the DHRS safety-related hydraulic-operated valves.	Each DHRS safety-related hydraulic-operated valve listed in Table 2.1-2 fails open on loss of motive power.
21.	The CNTS safety-related check valves change position under design differential pressure and flow.	A test will be performed of the CNTS safety-related check valves.	Each CNTS safety-related check valve listed in Table 2.1-2 strokes fully open and closed under forward and reverse flow conditions, respectively.
22.	The CNTS Class 1E containment electrical penetration assemblies are rated to withstand fault currents for the time required to clear the fault from its power source.	An analysis will be performed of the CNTS as-built Class 1E containment electrical penetration assemblies.	A circuit interrupting device coordination analysis exists and concludes that the current carrying capability for the CNTS Class 1E containment electrical penetration assemblies listed in Table 2.1-3 greater than the analyzed fault currents for the time required to clear the fault from its power source.

Figure 2.1-1: Containment System (Isolation Valves)



2.2 Chemical and Volume Control System

2.2.1 Design Description

System Description

The scope of this section is the chemical and volume control system (CVCS). The system purifies reactor coolant, manages reactor coolant chemistry, provides reactor coolant inventory injection and discharge, and supplies spray flow to the pressurizer to reduce the reactor coolant system pressure. The CVCS is nonsafety-related. Each NuScale Power Module (NPM) has its own module-specific CVCS. The Reactor Building houses all CVCS equipment.

The CVCS performs the following safety-related system functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The CVCS supports the RCS by isolating dilution sources.

Design Commitments

- The chemical and volume control system American Society of Mechanical Engineers (ASME) Code Class 3 piping complies with the ASME Code Section III.
- The chemical and volume control system ASME Code Class 3 components conform to the rules of construction of ASME Code Section III.
- The chemical and volume control system ASME Code Class 3 air-operated valves change position under design differential pressure.
- The chemical and volume control system ASME Code Class 3 check valves change position under design differential pressure and flow.
- The chemical and volume control system ASME Code Class 3 air-operated valves fail to or maintain their safety-related position on loss of motive power under design differential pressure.

2.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.2-3 contains the inspections, tests, and analyses for the CVCS.

Table 2.2-1: Chemical and Volume Control System Piping

Piping System Description	ASME Code Section III Class
Demineralized water supply line between valves CVC-AOV-0101 and CVC-AOV-0119	3
Reactor pressure vessel (RPV) discharge line between containment isolation valve, CNT-ISV-0336, and isolation valve, CVC-AOV-0339, including NPM removable spool piece	3
RPV high point degasification line between containment isolation valve, CNT-ISV-0403, and isolation valve, CVC-AOV-0406, including NPM removable spool piece	3
Pressurizer spray line between containment isolation valve, CNT-ISV-0323, and check valve, CVC-CKV-0352, including NPM removable spool piece	3
RPV injection line between containment isolation valve, CNT-ISV-0329, and check valve, CVC-CKV-0353, including NPM removable spool piece	3

Table 2.2-2: Chemical and Volume Control System Mechanical Equipment

Equipment Name	Equipment Identifier	ASME Code Section III Class	Loss of Motive Power Position
Demineralized water system supply isolation valve	CVC-AOV-0101	3	Closed
Demineralized water system supply isolation valve	CVC-AOV-0119	3	Closed
RPV discharge isolation valve	CVC-AOV-0339	3	Closed
RPV high point degasification isolation valve	CVC-AOV-0406	3	Closed
Injection check valve	CVC-CKV-0352	3	N/A
Pressurizer spray check valve	CVC-CKV-0353	3	N/A

Table 2.2-3: Chemical and Volume Control System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	The chemical and volume control system ASME Code Class 3 piping system complies with the ASME Code Section III.	An inspection will be performed of the chemical and volume control system ASME Code Class 3 as-built piping system Design Report required by ASME Code Section III.	The ASME Code Section III Design Report (NCA-3550) exists and concludes that the chemical and volume control system ASME Code Class 3 as-built piping system meets the requirements of ASME Code Section III.
2	The chemical and volume control system ASME Code Class 3 components conform to the rules of construction of ASME Code Section III	An inspection will be performed of the chemical and volume control system ASME Code Class 3 as-built component Data Reports required by ASME Code Section III.	ASME Code Section III Data Reports for the chemical and volume control system ASME Code Class 3 components listed in Table 2.2-2 and interconnecting piping exist and conclude that the requirements of ASME Code Section III are met.
3	The chemical and volume control system ASME Code Class 3 air-operated valves change position under design-basis temperature, differential pressure, and flow conditions.	A test will be performed of the chemical and volume control system ASME Code Class 3 air-operated valves under preoperational temperature, differential pressure, and flow conditions.	Each chemical and volume control system ASME Code Class 3 air-operated valves listed in Table 2.2-2 strokes fully open and fully closed by remote operation under preoperational temperature, differential pressure, and flow conditions.
4	The chemical and volume control system ASME Code Class 3 check valves will close under design basis temperature, differential pressure and flow conditions.	A test will be performed of the chemical and volume control system ASME Code Class 3 check valves under preoperational temperature, differential pressure and flow conditions.	Each chemical and volume control system ASME Code Class 3 check valve listed in Table 2.2-2 strokes fully closed (under reverse flow conditions) under preoperational temperature, differential pressure, and flow conditions.
5	The chemical and volume control system ASME Code Class 3 air-operated valves perform their function to fail (or maintain) their position on loss of motive power under design-basis temperature, differential pressure, and flow conditions.	A test will be performed of the chemical and volume control system ASME Code Class 3 air-operated valves under preoperational temperature, differential pressure and flow conditions.	Each chemical and volume control system ASME Code Class 3 air-operated valve listed in Table 2.2-2 performs fails closed on loss of motive power under preoperational temperature, differential pressure, and flow conditions.

2.3 Containment Evacuation System

2.3.1 Design Description

System Description

The scope of this section is the containment evacuation system (CES). Water vapor and non-condensable gases are removed from the containment vessel by the CES. The water vapor is collected and condensed into the CES sample vessel where it is monitored using level and temperature instrumentation. The CES pressure instrumentation and sample vessel level instrumentation is used to quantify and trend leak rates in the containment. The CES is a non-safety related system. Each NuScale Power Module (NPM) has its own module-specific CES. The Reactor Building houses all CES equipment.

The CES performs the following non-safety related system functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The CES supports the reactor coolant system (RCS) by providing RCS leak detection monitoring capability.

Design Commitments

- The CES level instrumentation supports RCS leakage detection.
- The CES pressure instrumentation supports RCS leakage detection.

2.3.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.3-1 contains the inspections, tests, and analyses for the CES.

Table 2.3-1: Containment Evacuation System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	The CES level instrumentation supports RCS leakage detection.	A test will be performed of the CES.	The CES detects a level increase in the CES sample tank, which correlates to a detection of an unidentified RCS leakage rate of one gpm within one hour.
2.	The CES pressure instrumentation supports RCS leakage detection.	A test will be performed of the CES.	The CES detects a pressure increase in the CES inlet pressure instrumentation (PIT-1001/PIT1019), which correlates to a detection of an unidentified RCS leakage rate of one gpm within one hour.

2.4 Turbine Generator System

2.4.1 Design Description

System Description

The scope of this section is the turbine generator system (TGS). The TGS converts steam into electricity. The turbine is equipped with independent and diverse electronic overspeed protection. The steam flow to the turbine is controlled by a single stop valve. Multiple inlet control valves are used to throttle steam flow to the turbine during normal operation. The turbine stop valve and turbine control valves close in response to a turbine overspeed trip signal. The TGS is a nonsafety-related system. Each NuScale Power Module has its own module-specific TGS. The Turbine Generator Building(s) house all TGS equipment.

Design Commitments

- The trip signals from the turbine overspeed emergency trip system are independent of the governor overspeed detection circuit.
- The turbine stop valve and turbine control valves close in response to a turbine overspeed trip signal.

2.4.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.4-1 contains the inspections, tests, and analyses for the TGB.

Table 2.4-1: Turbine Generator System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	The trip signals from the turbine overspeed emergency trip system are independent of the governor overspeed detection circuit.	An inspection will be performed of the as-built turbine overspeed protection arrangement.	The turbine overspeed emergency trip system is supplied from different power sources and does not share common equipment with the governor overspeed detection circuit.
2	The turbine stop valve and turbine control valves close in response to a turbine overspeed trip signal.	A test will be performed of the turbine stop valve and turbine control valves.	The turbine stop valve and turbine control valves close on a turbine overspeed trip signal from both the turbine overspeed emergency trip system and the governor overspeed detection circuit.

2.5 Module Protection System and Safety Display and Indication System

2.5.1 Design Description

<u>System Description</u>

The scope of this section is the module protection system (MPS) and its associated components in the safety display and indication system (SDIS). The primary purpose of the MPS is to monitor process parameters and provide automatic initiating signals in response to out-of-normal conditions to provide protection against unsafe reactor operation during steady state and transient power operation. The MPS is a safety-related system. Each NuScale Power Module has its own independent MPS and SDIS. The Reactor Building and the Control Building house all MPS and SDIS equipment.

The MPS is comprised of the reactor trip system (RTS) and the engineered safety features actuation system (ESFAS). The RTS is responsible for monitoring key parameters and shutting down the reactor when specified limits are reached. The ESFAS is responsible for monitoring key parameters and actuating the engineered safety features (ESF) such as the emergency core cooling system (ECCS) and the decay heat removal system (DHRS) when specified limits are reached.

The MPS performs the following safety-related system functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The MPS supports the containment system (CNTS) by removing electrical power to the trip solenoids of the following containment isolation valves (CIVs) on a containment system isolation actuation signal:
  - reactor coolant system (RCS) injection CIVs
  - RCS discharge CIVs
  - pressurizer spray CIVs
  - reactor pressure vessel (RPV) high point degasification containment isolation valves
  - feedwater CIVs
  - main steam CIVs
  - main steam bypass valves
  - containment evacuation (CE) system CIVs
  - reactor component cooling water CIVs
  - containment flooding and drain system (CFDS) containment isolation valves
- The MPS supports the CNTS by removing electrical power to the trip solenoids of the following valves on a DHRS actuation signal:
  - DHRS actuation valves
  - main steam CIVs
  - main steam bypass valves

- feedwater CIVs

- The MPS supports the ECCS by removing electrical power to the trip solenoids of the following valves on an ECCS actuation signal:
  - reactor vent valves
  - reactor recirculation valves
- The MPS supports the CNTS by removing electrical power to the trip solenoids of the following CIVs on a chemical and volume control isolation actuation signal:
  - RCS injection CIVs
  - RCS discharge CIVs
  - Pressurizer spray CIVs
  - RPV high point degasification CIVs
- The MPS supports the chemical and volume control system (CVCS) by removing electrical power to the trip solenoids of the demineralized water system supply isolation valves on a demineralized water system isolation actuation signal.
- The MPS supports the ECCS by removing electrical power to the trip solenoids of the reactor vent valves on a low temperature overpressure protection actuation signal.
- The MPS supports the low voltage AC electrical distribution system (ELVS) by removing electrical power to the pressurizer heaters on a pressurizer heater trip actuation signal.
- The MPS supports the normal DC power system by removing electrical power to the control rod drive system for a reactor trip.
- The MPS supports the following systems by providing power to sensors for reactor trip and ESFAS actuation:
  - CNTS
  - RCS
  - DHRS (main steam system pressure sensors)

The MPS performs the following nonsafety-related system function that is verified by ITAAC.

- The MPS supports the following systems by providing power to sensors for post-accident monitoring (PAM) Type B and Type C variables:
  - CNTS
  - RCS

The primary purpose of the SDIS is to provide accurate, complete and timely information pertinent to MPS status and information displays. The SDIS provides display panels of MPS post-accident monitoring variables to support manually controlled protective actions if required.

The SDIS performs the following nonsafety-related system function that is verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The SDIS supports the main control room (MCR) by providing displays of PAM Type B and Type C variables.

<u>Design Commitments</u>

- The MPS design and software are implemented using a quality process composed of the following software lifecycle phases, with each phase having outputs that satisfy the requirements of that phase:
  - system functional specification phase
  - system design phase
  - system prototype development phase
  - equipment requirements specification phase
  - hardware planning phase
  - hardware requirements phase
  - hardware design phase.
  - software planning phase
  - software requirements phase
  - software design phase
  - software implementation phase
  - software configuration phase
  - system testing phase
  - system installation phase
- Protective measures are provided to restrict modifications to the MPS tunable parameters.
- Physical separation exists between the redundant separation groups and divisions of the MPS Class 1E instrumentation and control current-carrying circuits, and between Class 1E instrumentation and control current-carrying circuits and non-Class 1E instrumentation and control current-carrying circuits.
- Electrical isolation exists between the redundant separation groups and divisions of the MPS Class 1E instrumentation and control circuits, and between Class 1E instrumentation and control circuits and non-Class 1E instrumentation and control circuits to prevent the propagation of credible electrical faults.
- Electrical isolation exists between the highly reliable DC power system-module-specific (EDSS-MS) subsystem non-Class 1E circuits and connected MPS 1E circuits to prevent the propagation of credible electrical faults.
- Communications independence exists between redundant separation groups and divisions of the Class 1E MPS.

- Communications independence exists between the Class 1E MPS and non-Class 1E digital systems.
- The MPS automatically initiates a reactor trip signal.
- The MPS automatically initiates an ESF actuation signal.
- The MPS automatically actuates a reactor trip.
- The MPS automatically actuates the ESF equipment.
- The MPS manually actuates a reactor trip.
- The MPS manually actuates the ESF equipment.
- The reactor trip logic fails to a safe state such that loss of electrical power to an MPS separation group or division results in a trip state for that separation group or division.
- The ESFs logic fails to a safe state such that loss of electrical power to an MPS separation group or division results in a predefined safe state for that separation group or division.
- An MPS signal, once initiated automatically or manually, results in an intended sequence of protective actions that continue until completion, and requires deliberate operator action in order to return the safety systems to normal.
- The MPS response times from sensor output through equipment actuation for the reactor trip functions and engineered safety feature functions are less than or equal to the value required to satisfy the design basis safety analysis response time assumptions.
- The MPS interlocks function as required when associated conditions are met.
- The MPS permissives function as required when associated conditions are met.
- The MPS overrides function as required when associated conditions are met.
- The MPS is capable of performing its safety-related functions when one of its separation channels is placed in maintenance bypass.
- The MPS operational bypasses are indicated in the MCR.
- The MPS maintenance bypasses are indicated in the MCR.
- The MPS self-test features detect faults in the system and provide an alarm in the MCR.
- The PAM Type B and Type C displays are indicated on the SDIS displays in the MCR.
- The controls located on the operator workstations in the MCR operate to perform important human actions (IHAs).
- The reactor trip breakers (RTBs) are installed and arranged in order to successfully accomplish the reactor trip function under design conditions.
- Two of the four separation groups and one of the two divisions of RTS and ESFAS will utilize a different programmable technology.
- The MCR isolation switches that isolate the manual MCR switches from MPS in case of a fire in the MCR are located in the remote shutdown station (RSS).

2.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.5-7 contains the inspections, tests, and analyses for the MPS and SDIS.

Table 2.5-1: Module Protection System Automatic Reactor Trip Functions

Parameter	Input Variable	Interlock/Permissive
High source range count rate	Source range count rate	N-1
High source range log power rate	Source range log power	N-1
High intermediate range log power rate	Intermediate range log power	N-2L
High-1 power range linear power	Power range linear power	N-2L
High-2 power range linear power	Power range linear power	None
High power range positive rate	Power range rate (calculated from power range power)	N-2H
High power range negative rate	Power range rate (calculated from power range power)	N-2H
High narrow range containment pressure	Narrow range containment pressure	None
High narrow range RCS hot temperature	Narrow range RCS hot temperature (NR RCS T_{hot})	L-1
High pressurizer level	Pressurizer level	None
High pressurizer pressure	Pressurizer pressure	None
High main steam pressure Steam Generator (SG) 1	Main steam pressure (DHRS inlet pressure)	None
High main steam pressure SG 2	Main steam pressure (DHRS inlet pressure)	None
High steam superheat SG 1	Main steam pressure (DHRS inlet pressure) Main steam temperature (DHRS inlet temperature)	None
High steam superheat SG 2	Main steam pressure (DHRS inlet pressure) Main steam temperature (DHRS inlet temperature)	None
Low AC Voltage to battery chargers	ELVS voltage	None
Low low RCS flow	RCS flow	None
Low pressurizer level	Pressurizer level	None
Low pressurizer pressure	Pressurizer pressure	T-4
Low low pressurizer pressure	Pressurizer pressure	None
Low main steam pressure SG 1	Main steam pressure (DHRS inlet pressure)	N-2H
Low main steam pressure SG 2	Main steam pressure (DHRS inlet pressure)	N-2H
Low low main steam pressure SG 1	Main steam pressure (DHRS inlet pressure)	None
Low low main steam pressure SG 2	Main steam pressure (DHRS inlet pressure)	None
Low steam superheat SG 1	Main steam pressure (DHRS inlet pressure) Main steam temperature (DHRS inlet temperature)	None
Low steam superheat SG 2	Main steam pressure (DHRS inlet pressure) Main steam temperature (DHRS inlet temperature)	None
High under-the-bioshield temperature	Under-the-bioshield temperature	None

Table 2.5-2: Module Protection System Automatic Engineered Safety Feature Functions

Engineered Safety Feature Function	Protective	Input Variable	Interlock/Permissive
ESFAS - ECCS actuation	High containment water level	Containment water level	T-3
	Low RPV riser level	RPV riser level	None
	Low ELVS voltage 24-hour timer	ELVS voltage	None
ESFAS - DHRS actuation	High narrow range containment pressure	Narrow range containment pressure	T-3 L-1
	High narrow range RCS hot temperature	Narrow range RCS hot temperature (NR RCS T_{hot})	L-1
	High pressurizer pressure	Pressurizer pressure	L-1
	High main steam pressure SG 1	Main steam pressure (DHRS inlet pressure)	L-1
	High main steam pressure SG 2	Main steam pressure (DHRS inlet pressure)	L-1
	High steam superheat SG 1	Main steam pressure (DHRS inlet pressure) Main steam temperature (DHRS inlet temperature)	L-1
	High steam superheat SG 2	Main steam pressure (DHRS inlet pressure) Main steam temperature (DHRS inlet temperature)	L-1
	Low AC Voltage to battery chargers	ELVS voltage	None
	Low low pressurizer level	Pressurizer level	T-2 L-1
	Low pressurizer pressure	Pressurizer pressure	T-4 L-1
	Low low pressurizer pressure	Pressurizer pressure	T-3 L-1
	Low main steam pressure SG 1	Main steam pressure (DHRS inlet pressure)	N-2H
	Low main steam pressure SG 2	Main steam pressure (DHRS inlet pressure)	N-2H
	Low low main steam pressure SG 1	Main steam pressure (DHRS inlet pressure)	L-1
	Low low main steam pressure SG 2	Main steam pressure (DHRS inlet pressure)	L-1
	Low steam superheat SG 1	Main steam pressure (DHRS inlet pressure) Main steam temperature (DHRS inlet temperature)	L-1
	Low steam superheat SG 2	Main steam pressure (DHRS inlet pressure) Main steam temperature (DHRS inlet temperature)	L-1
	High under-the-bioshield temperature	Under-the-bioshield temperature	None

Table 2.5-2: Module Protection System Automatic Engineered Safety Feature Functions (Continued)

Engineered Safety Feature Function	Protective	Input Variable	Interlock/Permissive
ESFAS - containment system isolation	High narrow range containment pressure	Narrow range containment pressure	T-3
	Low ELVS 480VAC to EDSS battery chargers	ELVS bus voltage	None
	Low low pressurizer level	Pressurizer level	T-2
	High under-the-bioshield temperature	Under-the-bioshield temperature	None
ESFAS - demineralized water system isolation	High subcritical multiplication	Source range count rate	N-1
	Low RCS flow	RCS flow	None
	Automatic reactor trip	N/A	N/A
	Manual reactor trip	N/A	N/A
ESFAS - chemical and volume control system isolation	High narrow range containment pressure	Narrow range containment pressure	T-3
	High pressurizer level	Pressurizer level	None
	Low low pressurizer level	Pressurizer level	T-2
	Low pressurizer pressure	Pressurizer pressure	T-4
	Low low pressurizer pressure	Pressurizer pressure	T-3
	Low low RCS flow	RCS flow	None
ESFAS - pressurizer heater trip	Low pressurizer level	Pressurizer level	None
	Automatic DHRS actuation	N/A	N/A
	Manual DHRS actuation	N/A	N/A
	Automatic containment isolation	N/A	N/A
	Manual containment isolation	N/A	N/A
Low temperature overpressure protection actuation	Low temperature interlock with high pressure	Wide range RCS cold temperature (WR RCS T_{cold}) Wide range RCS pressure	T-1

Table 2.5-3: Module Protection System Manual Switches

Reactor trip
Neutron flux trip bypass
ECCS actuation
Containment isolation actuation
DHRS actuation
CVCS isolation actuation
Demineralized water system isolation actuation
Pressurizer heater trip
Low temperature overpressure protection actuation
ESFAS actuation isolation
CNTS isolation override

Table 2.5-4: Module Protection System Interlocks/Permissives/Overrides

	Interlock/Permissive/Override
L-1	Containment water level interlock
N-1	Intermediate range log power interlock/permissive
N-2H	Power range linear power interlock
N-2L	Power range linear power interlock/permissive
O-1	CNTS isolation override
RT-1	Reactor tripped interlock
T-1	Wide range RCS cold temperature interlock
T-2	Wide range RCS hot temperature interlock
T-3	Wide range RCS hot temperature interlock
T-4	Narrow range RCS hot temperature interlock

Table 2.5-5: Safety Display and Indication System Accident Monitoring Variables

Variable	Type B	Type C
Source range count rate	X	
Intermediate range log power	X	
Power range linear power	X	
Neutron monitoring system-flood	X	
Core exit temperature	X	X
Core inlet temperature	X	
Wide range RCS pressure	X	X
Degrees of subcooling (calculated from WR RCS T_{hot} and WR RCS pressure)	X	
Wide range RCS hot temperature	X	
RPV riser level	X	X
Wide range containment pressure	X	X
Containment water level	X	X
CIV positions	X	X
Inside bioshield area radiation monitor	X	X

Table 2.5-6: Important Human Actions Controls

Tag No.	Component Description	Operation
CFDS Emergency Flooding		
NA	Enable nonsafety control switch	Enable
NA	Containment isolation system bypass enable switch	Enable bypass
CFD-AOV-0108	Containment drain inlet valve	Close
CFD-AOV-0109	Containment drain discharge valve	Close
CFD-AOV-0112	Containment drain separator gas discharge valve	Close
CFD-AOV-0128	Module flood isolation valve	Open/Close
CFD-AOV-0125	Module flood isolation valve	Open/Close
CFD-AOV-0122	Module flood isolation valve	Open/Close
CFD-AOV-0119	Module flood isolation valve	Open/Close
CFD-AOV-0116	Module flood isolation valve	Open/Close
CFD-AOV-0113	Module flood isolation valve	Open/Close
CFD-AOV-0102	Pool suction isolation valve	Open
CFD-AOV-0107	CFDS flood/drain selector valve	Open
CFD-FCV-0106	CFDS pump discharge flow control valve	Open
CFD-HV-0132	System priming valve	Open/Close
CFD-HV-0139A	CFDS pump A case vent valve	Open/Close
CFD-HV-0139B	CFDS pump B case vent valve	Open/Close
CNT-CFD-ISV-0129	Module flood outboard CIV	Open/Close
CNT-CFD-ISV-0130	Module flood inboard CIV	Open/Close
CFD-P-0001A	CFDS pump A	Start/Stop
CFD-P-0001B	CFDS pump B	Start/Stop
CVCS Injection Following Containment Isolation		
NA	Enable nonsafety control switch	Enable
NA	Containment isolation system bypass enable switch	Enable bypass
BAS-P-0007A	Boric acid supply pump A	Start/Stop
BAS-P-0007B	Boric acid supply pump B	Start/Stop
BAS-AOV-0130	CVCS makeup aligning valve	Open
CVC-AOV-0110	Boric acid supply to CVCS makeup pumps	Open
CVC-AOV-0113	CVCS three-way valve	Open
CVC-AOV-0124	CVCS isolation valve	Open
CVC-AOV-0311	CVCS isolation valve	Open
CVC-AOV-0312	CVCS to module heatup system isolation valve	Open
CVC-AOV-0313	CVCS from module heatup system isolation valve	Open
CVC-MOV-0318	CVCS isolation valve	Open
CVC-FCV-0356	CVCS isolation valve	Open
CVC-MOV-0319	CVCS isolation valve	Open
CNT-CVC-ISV-0329	RCS injection CIV	Open/Close
CNT-CVC-ISV-0331	RCS injection CIV	Open/Close
CNT-CVC-ISV-0323	Pressurizer spray CIV	Open/Close
CNT-CVC-ISV-0325	Pressurizer spray CIV	Open/Close
CVC-P-0002A	CVCS makeup pump A	Start/Stop
CVC-P-0002B	CVCS makeup pump B	Start/Stop

Table 2.5-7: Module Protection System and Safety Display and Indication System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	The MPS design and software are implemented using a quality process composed of the following software lifecycle phases, with each phase having outputs which satisfy the requirements of that phase. • System Functional Specification Phase • System Design Phase • System Prototype Development Phase • Equipment Requirements Specification Phase • Hardware Planning Phase • Hardware Requirements Phase • Hardware Design Phase • Software Planning Phase • Software Requirements Phase • Software Design Phase • Software Implementation Phase • Software Configuration Phase • System Testing Phase • System Installation Phase	i. An analysis will be performed of the output documentation of the System Functional Specification Phase. ii. An analysis will be performed of the output documentation of the System Design Phase. iii. An analysis will be performed of the output documentation of the System Prototype Development Phase. iv. An analysis will be performed of the output documentation of the Equipment Requirements Specification Phase. v. An analysis will be performed of the output documentation of the Hardware Planning Phase. vi. An analysis will be performed of the output documentation of the Hardware Requirements Phase. vii. An analysis will be performed of the output documentation of the Hardware Design Phase. viii. An analysis will be performed of the output documentation of the Software Planning Phase. ix. An analysis will be performed of the output documentation of the Software Requirements Phase. x. An analysis will be performed of the output documentation of the Software Design Phase. xi. An analysis will be performed of the output documentation of the Software Implementation Phase.	i. The output documentation of the MPS Functional Specification Phase satisfies the requirements of the System Functional Specification Phase. ii. The output documentation of the MPS Design Phase satisfies the requirements of the System Design Phase. iii. The output documentation of the MPS Prototype Development Phase satisfies the requirements of the System Prototype Development Phase. iv. The output documentation of the MPS Equipment Requirements Specification Phase satisfies the requirements of the Equipment Requirements Specification Phase. v. The output documentation of the MPS Hardware Planning Phase satisfies the requirements of the Hardware Planning Phase. vi. The output documentation of the MPS Hardware Requirements Phase satisfies the requirements of the Hardware Requirements Phase. vii. The output documentation of the MPS Hardware Design Phase satisfies the requirements of the Hardware Design Phase. viii. The output documentation of the MPS Software Planning Phase satisfies the requirements of the Software Planning Phase. ix. The output documentation of the MPS Software Requirements Phase satisfies the requirements of the Software Requirements Phase. x. The output documentation of the MPS Software Design Phase satisfies the requirements of the Software Design Phase. xi. The output documentation of the MPS Software Implementation Phase satisfies the requirements of the Software Implementation Phase.

Table 2.5-7: Module Protection System and Safety Display and Indication System Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
		xii. An analysis will be performed of the output documentation of the Software Configuration Phase. xiii. An analysis will be performed of the output documentation of the System Testing Phase. xiv. An analysis will be performed of the output documentation of the System Installation Phase.	xii. The output documentation of the MPS Software Configuration Phase satisfies the requirements of the Software Configuration Phase. xiii. The output documentation of the MPS Testing Phase satisfies the requirements of the System Testing Phase. xiv. The output documentation of the MPS Installation Phase satisfies the requirements of the System Installation Phase.
2.	Protective measures are provided to restrict modifications to the MPS tunable parameters.	A test will be performed on the access control features associated with MPS tunable parameters.	Protective measures restrict modification to the MPS tunable parameters without proper configuration and authorization.
3.	Physical separation exists between the redundant separation groups and divisions of the MPS Class 1E instrumentation and control current-carrying circuits, and between Class 1E instrumentation and control current-carrying circuits and non-Class 1E instrumentation and control current-carrying circuits.	An inspection will be performed of the MPS Class 1E as-built instrumentation and control current-carrying circuits.	i. Physical separation between redundant separation groups and divisions of MPS Class 1E instrumentation and control current-carrying circuits is provided by a minimum separation distance, or by barriers (where the minimum separation distances cannot be maintained), or by a combination of separation distance and barriers. ii. Physical separation between MPS Class 1E instrumentation and control current-carrying circuits and non-Class 1E instrumentation and control current-carrying circuits is provided by a minimum separation distance, or by barriers (where the minimum separation distances cannot be maintained), or by a combination of separation distance and barriers.
4.	Electrical isolation exists between the redundant separation groups and divisions of the MPS Class 1E instrumentation and control circuits, and between Class 1E instrumentation and control circuits and non-Class 1E instrumentation and control circuits to prevent the propagation of credible electrical faults.	An inspection will be performed of the MPS Class 1E as-built instrumentation and control circuits.	i. Class 1E electrical isolation devices are installed between redundant separation groups and divisions of MPS Class 1E instrumentation and control circuits. ii. Class 1E electrical isolation devices are installed between MPS Class 1E instrumentation and control circuits and non-Class 1E instrumentation and control circuits.

Table 2.5-7: Module Protection System and Safety Display and Indication System Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
5.	Electrical isolation exists between the EDSS-MS subsystem non-Class 1E circuits and connected MPS Class 1E circuits to prevent the propagation of credible electrical faults.	i. A type test, analysis, or a combination of type test and analysis will be performed of the Class 1E isolation devices.	i. The Class 1E circuit does not degrade below defined acceptable operating levels when the non-Class 1E side of the isolation device is subjected to the maximum credible voltage, current transients, shorts, grounds, or open circuits.
		ii. An inspection will be performed of the MPS Class 1E as-built circuits.	ii. Class 1E electrical isolation devices are installed between the EDSS-MS Subsystem non-Class 1E circuits and connected MPS Class 1E circuits.
6.	Communications independence exists between redundant separation groups and divisions of the Class 1E MPS.	A test will be performed of the Class 1E MPS.	Communications independence between redundant separation groups and divisions of the Class 1E MPS is provided.
7.	Communications independence exists between the Class 1E MPS and non-Class 1E digital systems.	A test will be performed of the Class 1E MPS.	Communications independence between the Class 1E MPS and non-Class 1E digital systems is provided.
8.	The MPS automatically initiates a reactor trip signal.	A test will be performed of the MPS.	A reactor trip signal is automatically initiated for each reactor trip function listed in Table 2.5-1.
9.	The MPS automatically initiates an ESF actuation signal.	A test will be performed of the MPS.	An ESF actuation signal is automatically initiated for each ESF function listed in Table 2.5-2.
10.	The MPS automatically actuates a reactor trip.	A test will be performed of the MPS.	The RTBs open upon an injection of a single simulated MPS reactor trip signal.
11.	The MPS automatically actuates the engineered safety feature equipment.	A test will be performed of the MPS.	The ESF equipment automatically actuates to perform its safety-related function listed in Table 2.5-2 upon an injection of a single simulated MPS signal.
12.	The MPS manually actuates a reactor trip.	A test will be performed of the MPS.	The RTBs open when a reactor trip is manually initiated from the main control room.
13.	The MPS manually actuates the ESF equipment.	A test will be performed of the MPS.	The MPS actuates the ESF equipment to perform its safety-related function listed in Table 2.5-3 when manually initiated.
14.	The reactor trip logic fails to a safe state such that loss of electrical power to a MPS separation group results in a trip state for that separation group.	A test will be performed of the MPS.	Loss of electrical power in a separation group results in a trip state for that separation group.
15.	The ESFs logic fails to a safe state such that loss of electrical power to a MPS separation group results in a predefined safe state for that separation group.	A test will be performed of the MPS.	Loss of electrical power in a separation group results in an actuation state for that separation group.

Table 2.5-7: Module Protection System and Safety Display and Indication System Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
16.	An MPS signal once initiated (automatically or manually), results in an intended sequence of protective actions that continue until completion, and requires deliberate operator action in order to return the safety systems to normal.	A test will be performed of the MPS reactor trip and engineered safety features signals.	i. Upon initiation of a real or simulated MPS reactor trip signal listed in Table 2.5-1, the RTBs open, and the RTBs do not automatically close when the MPS reactor trip signal clears. ii. Upon initiation of a real or simulated MPS engineered safety feature actuation signal listed in Table 2.5-2, the ESF equipment actuates to perform its safety-related function and continues to maintain its safety-related position and perform its safety-related function when the MPS engineered safety feature actuation signal clears.
17.	The MPS response times from sensor output through equipment actuation for the reactor trip functions and ESF functions are less than or equal to the value required to satisfy the design basis safety analysis response time assumptions.	A test will be performed of the MPS.	The MPS reactor trip functions listed in Table 2.5-1 and ESFs functions listed in Table 2.5-2 have response times that are less than or equal to the design basis safety analysis response time assumptions.
18.	The MPS interlocks function as required when associated conditions are met.	A test will be performed of the MPS.	The MPS interlocks listed in Table 2.5-4 automatically establish an operating bypass for the specified reactor trip of ESF actuations when the interlock condition is met. The operating bypass is automatically removed when the interlock condition is no longer satisfied.
19.	The MPS permissives function as required when associated conditions are met.	A test will be performed of the MPS.	The MPS permissives listed in Table 2.5-4 allows the manual bypass of the specified reactor trip or ESF actuations when the permissive condition is met. The operating bypass is automatically removed when the permissive condition is no longer satisfied.
20.	The MPS overrides function as required when associated conditions are met.	A test will be performed of the MPS.	The MPS overrides listed in Table 2.5-4 are established when the manual override switch is active and RT-1 interlock is established. The Override switch must be manually taken out of Override when the Override, O-1, is no longer needed.
21.	The MPS is capable of performing its safety-related functions when one of its protection channels is placed in maintenance bypass.	A test will be performed of the MPS.	With a safety function module out of service switch activated, the safety function is placed in trip or bypass based on the position of the safety function module trip/bypass switch.
22.	MPS operational bypasses are indicated in the MCR.	A test will be performed of the MPS.	Each operational MPS manual or automatic bypass is indicated in the MCR.
23.	MPS maintenance bypasses are indicated in the MCR.	A test will be performed of the MPS.	Each maintenance bypass is indicated in the MCR.

Table 2.5-7: Module Protection System and Safety Display and Indication System Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
24.	The MPS self-test features detect faults in the system and provide an alarm in the main control room.	A test will be performed of the MPS.	A report exists and concludes that: • Self-testing features verify that faults requiring detection are detected. • Self-testing features verify that upon detection, the system responds according to the type of fault. • Self-testing features verify that faults are detected and responded within a sufficient timeframe to ensure safety function is not lost. • The presence and type of fault is indicated by the MPS alarms and displays.
25.	The PAM Type B and Type C displays are indicated on the SDIS displays in the MCR.	An inspection will be performed for the ability to retrieve the as-built PAM Type B and Type C displays on the SDIS displays in the MCR.	The PAM Type B and Type C displays listed in Table 2.5-5 are retrieved and displayed on the SDIS displays in the MCR.
26.	The controls located on the operator workstations in the MCR operate to perform IHAs.	A test will be performed of the controls on the operator workstations in the MCR.	The IHAs controls provided on the operator workstations in the MCR perform the functions listed in Table 2.5-6.
27.	The RTBs are installed and arranged in order to successfully accomplish the reactor trip function under design conditions.	An inspection will be performed of the as-built RTBs, including the connections for the shunt and undervoltage trip mechanism and auxiliary contacts.	The RTBs have the proper connections for the shunt and undervoltage trip mechanisms and auxiliary contacts, and are arranged as shown in Figure 2.5-2 to successfully accomplish the reactor trip function.
28.	Two of the four separation groups and one of the two divisions of RTS and ESFAS will utilize a different programmable technology.	An inspection will be performed of the as-built MPS.	Separation groups A & C and Division I of RTS and ESFAS utilize a different programmable technology from separation groups B & D and Division II of RTS and ESFAS.
29.	The MCR isolation switches that isolate the manual MCR switches from MPS in case of a fire in the MCR are located in the remote shutdown station.	An inspection will be performed of the location of the as-built MCR isolation switches.	The MCR isolation switches are located in the remote shutdown station.

Figure 2.5-1: Module Protection System Safety Architecture Overview

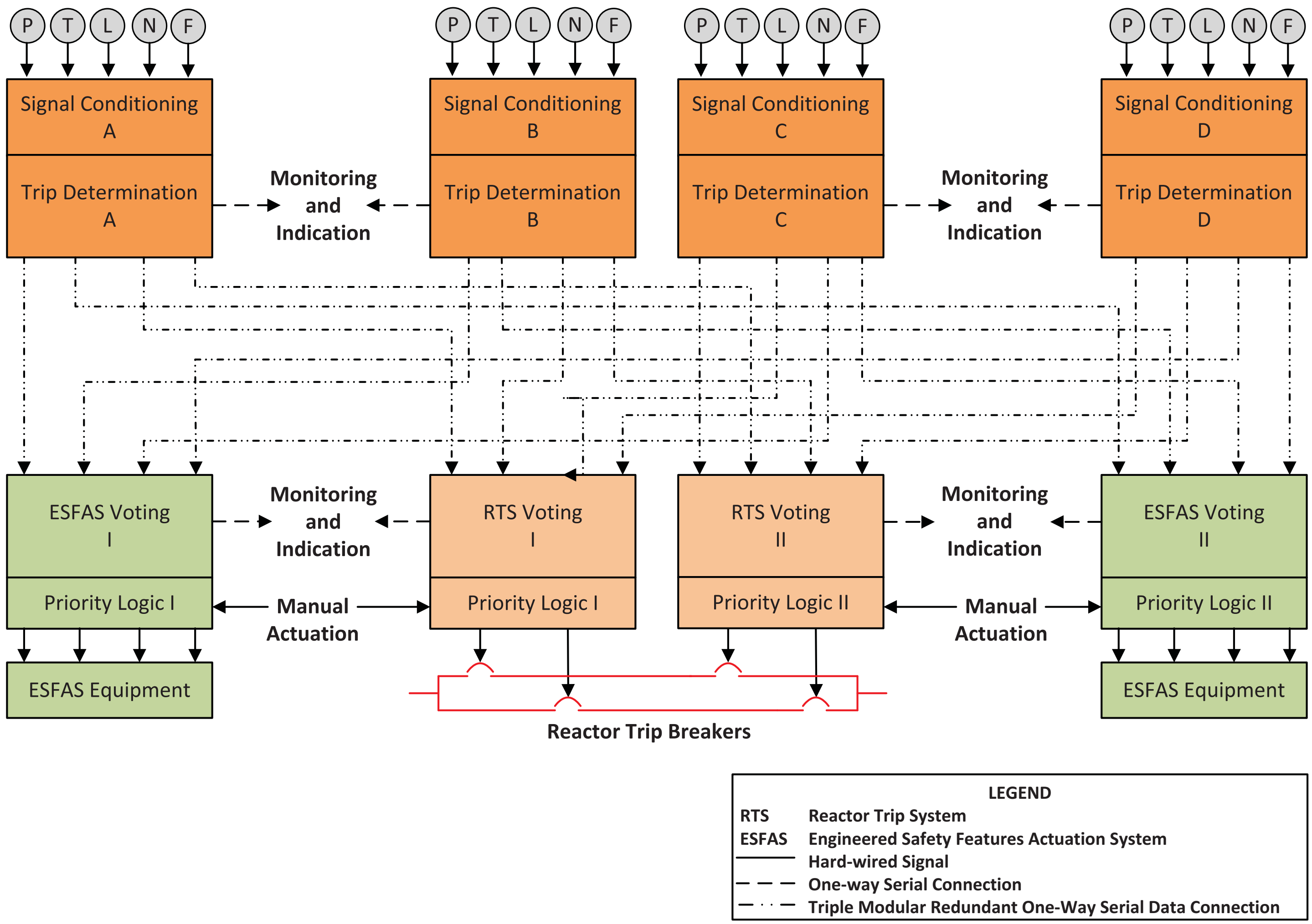
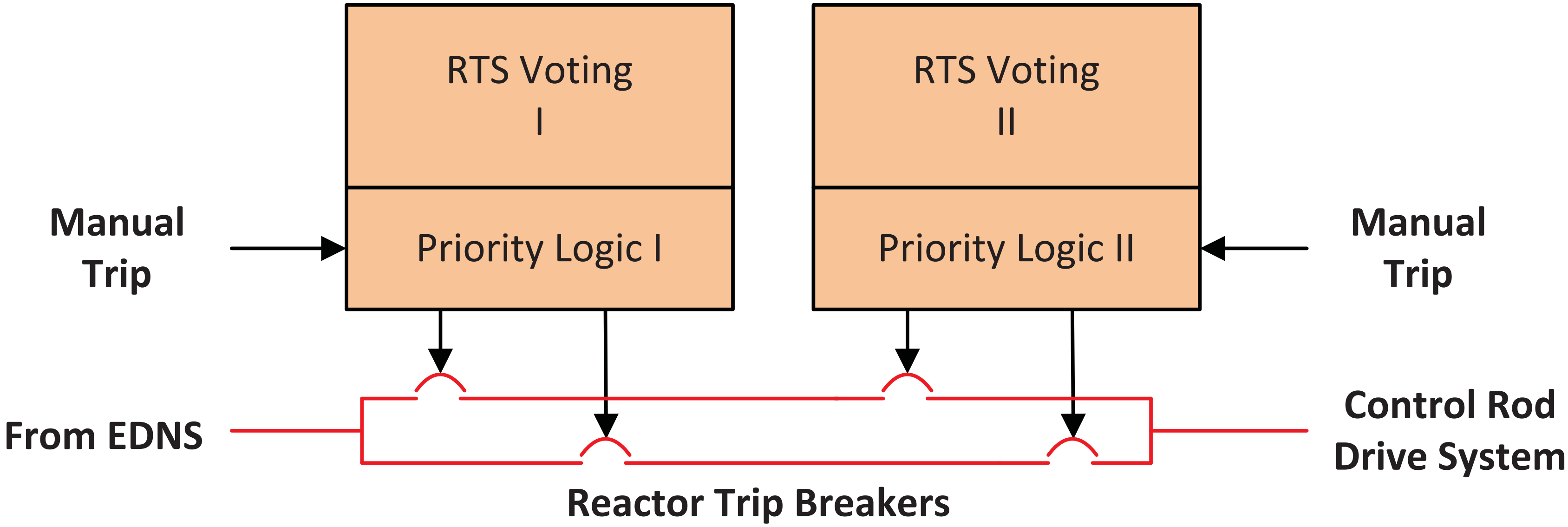


Figure 2.5-2: Reactor Trip Breaker Arrangement



2.6 Neutron Monitoring System

2.6.1 Design Description

System Description

The scope of this section is the neutron monitoring system (NMS). The NMS is a safety-related system. Each NuScale Power Module has its own module-specific NMS. The Reactor Building houses all NMS equipment.

The NMS monitors the neutron flux level of the reactor core by detecting neutron leakage from the core. The NMS measures neutron flux as an indication of core power and provides safety-related inputs to the module protection system.

The NMS performs the following safety-related system function that is verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The NMS supports the module protection system by providing neutron flux data for various reactor trips.

Design Commitments

- Electrical isolation exists between the NMS Class 1E circuits and connected non-Class 1E circuits to prevent the propagation of credible electrical faults.
- Physical separation exists between the redundant divisions of the NMS Class 1E instrumentation and control current-carrying circuits, and between Class 1E instrumentation and control current-carrying circuits and non-Class 1E instrumentation and current-carrying circuits.
- Electrical isolation exists between the redundant divisions of the NMS Class 1E instrumentation and control circuits as well as between Class 1E instrumentation and control circuits and non-Class 1E instrumentation and control circuits to prevent the propagation of credible electrical faults.

2.6.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.6-1 contains the inspections, tests, and analyses for the NMS.

Table 2.6-1: Neutron Monitoring Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	Electrical isolation exists between the NMS Class 1E circuits and connected non-Class 1E circuits to prevent the propagation of credible electrical faults.	i. A type test, analysis, or a combination of type test and analysis will be performed of the Class 1E isolation devices. ii. An inspection will be performed of the NMS Class 1E as-built circuits.	i. The Class 1E circuit does not degrade below defined acceptable operating levels when the non-Class 1E side of the isolation device is subjected to the maximum credible voltage, current transients, shorts, grounds, or open circuits. ii. Class 1E electrical isolation devices are installed between NMS Class 1E circuits and connected non-Class 1E circuits.
2.	Physical separation exists between the redundant divisions of the NMS Class 1E instrumentation and control current-carrying circuits, and between Class 1E instrumentation and control current-carrying circuits and non-Class 1E instrumentation and control current-carrying circuits.	An inspection will be performed of the NMS Class 1E as-built instrumentation and control current-carrying circuits.	i. Physical separation between redundant divisions of NMS Class 1E instrumentation and control current-carrying circuits is provided by a minimum separation distance, or by barriers (where the minimum separation distances cannot be maintained), or by a combination of separation distance and barriers. ii. Physical separation between NMS Class 1E instrumentation and control current-carrying circuits and non-Class 1E instrumentation and control current-carrying circuits is provided by a minimum separation distance, or by barriers (where the minimum separation distances cannot be maintained), or by a combination of separation distance and barriers.
3.	Electrical isolation exists between the redundant divisions of the NMS Class 1E instrumentation and control circuits, and between Class 1E instrumentation and control circuits and non-Class 1E instrumentation and control circuits to prevent the propagation of credible electrical faults.	An inspection will be performed of the NMS Class 1E as-built instrumentation and control circuits.	i. Class 1E electrical isolation devices are installed between redundant divisions of NMS Class 1E instrumentation and control circuits. ii. Class 1E electrical isolation devices are installed between NMS Class 1E instrumentation and control circuits and non-Class 1E instrumentation and control circuits.

2.7 Radiation Monitoring — Module Specific

2.7.1 Design Description

System Description

The scope of this section is automatic actions of various systems based on radiation monitoring. Automatic actions of systems based on radiation monitoring are nonsafety-related functions. The components actuated by these automatic radiation monitoring functions are contained in module-specific systems.

Design Commitments

- The containment evacuation system (CES) automatically responds to a high radiation signal from CES-RT-1011 to mitigate a release of radioactivity.
- The chemical and volume control system (CVCS) automatically responds to a high radiation signal from CVC-RT-3016 to mitigate a release of radioactivity.
- The CVCS automatically responds to a high radiation signal from 6A-AB-RT-0142 to mitigate a release of radioactivity.
- The CVCS automatically responds to a high radiation signal from 6B-AB-RT-0141 to mitigate a release of radioactivity.

2.7.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.7-2 contains the inspections, tests, and analyses for the radiation monitoring - module-specific automatic actions.

Table 2.7-1: Radiation Monitoring - Module-Specific Automatic Actions

Radiation Monitor ID(s)	Variable Monitored	Actuated Component(s)	Component ID(s)	Component Action(s)
CES-RT-1011	CES vacuum pump discharge	1. CES effluent to Reactor Building heating ventilation and air conditioning system isolation valve 2. CES effluent to gaseous waste management system isolation valve 3. CES effluent to process sample panel isolation valve 4. CES purge air solenoid valve to CES vacuum pump A 5. CES purge air solenoid valve to CES vacuum pump A 6. CES purge air solenoid valve to CES vacuum pump A 7. CES purge air solenoid valve to CES vacuum pump B 8. CES purge air solenoid valve to CES vacuum pump B 9. CES purge air solenoid valve to CES vacuum pump B	1. CES-A0V-0128 2. CES-A0V-0130 3. CES-A0V-0117 4. CES-SV-0123A 5. CES-SV-0124A 6. CES-SV-0125A 7. CES-SV-0123B 8. CES-SV-0124B 9. CES-SV-0125B	1. Close 2. Open 3. Close 4. Close 5. Close 6. Close 7. Close 8. Close 9. Close
CVC-RT-3016	Reactor coolant system discharge to regenerative heat exchanger	1. Reactor coolant system discharge to process sampling system isolation valve	1. CVC-AOV-0342	1. Close
6A-AB-RT-0142	AB system steam flow to 6A module heatup system heat exchanger	1. CVCS module heatup system 6A & 6B heat exchanger isolation valve 2. CVCS module heatup system 6A & 6B heat exchanger isolation valve	1. CVC-AOV-0354 2. CVC-AOV-0355	1. Close 2. Close
6B-AB-RT-0141	Auxiliary boiler system steam flow to 6B module heatup system heat exchanger	1. CVCS module heatup system 6A & 6B heat exchanger isolation valve 2. CVCS module heatup system 6A & 6B heat exchanger isolation valve	1. CVC-AOV-0354 2. CVC-AOV-0355	1. Close 2. Close

Table 2.7-2: Radiation Monitoring - Module-Specific Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	The CES automatically responds to a high radiation signal from CES-RT-1011 to mitigate a release of radioactivity.	A test will be performed of the CES high radiation signal.	Upon initiation of a real or simulated CES high radiation signal listed in Table 2.7-1, the CES automatically aligns/actuates the identified components to the positions identified in the table.
2.	The CVCS automatically responds to a high radiation signal from CVC-RT-3016 to mitigate a release of radioactivity.	A test will be performed of the CVCS high radiation signal.	Upon initiation of a real or simulated CVCS high radiation signal listed in Table 2.7-1, the CVCS automatically aligns/actuates the identified component to the position identified in the table.
3.	The CVCS automatically responds to a high radiation signal from 6A-AB-RT-0142 to mitigate a release of radioactivity.	A test will be performed of the CVCS high radiation signal.	Upon initiation of a real or simulated CVCS high radiation signal listed in Table 2.7-1, the CVCS automatically aligns/actuates the identified component to the position identified in the table.
4.	The CVCS automatically responds to a high radiation signal from 6B-AB-RT-0141 to mitigate a release of radioactivity.	A test will be performed of the CVCS high radiation signal.	Upon initiation of a real or simulated CVCS high radiation signal listed in Table 2.7-1, the CVCS automatically aligns/actuates the identified component to the position identified in the table.

2.8 Equipment Qualification

2.8.1 Design Description

System Description

The scope of this section is equipment qualification (EQ) of equipment specific to each NuScale Power Module. Equipment qualification applies to safety-related electrical and mechanical equipment located in harsh environments and digital instrumentation and controls equipment in mild environments. The electrical equipment identified in 10 CFR 50.49 as electric equipment are subject to EQ.

Design Commitments

- The Seismic Category I equipment, including its associated supports and anchorages, withstands design basis seismic loads without loss of its safety-related function(s) during and after a safe shutdown earthquake (SSE).
- The Class 1E electrical equipment located in a harsh environment, including its connection assemblies, withstands the design basis harsh environmental conditions experienced during normal operations, anticipated operational occurrences (AOOs), design basis accidents (DBAs), and post-accident conditions, and performs its function for the period of time required to complete the function.
- The non-metallic parts, materials, and lubricants used in safety-related mechanical equipment perform their safety-related function up to the end of their qualified life in the design basis harsh environmental conditions (both internal service conditions and external environmental conditions) experienced during normal operations, AOOs, DBAs, and post-accident conditions.
- The Class 1E computer-based instrumentation and control systems located in a mild environment withstand design basis mild environmental conditions without loss of safety-related functions.
- The Class 1E digital equipment performs its safety-related function when subjected to the design basis electromagnetic interference, radio frequency interference, and electrical surges that would exist before, during, and following a DBA.
- The safety-related valves are functionally designed and qualified to perform their safety-related function under the full range of fluid flow, differential pressure, electrical conditions, and temperature conditions up to and including DBA conditions.
- The safety-related relief valves provide overpressure protection.
- The safety-related decay heat removal system (DHRS) passive condensers have the capacity to transfer their design heat load.

2.8.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 2.8-2 contains the inspections, tests, and analyses for equipment qualification–module-specific equipment.

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category(1)
Containment System							
CNV-8	I&C DIv I Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
CNV-9	I&C DIv II Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
CNV-15	PZR Heater Power #1 Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
CNV-16	PZR Heater Power #2 Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
CNV-17	I&C Channel A Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
CNV-18	I&C Channel B Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
CNV-19	I&C Channel C Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
CNV-20	I&C Channel D Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
CNV-37	CRD Power Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
CNV-38	RPI Group #1 Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
CNV-39	RPI Group #2 Nozzle	RXB - Top of Module CNV-6	Harsh	Electrical Mechanical	Yes	Yes	A
MS-ISV-1005	MS #1 CIV (MSIV #1)	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
MS-ISV-2005	MS #2 CIV (MSIV #2)	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
MS-ISV-1006	MS line #1 Bypass Valve (MSIV Bypass #1)	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
MS-ISV-2006	MS line #2 Bypass Valve (MSIV Bypass #2)	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
FW-ISV-1003	FW #1 CIV (FWIV #1)	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category(1)
FW-ISV-2003	FW #2 CIV (FWIV #1)	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
FW-ISV-1002	FW line #1 Check Valve	RXB - Top of Module	Harsh	Mechanical	Yes	N/A	A B
FW-ISV-2002	FW line #2 Check Valve	RXB - Top of Module	Harsh	Mechanical	Yes	N/A	A B
CVC-ISV-0334 CVC-ISV-0336	CVC Discharge CIV	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
CVC-ISV-0329 CVC-ISV-0331	CVC Injection CIV	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
CVC-ISV-0323 CVC-ISV-0325	CVC PZR Spray CIV	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
CVC-ISV-0401 CVC-ISV-0403	RPV High Point Degas CIV	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
RCCW-ISV-0184 RCCW-ISV-0185	RCCW Supply CIV	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
RCCW-ISV-0190 RCCW-ISV-0191	RCCW Return CIV	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
CE-ISV-0101 CE-ISV-0102	CE CIV	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
CFD-ISV-0129 CFD-ISV-0130	CFDS CIV	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A B
None	Hydraulic Skid for valve reset	RXB - 100’	Harsh	Electrical Mechanical	Yes	No	A
PE-0021A PE-0021B PE-0021C PE-0021D	Containment Pressure Transducer (Narrow Range)	RXB - CNV-5 CNV-6	Harsh	Electrical	Yes	Yes	A
PE-0022A PE-0022B	Containment Pressure Transducer (Wide Range)	RXB - CNV-5 CNV-6	Harsh	Electrical	Yes	Yes	A

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category[1]
LE-0023A LE-0023B LE-0023C LE-0023D	Containment Water Level Sensors (Radar Transceiver)	RXB - Top of Module CNV-2 CNV-3 CNV-4 CNV-5 CNV-6	Harsh	Electrical	Yes	Yes	A
TE-1004A TE-1004B TE-1004C TE-1004D	SG #1 Steam Temperature Sensors (RTD)	RXB - Top of Module	Harsh	Electrical	Yes	Yes	A
TE-2004A TE-2004B TE-2004C TE-2004D	SG #2 Steam Temperature Sensor (RTD)	RXB - Top of Module	Harsh	Electrical	Yes	Yes	A
ZSC-0101	CE Inboard CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0101	CE Inboard CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0102	CE Outboard CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0102	CE Outboard CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0130	CFD Inboard CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0130	CFD Inboard CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0129	CFD Outboard CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0129	CFD Outboard CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0334	CVCS Inboard RCS Discharge CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0334	CVCS Inboard RCS Discharge CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0336	CVCS Outboard CIV RCS Discharge Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0336	CVCS Outboard CIV RCS Discharge Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0331	CVCS Inboard RCS Injection CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0331	CVCS Inboard RCS Injection CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category[1]
ZSC-0329	CVCS Outboard RCS Injection CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0329	CVCS Outboard RCS Injection CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0325	CVCS Inboard PZR Spray Line CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0325	CVCS Inboard PZR Spray Line CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0323	CVCS Outboard PZR Spray Line CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0323	CVCS Outboard PZR Spray Line CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0401	CVCS Inboard RPV High- Point Degasification CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0401	CVCS Inboard RPV High- Point Degasification CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0403	CVCS Outboard RPV High-Point Degasification CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0403	CVCS Outboard RPV High-Point Degasification CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0185	RCCW Supply Inboard CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0185	RCCW Supply Inboard CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0184	RCCW Supply Outboard CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0184	RCCW Supply Outboard CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0190	RCCW Return Inboard CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-0190	RCCW Return Inboard CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0190	RCCW Return Outboard CIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category[(1)]
ZSO-0191	RCCW Return Outboard CIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-0191	FW Supply to SG1 and DHR HX1 CIV/FWIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-1003B	FW Supply to SG1 and DHR HX1 CIV/FWIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-1003B	FW Supply to SG1 and DHR HX1 CIV/FWIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-1003A	FW Supply to SG1 and DHR HX1 CIV/FWIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-1003A	FW Supply to SG1 and DHR HX1 CIV/FWIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-2003B	FW Supply to SG2 and DHR HX2 CIV/FWIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-2003B	FW Supply to SG2 and DHR HX2 CIV/FWIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-2003A	FW Supply to SG2 and DHR HX2 CIV/FWIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-2003A	FW Supply to SG2 and DHR HX2 CIV/FWIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-1005A	SG1 Steam Supply CIV/ MSIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-1005A	SG1 Steam Supply CIV/ MSIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-1005B	SG1 Steam Supply CIV/ MSIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-1005B	SG1 Steam Supply CIV/ MSIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZCS-1006A	SG1 Steam Supply CIV/ MS Bypass Isolation Valve Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-1006A	SG1 Steam Supply CIV/ MS Bypass Isolation Valve Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-1006B	SG1 Steam Supply CIV/ MS Bypass Isolation Valve Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category(1)
ZSO-1006B	SG1 Steam Supply CIV/ MS Bypass Isolation Valve Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-2005A	SG2 Steam Supply CIV/ MSIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-2005A	SG2 Steam Supply CIV/ MSIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-2005B	S2 Steam Supply CIV/ MSIV Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-2005B	SG2 Steam Supply CIV/ MSIV Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-2006A	SG2 Steam Supply CIV/ MS Bypass Isolation Valve Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-2006A	SG2 Steam Supply CIV/ MS Bypass Isolation Valve Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSC-2006B	SG1 Steam Supply CIV/ MS Bypass Isolation Valve Close Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
ZSO-2006B	SG1 Steam Supply CIV/ MS Bypass Isolation Valve Open Position Sensor	RXB - Top of Module	Harsh	Electrical	Yes	No	A
Control Rod Drive System							
CRDS-CRD-0001 to 0016	Control Rod Drive Coils	RXB - CNV-5	Harsh	Electrical	Yes	No	A
CRDS-ZS-0001A to 0016A CRDS-ZS-0001B to 0016B	Rod Position Indication (RPI) Coils	RXB - CNV-5	Harsh	Electrical	Yes	No	B
None	CRDM Control Cabinet	RXB - 126′	Harsh	Electrical	Yes	No	A
None	Rod Position Indication Cabinets (Train A/ B)	RXB - 126′	Harsh	Electrical	Yes	No	B
None	CRDM Power & Rod Position Indication Cables	RXB - Top of Module 126′ CNV-5 CNV-6	Harsh	Electrical	Yes	No	B

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category[1]
CRDS-0100- HBBX-N CRDS-0200- HBBX-N CRDS-FHS- 0101 to 0116 CRDS-FHS- 0201 to 0216 CRDS-PSV- 0221	CRDS Cooling Water Piping and Pressure Relief Valve	RXB - CNV-5 CNV-6	Harsh	Mechanical	Yes	N/A	B
Reactor Coolant System							
None	Reactor Safety Valve Position Indicator	RXB - CNV-5	Harsh	Electrical	Yes	No	B
RCS-PSV-0003A RCS-PSV-0003B	Reactor Safety Valves	RXB - CNV-5	Harsh	Electrical Mechanical	Yes	N/A	A
PE0013A PE0013B PE0013C PE0013D	Narrow Range Pressurizer Pressure Elements	RXB - CNV-4 CNV-5	Harsh	Electrical	Yes	Yes	A
PE0014A PE0014B PE0014C PE0014D	Wide Range RCS Pressure	RXB - CNV-4 CNV-5	Harsh	Electrical	Yes	Yes	A
LE0015A LE0015B LE0015C LE0015D	RCS Level	RXB - Top of Module CNV-5 CNV-6	Harsh	Electrical	Yes	Yes	A

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category[1]
TE0005A TE0005B TE0005C TE0005D TE0006A TE0006B TE0006C TE0006D	Narrow Range RCS Hot Leg Temperature	RXB - CNV-3	Harsh	Electrical	Yes	Yes	A
TE0008A TE0008B TE0008C TE0008D	Wide Range RCS Hot Leg Temperature	RXB - CNV-3	Harsh	Electrical	Yes	Yes	A
TE0011A TE0011B TE0011C TE0011D	Wide Range RCS Cold Leg Temperature Element	RXB - CNV-2	Harsh	Electrical	Yes	Yes	A
FE0012A FE0012B FE0012C FE0012D	RCS Flow Transmitter (Ultrasonic)	RXB - CNV-2	Harsh	Electrical	Yes	Yes	A
Chemical and Volume Control System							
CVC-AOV-0101	DWS Supply Isolation Valve	RXB - 50′	Harsh	Electrical Mechanical	Yes	Yes	A B
CVC-AOV-0119	DWS Supply Isolation Valve	RXB - 50′	Harsh	Electrical Mechanical	Yes	Yes	A B
CVC-ZSO-0101 CVC-ZSC-0101	DWS Supply Isolation Valve Position Indication	RXB - 50′	Harsh	Electrical	Yes	No	A
CVC-ZSO-0119 CVC-ZSC-0119	DWS Supply Isolation Valve Position Indication	RXB - 50′	Harsh	Electrical	Yes	No	A
CVC-AOV-0339	Discharge Spoolpiece Drain Valve	RXB - 50′	Harsh	Electrical Mechanical	Yes	Yes	A

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category[(1)]
CVC-AOV-0342	Discharge PSS Isolation Valve	RXB - 50′	Harsh	Electrical Mechanical	Yes	Yes	A
CVC-CHK-0353	Spray Check Valve	RXB - Top of Module	Harsh	Mechanical	Yes	N/A	A B
CVC-CKV-0352	Injection Check Valve	RXB - Top of Module	Harsh	Mechanical	Yes	N/A	A B
Emergency Core Cooling System							
ECC-HOV-0101A ECC-HOV-0101B ECC-HOV-0101C	Reactor Vent Valve	RXB - CNV-5	Harsh	Mechanical	Yes	Yes	A
ECC-ZSC-0101A ECC-ZSO-0101A ECC-ZSC-0101B ECC-ZSO-0101B ECC-ZSC-0101C ECC-ZSO-0101C ECC-ZSC-0108 ECC-ZSO-0108	RVV Position Indication	RXB - CNV-5	Harsh	Electrical	Yes	No	A
ECC-HOV-0104A ECC-HOV-0104B	Reactor Recirculation Valve	RXB - CNV-2	Harsh	Mechanical	Yes	Yes	A
ECC-ZSC-0104A ECC-ZSO-0104A ECC-ZSC-0104B ECC-ZSO-0104B	RRV Position Indication	RXB - CNV-2	Harsh	Electrical	Yes	No	A
ECC-SV-0102A ECC-SV-0102B ECC-SV-0102C ECC-SV-0107	RVV Trip Valve	RXB - Pool	Harsh	Electrical Mechanical	Yes	Yes	A B
ECC-SV-0105A ECC-SV-0105B	RRV Trip Valve	RXB - Pool	Harsh	Electrical Mechanical	Yes	Yes	A B

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category[(1)]
ECC-ZSC-0102A ECC-ZSO-0102A ECC-ZSC-0102B ECC-ZSO-0102B ECC-ZSC-0102C ECC-ZSO-0102C ECC-ZSC-0107 ECC-ZSO-0107 ECC-ZSC-0105A ECC-ZSO-0105A ECC-ZSC-0105B ECC-ZSO-0105B	Trip Valve Position Indication	RXB - Pool	Harsh	Electrical	Yes	No	A
ECC-SV-0103A ECC-SV-0103B ECC-SV-0103C ECC-SV-0106A ECC-SV-0106B	Reset Valve	RXB - Pool	Harsh	Electrical Mechanical	Yes	Yes	A
ECC-ZSC-0103A ECC-ZSO-0103A ECC-ZSC-0103B ECC-ZSO-0103B ECC-ZSC-0103C ECC-ZSO-0103C ECC-ZSC-0106A ECC-ZSO-0106A ECC-ZSC-0106B ECC-ZSO-0106B	Reset Valve Position Indication	RXB - Pool	Harsh	Electrical	Yes	No	A

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category(1)
Decay Heat Removal System							
DHR-AOV-1001A DHR-AOV-1001B DHR-AOV-2001A DHR-AOV-2001B	DHRS Actuation Valve (2 per side)	RXB - Top of Module	Harsh	Electrical Mechanical	Yes	Yes	A
DHR-TT-1006A DHR-TT-1006B DHR-TT-2006A DHR-TT-2006B	DHRS Condenser Outlet Temperature (2 per side)	RXB - Pool	Harsh	Electrical	Yes	Yes	A
DHR-PT-1007A DHR-PT-1007B DHR-PT-1007C DHR-PT-2007A DHR-PT-2007B DHR-PT-2007C	DHRS Condenser Outlet Pressure (3 per side)	RXB - Pool	Harsh	Electrical	Yes	Yes	A
DHR-ZSO-1002A DHR-ZSC-1002A DHR-ZSO-1002B DHR-ZSC-1002B DHR-ZSO-2002A DHR-ZSC-2002A DHR-ZSO-2002B DHR-ZSC-2002B	DHRS Valve Position Indicator (2 for open, 2 for close per side)	RXB - Top of Module	Harsh	Electrical	Yes	No	A

Table 2.8-1: Module Specific Mechanical and Electrical/I&C Equipment (Continued)

Equipment Identifier	Description	Location	EQ Environment	Qualification Program	Seismic Category I	Class 1E	EQ Category[1]
DHR-PT-1001A DHR-PT-1001B DHR-PT-1001C DHR-PT-1001D DHR-PT-2001A DHR-PT-2001B DHR-PT-2001C DHR-PT-2001D	SG Steam Pressure (4 per side)	RXB - Top of Module	Harsh	Electrical	Yes	Yes	A
Condensate and Feedwater System							
FW-FCV-0067 A/B	Feedwater Regulating Valve A/B	RXB - 100′	Harsh	Electrical Mechanical	Yes	No	A
FW-ZT-0067 A/B	Feedwater Regulating Valve A/B Position Indicating Transmitter	RXB - 100′	Harsh	Electrical	Yes	No	A
CKV-0148A CKV-0148B	Feedwater Supply Check Valve	RXB - 100′	Harsh	Mechanical	Yes	N/A	A
Module Protection System							
None	Division I - Power Isolation, Conversion and Monitoring Devices	RXB - 75′	Harsh	Electrical	Yes	Yes	B
Neutron Monitoring System							
None	Neutron Detectors	RXB - Pool	Harsh	Electrical	Yes	Yes	A
In-Core Instrumentation System							
None	In-core instrument string/ temperature sensors	RXB - CNV-5 CNV-6	Harsh	Electrical	Yes	Yes	A
None	In-core instrument string sheath	RXB - CNV-5	Harsh	Mechanical	Yes	N/A	B

Notes:

1. EQ Categories:

- A Equipment that will experience the environmental conditions of design basis accidents for which it must function to mitigate said accidents, and that will be qualified to demonstrate operability in the accident environment for the time required for accident mitigation with safety margin to failure.
- B Equipment that will experience the environmental conditions of design basis accidents through which it need not function for mitigation of said accidents, but through which it must not fail in a manner detrimental to plant safety or accident mitigation, and that will be qualified to demonstrate the capability to withstand the accident environment for the time during which it must not fail with safety margin to failure.

Table 2.8-2: Equipment Qualification Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	The Seismic Category I equipment, including its associated supports and anchorages, withstands design basis seismic loads without loss of its safety-related function(s) during and after an SSE.	i. A type test, analysis, or a combination of type test and analysis will be performed of the Seismic Category I equipment, including its associated supports and anchorages. ii. An inspection will be performed of the Seismic Category I as-built equipment, including its associated supports and anchorages.	i. A seismic qualification record form exists and concludes that the Seismic Category I equipment listed in Table 2.8-1, including its associated supports and anchorages, will withstand the design basis seismic loads and perform its safety function during and after an SSE. ii. The Seismic Category I equipment listed in Table 2.8-1, including its associated supports and anchorages, is installed in its design location in a Seismic Category I structure in a configuration bounded by the equipment's seismic qualification record form.
2.	The Class 1E electrical equipment located in a harsh environment, including its connection assemblies, withstands the design basis harsh environmental conditions experienced during normal operations, AOOs, DBAs, and post-accident conditions and performs its function for the period of time required to complete the function.	i. A type test or a combination of type test and analysis will be performed of the Class 1E electrical equipment, including its connection assemblies. ii. An inspection will be performed of the Class 1E as-built electrical equipment, including its connection assemblies.	i. An EQ record form exists and concludes that the Class 1E electrical equipment listed in Table 2.8-1, including its connection assemblies, performs its function under the environmental conditions specified in the EQ record form for the period of time required to complete the function. ii. The Class 1E electrical equipment listed in Table 2.8-1, including its connection assemblies, is installed in its design location in a configuration bounded by the EQ record form.
3.	The non-metallic parts, materials, and lubricants used in safety-related mechanical equipment perform their safety-related function up to the end of their qualified life in the design basis harsh environmental conditions (both internal service conditions and external environmental conditions) experienced during normal operations, AOOs, DBAs, and post-accident conditions.	A type test or a combination of type test and analysis will be performed of the non-metallic parts, materials, and lubricants used in safety-related mechanical equipment.	A qualification record form exists and concludes that the non-metallic parts, materials, and lubricants used in safety-related mechanical equipment listed in Table 2.8-1 perform their safety-related function up to the end of their qualified life under the design basis harsh environmental conditions (both internal service conditions and external environmental conditions) specified in the qualification record form.

Table 2.8-2: Equipment Qualification Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4.	The Class 1E computer-based instrumentation and control systems located in a mild environment withstand design basis mild environmental conditions without loss of safety-related functions.	i. A type test or a combination of type test and analysis will be performed of the Class 1E computer-based instrumentation and control systems located in a mild environment. ii. An inspection will be performed of the Class 1E as-built computer-based instrumentation and control systems located in a mild environment.	i. An EQ record form exists and concludes that the Class 1E computer-based instrumentation and control systems listed in Table 2.8-1 perform their function under the environmental conditions specified in the EQ record form. ii. The Class 1E computer-based instrumentation and control systems listed in Table 2.8-1 are installed in their design location in a configuration bounded by the EQ record form.
5.	The Class 1E digital equipment performs its safety-related function when subjected to the design basis electromagnetic interference, radio frequency interference, and electrical surges that would exist before, during, and following a DBA.	A type test, analysis, or a combination of type test and analysis will be performed of the Class 1E digital equipment.	An EQ record form exists and concludes that the Class 1E digital equipment listed in Table 2.8-1 withstands the design basis electromagnetic interference, radio frequency interference, and electrical surges that would exist before, during, and following a DBA without loss of safety-related function.
6.	The safety-related valves are functionally designed and qualified to perform their safety-related function under the full range of fluid flow, differential pressure, electrical conditions, and temperature conditions up to and including DBA conditions.	A type test or a combination of type test and analysis will be performed of the safety-related valves.	A Functional Qualification Report exists and concludes that the safety-related valves listed in Table 2.8-1 are capable of performing their safety-related function under the full range of fluid flow, differential pressure, electrical conditions, and temperature conditions up to and including DBA conditions.
7.	The safety-related relief valves provide overpressure protection.	i. A vendor test will be performed of each safety-related relief valves. ii. An inspection will be performed of each safety-related as-built relief valves.	i. An American Society of Mechanical Engineers Code Section III Data Report exists and concludes that the relief valves listed in Table 2.8-1 meet the valve's required set pressure, capacity, and overpressure design requirements. ii. Each relief valve listed in Table 2.8-1 is provided with an American Society of Mechanical Engineers Code Certification Mark that identifies the sump recirculation valve's set pressure, capacity, and overpressure.
8.	The safety-related DHRS passive condensers have the capacity to transfer their design heat load.	A type test or a combination of type test and analysis will be performed of the safety-related DHRS passive condensers.	A report exists and concludes that the safety-related DHRS passive condensers listed in Table 2.8-1 have a heat removal capacity sufficient to transfer their design heat load.

CHAPTER 3 SHARED STRUCTURES, SYSTEMS, AND COMPONENTS AND NON-STRUCTURES, SYSTEMS, AND COMPONENTS DESIGN DESCRIPTIONS AND INSPECTIONS, TESTS, ANALYSES, AND ACCEPTANCE CRITERIA

3.0 Shared Structures, Systems, and Components and Non-Structures, Systems, and Components Design Descriptions and Inspections, Tests, Analyses, and Acceptance Criteria

This chapter of Tier 1 provides the structures, systems, and components (SSC) Design Descriptions and Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC) for those SSC that are common or shared by multiple NuScale Power Modules (NPMs). Shared systems in this chapter of Tier 1 are either shared by 1-12 NPMs or by 1- 6 NPMs as shown in Table 3.0-1. This chapter also includes non-SSC based Design Descriptions and ITAAC that are common or shared by multiple NPMs. For a multi-module plant, satisfactory completion of a shared ITAAC for the lead module shall constitute satisfactory completion of the shared ITAAC for associated modules. The ITAAC in Sections 3.1 through 3.17 shall only be completed once in conjunction with the ITAAC in Chapter 2 for the first NPM. The ITAAC in Section 3.18 shall only be completed once in conjunction with the ITAAC in Chapter 2 for NPM 7 or NPM 12, whichever is completed first.

Table 3.0-1: Shared Systems Subject to Inspections, Tests, Analyses, and Acceptance Criteria

Shared System	NPMs Supported
Balance-of-plant drain system	1 system per 6 modules
Containment flooding and drain system	1 system per 6 modules
Normal control room heating ventilation and air conditioning system	1 system per 12 modules
Control room habitability system	1 system per 12 modules
Reactor Building heating ventilation and air conditioning system	1 system per 12 modules
Fuel handling equipment system	1 system per 12 modules
Fuel storage system	1 system per 12 modules
Ultimate heat sink	1 system per 12 modules
Fire protection system	1 system per 12 modules
Plant lighting system	1 system per 12 modules
Gaseous radioactive waste system	1 system per 12 modules
Liquid radioactive waste system	1 system per 12 modules
Auxiliary boiler system	1 system per 12 modules
Pool surge control system	1 system per 12 modules
Reactor Building crane system	1 system per 12 modules
Reactor Building and Reactor Building components	1 system per 12 modules
Radioactive Waste Building	1 system per 12 modules
Control Building	1 system per 12 modules
Physical security system	1 system per 12 modules

3.1 Control Room Habitability

3.1.1 Design Description

System Description

The scope of this section is the control room habitability system (CRHS). The CRHS provides clean breathing air to the control room envelope and maintains a positive control room pressure during high radiation or loss of offsite power conditions for habitability and control of radioactivity. The CRHS is a nonsafety-related system which supports up to 12 NuScale Power Modules (NPMs). The Control Building houses all CRHS equipment.

The CRHS performs the following nonsafety-related system function that is verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The CRHS supports the Control Building by providing clean breathing air to the main control room (MCR) and maintains a positive control room pressure during high radiation or loss of normal AC power conditions.

Design Commitments

- The air exfiltration out of the control room envelope (CRE) does not exceed the assumptions used to size the CRHS inventory and the supply flow rate.
- The CRHS valves change position under design basis temperature, differential pressure, and flow conditions.
- The CRHS solenoid-operated valves perform their function to fail open on loss of motive power under design basis temperature, differential pressure, and flow conditions.
- The CRE heat sink passively maintains the temperature of the CRE within an acceptable range for the first 72 hours following a design basis accident (DBA).
- The CRHS maintains a positive pressure in the MCR relative to the adjacent areas.

3.1.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.1-2 contains the inspections, tests, and analyses for the CRHS.

Table 3.1-1: Control Room Habitability System Mechanical Equipment

Equipment Name	Equipment Identifier	Failure Position
Air supply isolation solenoid valve	00-CRH-SV-0001A	Open
Air supply isolation solenoid valve	00-CRH-SV-0001B	Open
CRE pressure relief isolation valve	00-CRH-SV-0002A	Open
CRE pressure relief isolation valve	00-CRH-SV-0002B	Open

Table 3.1-2: Control Room Habitability System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	The air exfiltration out of the CRE meets the assumptions used to size the CRHS inventory and the supply flow rate.	A test will be performed of the CRE.	The air exfiltration measured by tracer gas testing meets the air exfiltration assumed in the CRHS breathing and pressurization analysis.
2	The CRHS valves change position under design basis temperature, differential pressure, and flow conditions.	A test will be performed of the CRHS valves under preoperational temperature, differential pressure, and flow conditions.	Each CRHS valve listed in Table 3.1-1 strokes fully open and fully closed by remote operation under preoperational temperature, differential pressure, and flow conditions.
3	The CRHS solenoid-operated valves perform their function to fail open on loss of motive power under design basis temperature, differential pressure, and flow conditions.	A test will be performed of the CRHS solenoid-operated valves under preoperational temperature, differential pressure and flow conditions.	Each CRHS solenoid-operated valve listed in Table 3.1-1 performs its function to fail open on loss of motive power under preoperational temperature, differential pressure, and flow conditions.
4	The CRE heat sink passively maintains the temperature of the CRE within an acceptable range for the first 72 hours following a DBA.	An analysis will be performed of the as-built CRE heat sinks.	A report exists and concludes that the CRE heat sink passively maintains the temperature of the CRE within an acceptable range for the first 72 hours following a DBA.
5	The CRHS maintains a positive pressure in the MCR relative to adjacent areas.	A test will be performed of the CRHS.	The CRHS maintains a positive pressure of greater than or equal to 1/8 inches water gauge in the CRE relative to adjacent areas, while operating in DBA alignment.

3.2 Normal Control Room Heating Ventilation and Air Conditioning System

3.2.1 Design Description

System Description

The scope of this section is the normal control room HVAC system (CRVS). The CRVS serves the entire Control Building (CRB) and the access tunnel between the CRB and the Reactor Building (RXB). The CRVS is a nonsafety-related system. The CRVS supports up to 12 NuScale Power Modules. The CRB houses all CRVS equipment.

The CRVS performs the following nonsafety-related system functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The CRVS supports the CRB by providing isolation of the control room envelope (CRE) from the surrounding areas and outside environment via isolation dampers.
- The CRVS supports the CRB by maintaining the CRB at a positive pressure relative to the RXB and the outside atmosphere to control the ingress of potentially airborne radioactivity from the RXB or the outside atmosphere to the CRB.
- The CRVS supports the highly reliable DC power system by providing ventilation to maintain airborne hydrogen concentrations below the allowable limits.
- The CRVS supports the normal DC power system by providing ventilation to maintain airborne hydrogen concentrations below allowable limits.

Design Commitments

- The CRVS air-operated CRE isolation dampers perform their function to fail to the closed position on loss of motive power under design basis temperature, differential pressure, and flow conditions.
- The CRVS maintains a positive pressure in the CRB relative to the outside environment.
- The CRVS maintains the hydrogen concentration levels in the CRB battery rooms containing batteries below one percent by volume.

3.2.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.2-2 contains the inspections, tests, and analyses for the CRVS.

Table 3.2-1: Normal Control Room Heating Ventilation and Air Conditioning System Mechanical Equipment

Equipment Name	Equipment Identifier	Actuator Type
CRE isolation damper	None	Pneumatic
CRE isolation damper	None	Pneumatic
CRE isolation damper	None	Pneumatic
CRE isolation damper	None	Pneumatic
CRE isolation damper	None	Pneumatic
CRE isolation damper	None	Pneumatic
CRE isolation damper	None	Pneumatic
CRE isolation damper	None	Pneumatic

Table 3.2-2: Normal Control Room Heating Ventilation and Air Conditioning Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	The CRVS air-operated CRE isolation dampers perform their function to fail to the closed position on loss of motive power under design basis temperature, differential pressure, and flow conditions.	A test will be performed of the air-operated CRE isolation dampers under preoperational temperature, differential pressure and flow conditions.	Each CRVS air-operated CRE isolation damper listed in Table 3.2-1 performs its function to fail to the closed position on loss of motive power under preoperational temperature, differential pressure, and flow conditions.
2	The CRVS maintains a positive pressure in the CRB relative to the outside environment.	A test will be performed of the CRVS while operating in the normal operating alignment.	The CRVS maintains a positive pressure of greater than or equal to 1/8 inches water gauge in the CRB relative to the outside environment, while operating in the normal operating alignment.
3	The CRVS maintains the hydrogen concentration levels in the CRB battery rooms containing batteries below one percent by volume.	A test will be performed of the CRVS while operating in the normal operating alignment.	The airflow capability of the CRVS maintains the hydrogen concentration levels in the CRB battery rooms containing batteries below one percent by volume.

3.3 Reactor Building Heating Ventilation and Air Conditioning System

3.3.1 Design Description

System Description

The scope of this section is the Reactor Building HVAC system (RBVS). The RBVS is designed to remove radioactive contaminants from the exhaust streams of the Reactor Building (RXB) general area, the Radioactive Waste Building (RWB) general area, and the Annex Building. The RBVS is a nonsafety-related system. The RBVS supports up to 12 NuScale Power Modules. The RXB and the RWB house the RBVS equipment.

The RBVS performs the following nonsafety-related system functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The RBVS supports the RXB by maintaining the RXB at a negative pressure relative to the outside atmosphere to control the movement of potentially airborne radioactivity from the RXB to the environment.
- The RBVS supports the RWB by maintaining the RWB at a negative ambient pressure relative to the outside atmosphere to control the movement of potentially airborne radioactivity from the RWB to the environment.
- The RBVS supports the highly reliable DC power system by providing ventilation to maintain airborne hydrogen concentrations below allowable limits.
- The RBVS supports the normal DC power system by providing ventilation to maintain airborne hydrogen concentrations below allowable limits.

Design Commitments

- The RBVS maintains a negative pressure in the RXB relative to the outside environment.
- The RBVS maintains a negative pressure in the RWB relative to the outside environment.
- The RBVS maintains the hydrogen concentration levels in the RXB battery rooms below one percent by volume.

3.3.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.3-1 contains the inspections, tests, and analyses for the RBVS.

Table 3.3-1: Reactor Building Heating Ventilation and Air Conditioning System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	The RBVS maintains a negative pressure in the RXB relative to the outside environment.	A test will be performed of the RBVS while operating in the normal operating alignment.	The RBVS maintains a negative pressure in the RXB relative to the outside environment, while operating in the normal operating alignment.
2	The RBVS maintains a negative pressure in the RWB relative to the outside environment.	A test will be performed of the RBVS while operating in the normal operating alignment.	The RBVS maintains a negative pressure in the RWB relative to the outside environment, while operating in the normal operating alignment.
3.	The RBVS maintains the hydrogen concentration levels in the RXB battery rooms containing batteries below one percent by volume.	A test will be performed of the RBVS while operating in the normal operating alignment.	The airflow capability of the RBVS maintains the hydrogen concentration levels in the RXB battery rooms containing batteries below one percent by volume.

3.4 Fuel Handling Equipment System

3.4.1 Design Description

System Description

The scope of this section is the fuel handling equipment (FHE) system. The FHE system is designed to support the periodic refueling of the reactor as well as movement of control rods and other radioactive components within the reactor core, refueling pool, and spent fuel pool. The FHE system is a nonsafety-related system. The FHE system supports up to 12 NuScale Power Modules (NPMs). The Reactor Building houses all FHE system equipment.

The FHE system performs the following nonsafety-related system function that is verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The FHE system supports the reactor fuel assembly by providing structural support during handling of fuel.

Design Commitments

- The single-failure-proof fuel handling machine (FHM) main and auxiliary hoists are constructed to provide assurance that a failure of a single hoist mechanism component does not result in the uncontrolled movement of the lifted load.
- The FHM main hoist is capable of lifting and supporting its rated load, holding the rated load, and transporting the rated load.
- The FHM auxiliary hoist is capable of lifting and supporting its rated load, holding the rated load, and transporting the rated load.
- Single-failure-proof FHM welds are inspected.
- The FHM travel is limited to maintain a water inventory for personnel shielding with the pool level at the lower limit of the normal operating low water level.

3.4.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.4-1 contains the inspections, tests, and analyses for the FHE system.

Table 3.4-1: Fuel Handling Equipment System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	The single-failure-proof FHM main and auxiliary hoists are constructed to provide assurance that a failure of a single hoist mechanism component does not result in the uncontrolled movement of the lifted load.	An inspection will be performed of the as-built FHM main and auxiliary hoists.	The FHM main and auxiliary hoists are single-failure-proof.
2.	The FHM main hoist is capable of lifting and supporting its rated load, holding the rated load, and transporting the rated load.	A rated load test will be performed of the FHM main hoist.	The FHM main hoist lifts, supports, holds with the brakes, and transports a load of 125 percent of the manufacturer's rated capacity.
3.	The FHM auxiliary hoist is capable of lifting and supporting its rated load, holding the rated load, and transporting the rated load.	A rated load test will be performed of the FHM auxiliary hoist.	The FHM auxiliary hoist lifts, supports, holds with the brakes, and transports a load of 125 percent of the manufacturer's rated capacity.
4.	Single-failure-proof FHM welds are inspected.	An inspection will be performed of the as-built FHM.	The results of the non-destructive examination of the FHM welds comply with American Society of Mechanical Engineers NOG-1 Code.
5.	The FHM travel is limited to maintain a water inventory for personnel shielding with the pool level at the lower limit of the normal operating low water level.	A test will be performed of the FHM gripper mast limit switches.	The FHM maintains at least 10 feet of water above the top of the fuel assembly when lifted to its maximum height with the pool level at the lower limit of the normal operating low water level.

3.5 Fuel Storage System

3.5.1 Design Description

System Description

The scope of this section is the fuel storage system. The fuel storage system consists of the fuel storage racks in the spent fuel pool (SFP) that can store either spent fuel assemblies or new fuel assemblies. The fuel storage system is a nonsafety-related system. The fuel storage system supports up to 12 NuScale Power Modules (NPMs). The Reactor Building houses all fuel storage system equipment.

The fuel storage system performs the following nonsafety-related system functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The fuel storage system supports the reactor fuel assembly system by providing mechanical support for storage of new and spent fuel in a wet storage location.
- The fuel storage system supports the reactor fuel assembly system by providing neutron absorption to ensure subcriticality during storage of new and spent fuel.
- The fuel storage system supports the control rod assembly system by providing mechanical support for storage of control rods in fuel assemblies.

Design Commitments

- The fuel storage system American Society of Mechanical Engineers (ASME) Code Class NF components conform to the rules of construction of ASME Code Section III.
- The fuel storage racks maintain an effective neutron multiplication factor (k-effective) within the following limits at a 95 percent probability, 95 percent confidence level when loaded with fuel of the maximum reactivity to assure subcriticality during plant life, including normal operations and postulated accident conditions:
  - If credit for soluble boron is taken, k-effective must not exceed 0.95 if flooded with borated water, and k-effective must not exceed 1.0 if flooded with unborated water.

3.5.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.5-1 contains the inspections, tests, and analyses for the fuel storage system.

Table 3.5-1: Fuel Storage System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	The fuel storage system ASME Code Class NF components conform to the rules of construction of ASME Code Section III.	An inspection will be performed of the fuel storage system ASME Code Class NF as-built component Data Reports required by ASME Code Section III.	ASME Code Section III Data Reports for the fuel storage system ASME Code Class NF fuel storage racks exist and conclude that the requirements of ASME Code Section III are met.
2	The fuel storage racks maintain an effective neutron multiplication factor (k-effective) within the following limits at a 95 percent probability, 95 percent confidence level when loaded with fuel of the maximum reactivity to assure subcriticality during plant life, including normal operations and postulated accident conditions: • If credit for soluble boron is taken, k-effective must not exceed 0.95 if flooded with borated water, and k-effective must not exceed 1.0 if flooded with unborated water.	An inspection will be performed of the as-built fuel storage racks, their configuration in the SFP, and the associated documentation.	The as-built fuel storage racks, including any neutron absorbers, and their configuration within the SFP conform to the design values for materials and dimensions and their tolerances, as shown to be acceptable in the approved fuel storage criticality analysis.

3.6 Ultimate Heat Sink

3.6.1 Design Description

System Description

The scope of this section is the ultimate heat sink (UHS). The UHS is the system of structures and components credited for functioning as a heat sink for decay heat removal from the NuScale Power Modules during normal reactor operations or shutdown following an accident or transient, including a loss-of-coolant accident. The UHS is a safety-related system and supports up to 12 NuScale Power Modules. The Reactor Building (RXB) houses all UHS equipment.

The configuration of the UHS includes the combined volume of water in the reactor pool, refueling pool (RFP), and spent fuel pool (SFP). The pool areas are open to each other with a weir wall partially separating the SFP from the RFP. The dry dock area is not considered part of the UHS volume.

The structural components of the reactor pool, RFP, and SFP (i.e., structural walls, weir wall, and floor) and associated pool liners are a component of the RXB structure.

The UHS performs the following safety-related system functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The UHS supports the containment system by providing the removal of heat via direct water contact with the containment vessel.
- The UHS supports the decay heat removal system by accepting the heat from the decay heat removal heat exchanger.
- The UHS supports the spent fuel system by providing the removal of decay heat from the spent fuel via direct water contact with the spent fuel assemblies.

The UHS performs the following nonsafety-related system functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The UHS supports the containment system by providing the radiation shielding for the NPMs via the water surrounding the components.
- The UHS supports the spent fuel system by providing radiation shielding for spent fuel via the water surrounding the components.
- The UHS supports the RXB by having an assured water make-up line that can provide emergency make-up water to the UHS during off-normal events.

Design Commitments

- The UHS American Society of Mechanical Engineers (ASME) Code Class 3 piping system listed in Table 3.6-1 complies with ASME Code Section III requirements.
- The spent fuel pool, refueling pool, reactor pool, and dry dock piping and connections are located to prevent the drain down of the SFP water level below the minimum safety water level.

3.6.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.6-2 contains the inspections, tests, and analyses for the UHS.

Table 3.6-1: Ultimate Heat Sink Piping System

Piping System Description	ASME Code Section III Class
Make-up line from the exterior of the RXB to the SFP.	3

Table 3.6-2: Ultimate Heat Sink Piping System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
	The ultimate heat sink ASME Code Class 3 piping system listed in Table 3.6-1 complies with ASME Code Section III requirements.	An inspection will be performed of the ultimate heat sink ASME Code Class 3 as-built piping system Design Report required by ASME Code Section III.	The ASME Code Section III Design Report (NCA-3550) exists and concludes that the ultimate heat sink ASME Code Class 3 as-built piping system meets the requirements of ASME Code Section III.
	The spent fuel pool, refueling pool, reactor pool, and dry dock piping and connections are located to prevent the drain down of the SFP and reactor pool water level below the minimum safety water level.	An inspection will be performed of the as-built SFP, RFP, reactor pool and dry dock piping and connections.	There are no gates, openings, drains, or piping within the SFP, RFP, reactor pool, and dry dock that are below 80 ft building elevation (55 ft pool level) as measured from the bottom of the SFP and reactor pool.

3.7 Fire Protection System

3.7.1 Design Description

System Description

The scope of this section is the fire protection system (FPS). The FPS is comprised of the equipment and components that provide early fire detection and suppression to limit the spread of fires. The FPS is a nonsafety-related system that supports up to 12 NuScale Power Modules (NPMs). The FPS equipment is located throughout the plant site.

The FPS includes the following equipment:

- fire water storage tanks, motor and diesel driven fire pumps, jockey pump, distribution piping, valves, and fire hydrants
- automatic fire detection, fire alarm notification, and fire suppression systems, including fire water supply and distribution systems
- manual firefighting capability, including portable fire extinguishers, standpipes, hydrants, hose stations, and fire department connections

The FPS performs the following nonsafety-related system functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The FPS supports the Reactor Building by providing fire prevention, detection, and suppression.
- The FPS supports the Radioactive Waste Building by providing fire prevention, detection, and suppression.
- The FPS supports the Control Building by providing fire prevention, detection, and suppression.

Design Commitments

- Two separate firewater storage tanks provide a dedicated volume of water for firefighting.
- The FPS has a sufficient number of fire pumps to satisfy the flow demand for any FPS connected to the pumps.
- Safe-shutdown can be achieved assuming that all equipment in any one fire area (except for the main control room (MCR) and under the bioshield) is rendered inoperable by fire damage and that reentry into the fire area for repairs and operator actions is not possible. An alternative shutdown capability that is physically and electrically independent of the MCR exists. Additionally, smoke, hot gases, or fire suppressant cannot migrate from the affected fire area into other fire areas to the extent that they could adversely affect safe-shutdown capabilities, including operator actions.
- A plant fire hazards analysis (FHA) considers potential fire hazards and ensures the fire protection features in each fire area are suitable for the hazards.

3.7.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.7-1 contains the inspections, tests, and analyses for the FPS.

Table 3.7-1: Fire Protection System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	Two separate firewater storage tanks provide a dedicated volume of water for firefighting.	An inspection will be performed of the as-built firewater storage tanks.	Each firewater storage tank provides a usable water volume dedicated for firefighting that is greater than or equal to 300,000 gallons.
2	The FPS has a sufficient number of fire pumps to satisfy the flow demand for any FPS connected to the pumps.	i. An analysis will be performed of the as-built fire pumps. ii. A test will be performed of the fire pumps.	i. A report exists and concludes that the fire pumps for fire protection are selected so that the greatest single demand for any FPS connected to the pump is less than or equal to 150 percent of the rated capacity (flow) of the pump. ii. Each fire pump delivers the design flow to the FPS, while operating in the fire-fighting alignment.
3	Safe-shutdown can be achieved assuming that all equipment in any one fire area (except for the MCR and under the bioshield) is rendered inoperable by fire damage and that reentry into the fire area for repairs and operator actions is not possible. An alternative shutdown capability that is physically and electrically independent of the MCR exists. Additionally, smoke, hot gases, or fire suppressant cannot migrate from the affected fire area into other fire areas to the extent that they could adversely affect safe-shutdown capabilities, including operator actions.	A safe-shutdown analysis of the as-built plant will be performed, including a post-fire safe-shutdown circuit analysis.	A safe-shutdown analysis report exists and concludes that: • Safe-shutdown can be achieved assuming that all equipment in any one fire area (except for the MCR and under the bioshield) is rendered inoperable by fire and that reentry into the fire area for repairs and operator actions is not possible • Smoke, hot gases, or fire suppressant cannot migrate from the affected fire area into other fire areas to the extent that they could adversely affect safe-shutdown capabilities, including operator actions. • An independent alternative shutdown capability that is physically and electrically independent of the MCR exists.
4	A plant FHA considers potential fire hazards and ensures the fire protection features in each fire area are suitable for the hazards.	A FHA of the as-built plant will be performed.	A FHA report exists and concludes that: • Combustible loads and ignition sources are accounted for, and • Fire protection features are suitable for the hazards they are intended to protect against.

3.8 Plant Lighting System

3.8.1 Design Description

System Description

The scope of this section is the plant lighting system (PLS). The PLS is a nonsafety-related system and supports up to 12 NuScale Power Modules (NPMs). The PLS provides artificial illumination for the entire plant: buildings (interior and exterior), rooms, spaces, and all outdoor areas of the plant. The PLS consists of normal and emergency lighting and includes miscellaneous non-lighting loads as required.

The PLS performs the following nonsafety-related system functions that are verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The PLS supports the Reactor Building (RXB) by providing normal lighting.
- The PLS supports the RXB by providing emergency lighting.
- The PLS supports the RXB by providing emergency lighting for the remote shutdown station (RSS).
- The PLS supports the Control Building by providing normal lighting.
- The PLS supports the Control Building by providing emergency lighting in the main control room (MCR).

Design Commitments

- The PLS provides normal illumination of the operator workstations and auxiliary panels in the MCR and the operator workstations in the RSS.
- The PLS provides emergency illumination of the operator workstations and auxiliary panels in the MCR and the operator workstations in the RSS.
- Eight-hour battery-pack emergency lighting fixtures provide illumination for post-fire safe shutdown (FSSD) activities performed by operators outside the MCR and RSS where post-FSSD activities are performed.

3.8.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.8-1 contains the inspections, tests, and analyses for the PLS.

Table 3.8-1: Plant Lighting System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	The PLS provides normal illumination of the operator workstations and auxiliary panels in the MCR and operator workstations in the RSS.	i. A test will be performed of the MCR operator workstations and auxiliary panel illumination. ii. A test will be performed of the RSS operator workstations illumination.	i. The PLS provides at least 100 foot-candles illumination at the MCR operator workstations and at least 50 foot-candles at the auxiliary panels. ii. The PLS provides at least 100 foot-candles illumination at the RSS operator workstations.
2	The PLS provides emergency illumination of the operator workstations and auxiliary panels in the MCR and operator workstations in the RSS.	i. A test will be performed of the MCR operator workstations and auxiliary panel illumination. ii. A test will be performed of the RSS operator workstations illumination.	i. The PLS provides at least 10 foot-candles of illumination at the MCR operator workstations and auxiliary panels when it is the only MCR lighting system in operation. ii. The PLS provides at least 10 foot-candles at the RSS operator workstations when it is the only RSS lighting system in operation.
3	Eight-hour battery-pack emergency lighting fixtures provide illumination for post-FSSD activities performed by operators outside the MCR and RSS where post-FSSD activities are performed.	A test will be performed of the eight-hour battery-pack emergency lighting fixtures.	Eight-hour battery-pack emergency lighting fixtures illuminate their required target areas to provide at least one foot-candle illumination in the areas outside the MCR or RSS where post-FSSD activities are performed.

3.9 Radiation Monitoring - NuScale Power Modules 1 - 12

3.9.1 Design Description

System Description

The scope of this section is automatic actions of various systems based on radiation monitoring (RM). Automatic actions of systems based on RM are nonsafety-related functions. The systems actuated by these automatic RM functions are shared by NuScale Power Modules (NPMs) 1-12.

Design Commitments

- The normal control room HVAC system (CRVS) automatically responds to a high-radiation signal from 00-CRV-RT-0503, 00-CRV-RT-0504, and 00-CRV-RT-0505 to mitigate a release of radioactivity.
- The CRVS and the control room habitability system (CRHS) automatically respond to a high-radiation signal from 00-CRV-RT-0510 and 00-CRV-RT-0511 to mitigate a release of radioactivity.
- The Reactor Building HVAC system (RBVS) automatically responds to a high-radiation signal from 00-RBV-RE-0510, 00-RBV-RE-0511, and 00-RBV-RE-0512 to mitigate a release of radioactivity.
- The gaseous radioactive waste system (GRWS) automatically responds to a high-radiation signal from 00-GRW-RIT-0046 to mitigate a release of radioactivity.
- The GRWS automatically responds to a high-radiation signal from 00-GRW-RIT-0060 to mitigate a release of radioactivity.
- The GRWS automatically responds to a high-radiation signal from 00-GRW-RIT-0071 to mitigate a release of radioactivity.
- The liquid radioactive waste system (LRWS) automatically responds to a high-radiation signal from 00-LRW-RIT-0569 and 00-LRW-RIT-0571 to mitigate a release of radioactivity.
- The auxiliary boiler system (ABS) automatically responds to a high-radiation signal from 00-AB-RT-0153 to mitigate a release of radioactivity.
- The ABS automatically responds to a high-radiation signal from 00-AB-RT-0166 to mitigate a release of radioactivity.
- The pool surge control system (PSCS) automatically responds to a high-radiation signal from 00-PSC-RE-1003 to mitigate a release of radioactivity.

3.9.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.9-2 contains the inspections, tests, and analyses for radiation monitoring NPMs 1-12.

Table 3.9-1: Radiation Monitoring - NuScale Power Modules 1-12 Automatic Actions

Radiation Monitor ID(s)	Variable Monitored	Actuated Component(s)	Component ID(s)	Component Action(s)
00-CRV-RT-0503 00-CRV-RT-0504 00-CRV-RT-0505	CRVS outside air upstream of CRVS filter unit	1. CRVS filter unit bypass damper 2. CRVS filter unit bypass damper 3. CRVS filter unit inlet isolation damper 4. CRVS filter unit outlet isolation damper 5. CRVS filter unit fan	1. None 2. None 3. None 4. None 5. None	1. Close 2. Close 3. Open 4. Open 5. Start
00-CRV-RT-0510 00-CRV-RT-0511	CRVS outside air downstream of CRVS filter unit	1. CRVS outside air intake damper 2. CRVS outside air intake damper 3. CRVS filter unit fan 4. CRVS control room envelope supply damper 5. CRVS control room envelope supply damper 6. CRVS control room envelope return damper 7. CRVS control room envelope return damper 8. CRVS control room envelope smoke purge damper 9. CRVS control room envelope smoke purge damper 10. CRVS control room envelope exhaust damper 11. CRVS control room envelope exhaust damper 12. CRHS air supply isolation valve 13. CRHS air supply isolation valve 14. CRHS pressure relief isolation valve 15. CRHS pressure relief isolation valve	1. None 2. None 3. None 4. None 5. None 6. None 7. None 8. None 9. None 10. None 11. None 12. 00-CRH-SV-0001A 13. 00-CRH-SV-0001B 14. 00-CRH-SV-0002A 15. 00-CRH-SV-0002B	1. Close 2. Close 3. Stop 4. Close 5. Close 6. Close 7. Close 8. Close 9. Close 10. Close 11. Close 12. Open 13. Open 14. Open 15. Open
00-RBV-RE-0510 00-RBV-RE-0511 00-RBV-RE-0512	RBVS spent fuel pool exhaust	1. RBVS Reactor Building general exhaust isolation damper for the spent fuel pool and dry dock area 2. RBVS spent fuel pool filter unit A inlet isolation damper 3. RBVS spent fuel pool filter unit A outlet isolation damper 4. RBVS spent fuel pool filter unit A bypass isolation damper 5. RBVS spent fuel pool filter unit B inlet isolation damper 6. RBVS spent fuel pool filter unit B outlet isolation damper 7. RBVS spent fuel pool filter unit B bypass isolation damper 8. RBVS main supply AHU fan 9. RBVS main supply AHU fan 10. RBVS main supply AHU fan 11. RBVS main supply AHU fan	1. None 2. None 3. None 4. None 5. None 6. None 7. None 8. 00-RBV-AHU-0001A 9. 00-RBV-AHU-0001B 10. 00-RBV-AHU-0001C 11. 00-RBV-AHU-0001D	1. Close 2. Open 3. Open 4. Close 5. Open 6. Open 7. Close 8. Reduce flow to maintain Reactor Building (RXB) & Radioactive Waste Building (RWB) dP 9. Reduce flow to maintain RXB & RWB dP 10. Reduce flow to maintain RXB & RWB dP 11. Reduce flow to maintain RXB & RWB dP

Table 3.9-1: Radiation Monitoring - NuScale Power Modules 1-12 Automatic Actions (Continued)

Radiation Monitor ID(s)	Variable Monitored	Actuated Component(s)	Component ID(s)	Component Action(s)
00-GRW-RIT-0046	GRWS train A charcoal decay bed discharge	1. GRWS train A charcoal bed effluent isolation valve	1. 00-GRW-AOV-0047	1. Close
00-GRW-RIT-0060	GRWS train B charcoal decay bed discharge	1. GRWS train B charcoal bed effluent isolation valve	1. 00-GRW-AOV-0061	1. Close
00-GRW-RIT-0071	GRWS effluent to RBVS	1. GRWS common charcoal bed effluent isolation valve 2. GRWS common charcoal bed effluent isolation valve	1. 00-GRW-AOV-0072 2. 00-GRW-AOV-0117	1. Close 2. Close
00-LRW-RIT-0569 00-LRW-RIT-0571	LRWS discharge to utility water system (UWS)	1. LRWS to UWS isolation valve 2. LRWS to UWS isolation valve	1. 00-LRW-AOV-0570 2. 00-LRW-AOV-0580	1. Close 2. Close
00-AB-RT-0153	ABS flash tank vent	1. ABS flash tank vent pressure control valve 2. ABS high pressure steam supply isolation valve 3. ABS high pressure steam supply isolation valve	1. 00-AB-PCV-0002 2. 00-AB-AOV-0014 3. 00-AB-AOV-0160	1. Close 2. Close 3. Close
00-AB-RT-0166	ABS high pressure to low pressure steam supply	1. ABS high pressure to low pressure steam supply pressure control valve	1. 00-AB-PCV-0052	1. Close
00-PSC-RE-1003	PSCS tank vent	1. PSCS tank inlet isolation valve 2. PSCS tank outlet isolation valve	1. 00-PSC-AOV-0006 2. 00-PSC-AOV-0008	1. Close 2. Close

Table 3.9-2: Radiation Monitoring - NuScale Power Modules 1-12 Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	The CRVS automatically responds to a high-radiation signal from 00-CRV-RT-0503, 00-CRV-RT-0504, and 00-CRV-RT-0505 to mitigate a release of radioactivity.	A test will be performed of the CRVS high-radiation signals.	Upon initiation of a real or simulated CRVS high-radiation signals listed in Table 3.9-1, the CRVS automatically aligns/actuates the identified components to the positions identified in the table.
2	The CRVS and the CRHS automatically respond to a high-radiation signal from 00-CRV-RT-0510 and 00-CRV-RT-0511 to mitigate a release of radioactivity.	A test will be performed of the CRVS high-radiation signals.	Upon initiation of a real or simulated CRVS high-radiation signals listed in Table 3.9-1, the CRVS and the CRHS automatically align/actuate the identified components to the positions identified in the table.
3	The RBVS automatically responds to a high-radiation signal from 00-RBV-RE-0510, 00-RBV-RE-0511, and 00-RBV-RE-0512 to mitigate a release of radioactivity.	A test will be performed of the RBVS high-radiation signals.	Upon initiation of a real or simulated RBVS high-radiation signals listed in Table 3.9-1, the RBVS automatically aligns/actuates the identified components to the positions identified in the table.
4	The GRWS automatically responds to a high-radiation signal from 00-GRW-RIT-0046 to mitigate a release of radioactivity.	A test will be performed of the GRWS high-radiation signals.	Upon initiation of a real or simulated GRWS high-radiation signals listed in Table 3.9-1, the GRWS automatically aligns/actuates the identified components to the positions identified in the table.
5	The GRWS automatically responds to a high-radiation signal from 00-GRW-RIT-0060 to mitigate a release of radioactivity.	A test will be performed of the GRWS high-radiation signals.	Upon initiation of a real or simulated GRWS high-radiation signals listed in Table 3.9-1, the GRWS automatically aligns/actuates the identified components to the positions identified in the table.
6	The GRWS automatically responds to a high-radiation signal from 00-GRW-RIT-0071 to mitigate a release of radioactivity.	A test will be performed of the GRWS high-radiation signals.	Upon initiation of a real or simulated GRWS high-radiation signals listed in Table 3.9-1, the GRWS automatically aligns/actuates the identified components to the positions identified in the table.
7	The LRWS automatically responds to a high-radiation signal from 00-LRW-RIT-0569 and 00-LRW-RIT-0571 to mitigate a release of radioactivity.	A test will be performed of the LRWS high-radiation signals.	Upon initiation of a real or simulated LRWS high-radiation signals listed in Table 3.9-1, the LRWS automatically aligns/actuates the identified components to the positions identified in the table.
8	The ABS automatically responds to a high-radiation signal from 00-AB-RT-0153 to mitigate a release of radioactivity.	A test will be performed of the ABS high-radiation signal.	Upon initiation of a real or simulated ABS high-radiation signal listed in Table 3.9-1, the ABS automatically aligns/actuates the identified components to the positions identified in the table.

Table 3.9-2: Radiation Monitoring - NuScale Power Modules 1-12 Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
9	The ABS automatically responds to a high-radiation signal from 00-AB-RT-0166 to mitigate a release of radioactivity.	A test will be performed of the ABS high-radiation signal.	Upon initiation of a real or simulated ABS high-radiation signal listed in Table 3.9-1, the ABS automatically aligns/actuates the identified components to the positions identified in the table.
10	The PSCS automatically responds to a high-radiation signal from 00-PSC-RE-1003 to mitigate a release of radioactivity.	A test will be performed of the PSCS high-radiation signal.	Upon initiation of a real or simulated PSCS high-radiation signal listed in Table 3.9-1, the PSCS automatically aligns/actuates the identified components to the positions identified in the table.

3.10 Reactor Building Crane

3.10.1 Design Description

System Description

The scope of this section is the Reactor Building crane (RBC). The RBC is a bridge crane that rides on rails anchored to the Reactor Building. The bridge crane can travel the length of the reactor pool, refueling pool, and the dry dock. The RBC is nonsafety-related and supports up to 12 NuScale Power Modules (NPMs). The Reactor Building houses all RBC equipment.

The RBC includes the following:

- RBC with auxiliary hoist
- below-the-hook lifting devices, including the module lifting adapter and the wet hoist

The RBC performs the following risk-significant system function that is verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The RBC supports the NuScale Power Module by providing structural support and mobility while moving from refueling, inspection and operating bay.

Design Commitments

- The single-failure-proof RBC main hoist is constructed to provide assurance that a failure of a single hoist mechanism does not result in the uncontrolled movement of the lifted load.
- The single-failure-proof RBC auxiliary hoists are constructed to provide assurance that a failure of a single hoist mechanism does not result in the uncontrolled movement of the lifted load.
- The single-failure-proof RBC wet hoist is constructed to provide assurance that a failure of a single hoist mechanism does not result in the uncontrolled movement of the lifted load.
- The RBC main hoist is capable of lifting and supporting its rated load, holding the rated load, and transporting the rated load.
- The RBC auxiliary hoists are capable of lifting and supporting their rated load, holding the rated load, and transporting the rated load.
- The RBC wet hoist is capable of lifting and supporting its rated load, holding the rated load, and transporting the rated load.
- Load path RBC welds are inspected.
- Load path RBC wet hoist welds are inspected.

3.10.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.10-1 contains the inspections, tests, and analyses for the RBC.

Table 3.10-1: Reactor Building Crane Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	The single-failure-proof RBC main hoist is constructed to provide assurance that a failure of a single hoist mechanism does not result in the uncontrolled movement of the lifted load.	An inspection will be performed of the as-built RBC main hoist.	The RBC main hoist is single-failure-proof.
2	The single-failure-proof RBC auxiliary hoists are constructed to provide assurance that a failure of a single hoist mechanism does not result in the uncontrolled movement of the lifted load.	An inspection will be performed of the as-built RBC auxiliary hoists.	The RBC auxiliary hoists are single-failure-proof.
3	The single-failure-proof RBC wet hoist is constructed to provide assurance that a failure of a single hoist mechanism does not result in the uncontrolled movement of the lifted load.	An inspection will be performed of the as-built RBC wet hoist.	The RBC wet hoist is single-failure-proof.
4	The RBC main hoist is capable of lifting and supporting its rated load, holding the rated load, and transporting the rated load.	A rated load test will be performed of the RBC main hoist.	The RBC main hoist lifts, supports, holds with the brakes, and transports a load of 125 to 130 percent of the manufacturer's rated capacity.
5	The RBC auxiliary hoists are capable of lifting and supporting their rated load, holding the rated load, and transporting the rated load.	A rated load test will be performed of the RBC auxiliary hoists.	The RBC auxiliary hoists lift, support, hold with the brakes, and transport a load of 125 to 130 percent of the manufacturer's rated capacity.
6	The RBC wet hoist is capable of lifting and supporting its rated load, holding the rated load, and transporting the rated load.	A rated load test will be performed of the RBC wet hoist.	The RBC wet hoist lifts, supports, holds with the brakes, and transports a load of 125 to 130 percent of the manufacturer's rated capacity.
7	Load path RBC welds are inspected.	An inspection will be performed of the as-built RBC.	The results of the non-destructive examination of the RBC welds comply with American Society of Mechanical Engineers NOG-1 Code.
8	Load path RBC wet hoist welds are inspected.	An inspection will be performed of the as-built RBC wet hoist.	The results of the non-destructive examination of the RBC wet hoist welds comply with American Society of Mechanical Engineers NOG-1 Code.

3.11 Reactor Building

3.11.1 Design Description

Building Description

The scope of this section is the Reactor Building (RXB) and the Reactor Building components (RBCM). The RXB is a safety-related structure. The RBCM is a nonsafety-related system. The RXB and RBCM support up to 12 NuScale Power Modules. The RXB is a reinforced-concrete structure that is embedded in soil and supported on a basemat foundation. The RBCM consists of the dry dock gate, RXB equipment door, bioshields, and pool liners. The RXB houses all RBCM equipment.

The RXB performs the following safety-related system function that is verified by Inspections, Tests, Analyses, and Acceptance Criteria (ITAAC):

- The RXB supports the following systems by housing and providing structural support:
  - NuScale Power Module
  - chemical and volume control system (CVCS)
  - ultimate heat sink
  - module protection system
  - nuclear monitoring system

The RXB performs the following nonsafety-related, risk-significant system function that is verified by ITAAC:

- The RXB supports the RXB crane by housing and providing structural support.

The RBCM perform the following nonsafety-related system function that is verified by ITAAC:

- The RBCM Reactor Building equipment door supports the RXB by providing part of the RXB wall and a physical barrier between the RXB and Radioactive Waste Building.

Design Commitments

- Fire and smoke barriers provide confinement so that the impact from internal fires, smoke, hot gases, or fire suppressants is contained within the RXB fire area of origin.
- Internal flooding barriers provide confinement so that the impact from internal flooding is contained within the RXB flooding area of origin.
- The Seismic Category I RXB is protected against external flooding in order to prevent flooding of safety-related structures, systems, and components (SSC) within the structure.
- The RXB includes radiation shielding barriers for normal operation and post-accident radiation shielding.
- The RXB includes radiation attenuating doors for normal operation and post-accident radiation shielding. These doors have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed.

- The RXB is Seismic Category I and maintains its structural integrity under the design basis loads.
- Non-Seismic Category I SSC located where a potential for adverse interaction with a Seismic Category I SSC exists in the RXB will not impair the ability of Seismic Category I SSC to perform their safety functions during or following a safe shutdown earthquake (SSE).

3.11.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.11-2 contains the inspections, tests, and analyses for the RXB.

Table 3.11-1: Shield Wall Geometry

Elev.	Room Name	North Wall	East Wall	South Wall	West Wall	Floor	Ceiling
24′	Module 1 CVCS ion exchanger sluice room	20″ structural steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 2 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 3 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 4 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 5 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 6 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 7 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 8 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 9 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 10 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 11 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Module 12 CVCS ion exchanger sluice room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	20" concrete/steel composite slab
24′	Degasifier room “A”	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
24′	Degasifier room “B”	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
24′	Pool cleanup filter room “A”	5′ concrete, RXB wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
24′	Pool cleanup filter room “B”	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
24′	Pool cleanup system (PCUS) demin room #1	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)

Table 3.11-1: Shield Wall Geometry (Continued)

Elev.	Room Name	North Wall	East Wall	South Wall	West Wall	Floor	Ceiling
24′	PCUS demin room #2	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
24′	PCUS demin room #3	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	10′ concrete (ground floor)	3′ concrete (floor of 50′ elevation)
35-8″	Module 1 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 2 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 3 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 4 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 5 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 6 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 7 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 8 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 9 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 10 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 11 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
35-8″	Module 12 CVCS recirc. pump room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 50′ elevation)
50′	Module 1 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 2 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 3 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 4 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab

Table 3.11-1: Shield Wall Geometry (Continued)

Elev.	Room Name	North Wall	East Wall	South Wall	West Wall	Floor	Ceiling
50′	Module 5 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 6 CVCS heat exchanger room	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 7 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20″ structural steel partition wall
50′	Module 8 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 9 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 10 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 11 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Module 12 CVCS heat exchanger room	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ structural steel partition wall	20″ concrete/steel partition wall	3′ concrete (floor of 50′ elevation)	20" concrete/steel composite slab
50′	Vertical pipe chase	20″ concrete	20″ concrete	20″ concrete	5′ concrete (RXB exterior)	N/A	N/A
62′	Modules 1-6 heatup heat exchangers	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 75′ elevation)
62′	Modules 7-12 heatup heat exchangers	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete, RXB exterior wall	20″ concrete/steel partition wall	20" concrete/steel composite slab	3′ concrete (floor of 75′ elevation)
75′	Modules 1-6 CVCS vertical pipe chases	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	N/A	N/A
75′	Modules 7-12 CVCS vertical pipe chases	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	N/A	N/A
86′	Modules 1-6 CVCS vertical pipe chases	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	N/A	N/A
86′	Modules 7-12 CVCS vertical pipe chases	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	N/A	N/A
100′	Modules 1-6 CVCS vertical pipe chases	20″ concrete/steel partition wall	20″ concrete/steel partition wall	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	N/A	N/A

Table 3.11-1: Shield Wall Geometry (Continued)

Elev.	Room Name	North Wall	East Wall	South Wall	West Wall	Floor	Ceiling
100′	Modules 7-12 CVCS vertical pipe chases	5′ concrete (reactor pool wall)	20″ concrete/steel partition wall	20″ concrete/steel partition wall	20″ concrete/steel partition wall	N/A	N/A
126′	Reactor pool area	5′ concrete wall	5′ concrete wall	5′ concrete wall	5′ concrete wall	21.5″ concrete, 2″ high-density polyethylene, 0.25″ steel (Bioshield)	4′ concrete roof

Table 3.11-2: Reactor Building Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	Fire and smoke barriers provide confinement so that the impact from internal fires, smoke, hot gases,or fire suppressants is contained within the RXB fire area of origin.	An inspection will be performed of the RXB as-built fire and smoke barriers.	The following RXB fire and smoke barriers exist in accordance with the fire hazards analysis, and have been qualified for the fire rating specified in the fire hazards analysis: • fire-rated doors • fire-rated penetration seals • fire-rated dampers • fire-rated walls, floors, and ceilings • smoke barriers
2	Internal flooding barriers provide confinement so that the impact from internal flooding is contained within the RXB flooding area of origin.	An inspection will be performed of the RXB as-built internal flooding barriers.	The following RXB internal flooding barriers exist in accordance with the internal flooding analysis report and have been qualified as specified in the internal flooding analysis report: • flood resistant doors • curbs and sills • walls • water tight penetration seals • National Electrical Manufacturer's Association enclosures
3	The Seismic Category I RXB is protected against external flooding in order to prevent flooding of safety-related SSC within the structure.	An inspection will be performed of the RXB as-built floor elevation at ground entrances.	The RXB floor elevation at ground entrances is higher than the maximum external flood elevation.
4	The RXB includes radiation shielding barriers for normal operation and post-accident radiation shielding.	An inspection will be performed of the as-built RXB radiation shielding barriers.	The thickness of RXB radiation shielding barriers is greater than or equal to the required thickness specified in Table 3.11-1.
5	The RXB includes radiation attenuating doors for normal operation and for post-accident radiation shielding. These doors have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed.	An inspection will be performed of the as-built RXB radiation attenuating doors.	The RXB radiation attenuating doors are installed in their design location and have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed in accordance with the approved door schedule design.

Table 3.11-2: Reactor Building Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
6	The RXB is Seismic Category I and maintains its structural integrity under the design basis loads.	i. An inspection and analysis will be performed of the as-built RXB. ii. An inspection will be performed of the as- built RXB.	i. A design report exists and concludes that the deviations between the drawings used for construction and the as-built RXB have been reconciled, and the RXB maintains its structural integrity under the design basis loads. ii. The dimensions of the RXB critical sections conform to the approved design.
7	Non-Seismic Category I SSC located where a potential for adverse interaction with a Seismic Category I SSC exists in the RXB will not impair the ability of Seismic Category I SSC to perform their safety functions during or following a SSE.	An inspection and analysis will be performed of the as-built non-Seismic Category I SSC in the RXB.	A report exists and concludes that the Non-Seismic Category I SSC located where a potential for adverse interaction with a Seismic Category I SSC exists in the RXB will not impair the ability of Seismic Category I SSC to perform their safety functions during or following an SSE as demonstrated by one or more of the following criteria: • Seismic Category I SSC are isolated from non-Seismic Category I SSC, so that interaction does not occur. • Seismic Category I SSC are analyzed to confirm that the ability to perform their safety functions is not impaired as a result of impact from non-Seismic Category I SSC. • A non-Seismic Category I restraint system designed to Seismic Category I requirements is used to assure that no interaction occurs between Seismic Category I SSC and non-Seismic Category I SSC.

3.12 Radioactive Waste Building

3.12.1 Design Description

Building Description

The scope of this section is the Radioactive Waste Building (RWB). The RWB is a nonsafety-related building which supports up to 12 NuScale Power Modules (NPMs). The RWB is located west of the Reactor Building (RXB) and serves as the primary radioactive waste facility to collect waste from the RXB and the Annex Building.

The RWB is a reinforced-concrete structure with a concrete roof supported on a steel frame. It is embedded in soil and is supported on a foundation basemat. There are penetrations in the east wall and in the west wall through which the NuScale Power Module is transported into the RXB using a module import trolley.

Design Commitments

- The RWB includes radiation shielding barriers for normal operation and post-accident radiation shielding.
- The RWB includes radiation attenuating doors for normal operation and for post-accident radiation shielding. These doors have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed.
- The RWB is an RW-IIa structure and maintains its structural integrity under the design basis loads.

3.12.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.12-2 contains the inspections, tests, and analyses for the RWB.

Table 3.12-1: Radioactive Waste Building Shield Wall Geometry

Elev.	Room Name	North wall	East wall	South wall	West wall	Floor	Ceiling
71′	Tank room	20″ concrete	20″ concrete	20″ concrete	48″ concrete wall (Facility external wall)	60″ concrete (Facility basemat)	24″ concrete
71′	Tank room	20″ concrete	20″ concrete	20″ concrete	48″ concrete wall (Facility external wall)	60″ concrete (Facility basemat)	24″ concrete
71′	Tank room	36″ concrete	48″ concrete wall (Facility external wall)	15″ concrete	15″ concrete	60″ concrete (Facility basemat)	24″ concrete
71′	Tank room	36″ concrete	15″ concrete	15″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	36″ concrete	24″ concrete	24″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	36″ concrete	24″ concrete	24″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	24″ concrete	36″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	24″ concrete	36″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	24″ concrete	36″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	24″ concrete	24″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	24″ concrete	24″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	24″ concrete	34″ concrete	24″ concrete	24″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	36″ concrete	34″ concrete	36″ concrete	34″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Tank room	36″ concrete	48″ concrete wall (Facility external wall)	36″ concrete	34″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	High integrity container filling room	36″ concrete	36″ concrete	36″ concrete	36″ concrete	60″ concrete (facility basemat)	24″ concrete
71′	Class A/B/C high integrity container room	36″ concrete	36″ concrete	36″ concrete	48″ concrete wall (Facility external wall)	60″ concrete (facility basemat)	24″ concrete
82′	Pipe chase	24″ concrete	24″ concrete	24″ concrete	24″ concrete	20″ concrete	24″ concrete
100′	Liquid radioactive waste mobile processing area	24″ concrete	36″ concrete	24″ concrete	36″ concrete	24″ concrete	12″ concrete - Facility ceiling
100′	Drum dryer room A	24″ concrete	36″ concrete	24″ concrete	12″ concrete	24″ concrete	12″ concrete - Facility ceiling

Table 3.12-2: Radioactive Waste Building ITAAC

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	The RWB includes radiation shielding barriers for normal operation and post-accident radiation shielding.	An inspection will be performed of the as-built RWB radiation shielding barriers.	The thickness of RWB radiation shielding barriers is greater than or equal to the required thickness specified in Table 3.12-1.
2	The RWB includes radiation attenuating doors for normal operation and for post-accident radiation shielding. These doors have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed.	An inspection will be performed of the as-built RWB radiation attenuating doors.	The RWB radiation attenuating doors are installed in their design location and have a radiation attenuation capability that meets or exceeds that of the wall within which they are installed in accordance with the approved door schedule design.
3	The RWB is an RW-IIa structure and maintains its structural integrity under the design basis loads.	An inspection and analysis will be performed of the as-built RW-IIa RWB.	A design report exists and concludes that the deviations between the drawings used for construction and the as-built RW-IIa RWB have been reconciled and that the as-built RW-IIa RWB maintains its structural integrity under the design basis loads.

3.13 Control Building

3.13.1 Design Description

Building Description

The scope of this section is the Control Building (CRB). The CRB is a safety-related building that supports up to 12 NuScale Power Modules (NPMs). The CRB houses the main control room, the technical services center, the control room habitability system, the normal control room HVAC system, and safety and non-safety control and instrumentation systems.

The CRB is designated as Seismic Category I up to and including Elevation 120'-0" and Seismic Category II above Elevation 120'-0". The CRB is a reinforced-concrete building with an upper steel structure supporting the roof and has an underground equipment tunnel that connects to the Reactor Building. The tunnel is comprised of two levels-- an upper tunnel for personnel access to the Reactor Building and a lower tunnel that is a utilities tunnel between the CRB and for the Reactor Building. Above Elevation 120'-0", the CRB is a steel structure supporting a steel roof.

The CRB performs the following safety-related system function that is verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The CRB supports the module protection system by housing and providing structural support.

The CRB performs the following nonsafety-related system function that is verified by Inspections, Tests, Analyses, and Acceptance Criteria:

- The CRB supports the normal control room HVAC system by providing a portion of the control room envelope.

Design Commitments

- Fire and smoke barriers provide confinement so that the impact from internal fires, smoke, hot gases, or fire suppressants is contained within the CRB fire area of origin.
- Internal flooding barriers provide confinement so that the impact from internal flooding is contained within the CRB flooding area of origin.
- The Seismic Category I CRB is protected against external flooding in order to prevent flooding of safety-related structures, systems, and components (SSC) within the structure.
- The CRB at Elevation 120'-0" and below is Seismic Category I and maintains its structural integrity under the design basis loads.
- Non-Seismic Category I SSC located where a potential for adverse interaction with a Seismic Category I SSC exists in the CRB will not impair the ability of Seismic Category I SSC to perform their safety functions during or following a safe shutdown earthquake.

3.13.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.13-1 contains the inspections, tests, and analyses for the CRB.

Table 3.13-1: Control Building Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1	Fire and smoke barriers provide confinement so that the impact from internal fires, smoke, hot gases, or fire suppressants is contained within the CRB fire area of origin.	An inspection will be performed of the CRB as-built fire and smoke barriers.	The following CRB fire and smoke barriers exist in accordance with the fire hazards analysis, and have been qualified for the fire rating specified in the fire hazards analysis: • fire-rated doors • fire-rated penetration seals • fire-rated dampers • fire-rated walls, floors, and ceilings • smoke barriers
2	Internal flooding barriers provide confinement so that the impact from internal flooding is contained within the CRB flooding area of origin.	An inspection will be performed of the CRB as-built internal flooding barriers.	The following CRB internal flooding barriers exist in accordance with the internal flooding analysis report and have been qualified as specified in the internal flooding analysis report: • flood resistant doors • walls • water tight penetration seals • National Electrical Manufacturer's Association (NEMA) enclosures
3	The Seismic Category I CRB is protected against external flooding in order to prevent flooding of safety-related SSC within the structure.	An inspection will be performed of the CRB as-built floor elevation at ground entrances.	The CRB floor elevation at ground entrances is higher than the maximum external flood elevation.

Table 3.13-1: Control Building Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
4	The CRB at Elevation 120'-0" and below is Seismic Category I and maintains its structural integrity under the design basis loads.	i. An inspection and analysis will be performed of the as-built CRB. ii. An inspection will be performed of the as-built CRB at Elevation 120'-0" and below.	i. A design report exists and concludes that the deviations between the drawings used for construction and the as-built CRB have been reconciled, and the CRB at Elevation 120'-0" and below maintains its structural integrity under the design basis loads. ii. The dimensions of the CRB critical sections conform to the approved design.
5	Non-Seismic Category I SSC located where a potential for adverse interaction with a Seismic Category I SSC exists in the CRB will not impair the ability of Seismic Category I SSC to perform their safety functions during or following a safe shutdown earthquake.	An inspection and analysis will be performed of the as-built non-Seismic Category I SSC in the CRB.	A report exists and concludes that the Non-Seismic Category I SSC located where a potential for adverse interaction with a Seismic Category I SSC exists in the CRB will not impair the ability of Seismic Category I SSC to perform their safety functions during or following a safe-shutdown earthquake as demonstrated by one or more of the following criteria: • The collapse of the non-seismic Category I structure to strike a seismic Category I SSC. • The collapse of the non-Category I structure will not impair the integrity of Seismic Category I SSCs, nor result in incapacitating injury to control room occupants, • The non-Category I structure will be analyzed and designed to prevent its failure under SSE conditions.

3.14 Environmental Qualification - Common Equipment

3.14.1 Design Description

System Description

The scope of this section is equipment qualification (EQ) of equipment shared by NuScale Power Modules 1 through 12. Equipment qualification applies to mechanical and electrical equipment located in harsh environments. The mechanical and electrical equipment identified in 10 CFR 50.49 are subject to EQ.

Design Commitments

- The Seismic Category I equipment, including its associated supports and anchorages, withstands design basis seismic loads without loss of its safety-related function(s) during and after a safe shutdown earthquake.
- The Class 1E electrical equipment located in a harsh environment, including its connection assemblies, withstands the design basis harsh environmental conditions experienced during normal operations, anticipated operational occurrences, design basis accidents, and post-accident conditions, and performs its function for the period of time required to complete the function.

3.14.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.14-2 contains the inspections, tests, and analyses for EQ -- common equipment.

Table 3.14-1: Mechanical and Electrical/Instrumentation and Controls Common Equipment

Plant ID	Description	Location	EQ Environment	EQ Program	Seismic Cate	Class 1E	EQ Category[(1)]
Fuel Handling Equipment							
CRN-0001	Fuel handling machine (FHM)	Reactor Building (RXB) 24'-0" Elevation	Harsh	Electrical Mechanical	I	N/A	B
None	FHM load path components.	RXB 24'-0" Elevation	Harsh	Mechanical	I	N/A	B
None	FHM critical control systems	RXB 100'-0" Elevation	Harsh	Electrical	I	N/A	B
None	FHM load cell	RXB 100'-0" Elevation	Harsh	Electrical	I	N/A	B
Reactor Pool Cooling System							
TE-1010A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1010B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1011A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1011B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1012A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1012B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1013A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1013B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1014A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1014B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1015A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1015B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1016A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1016B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1017A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1017B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1018A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1018B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1019A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1019B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1020A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1020B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1021A	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A
TE-1021B	Instrumentation - temperature	RXB 24'-0" Elevation	Harsh	Electrical	I	N/A	A

Table 3.14-1: Mechanical and Electrical/Instrumentation and Controls Common Equipment (Continued)

Plant ID	Description	Location	EQ Environment	EQ Program	Seismic Cate	Class 1E	EQ Category(1)
Ultimate Heat Sink							
LI/LIT-101A LI/LIT-101B LI/LIT-102A LI/LIT-102B	Pool level instruments	RXB 24′-0″ Elevation	Harsh	Electrical	I	N/A	A
Radiation Monitoring System							
None	Radiation monitoring that monitor post-accident monitoring B & C variables	Containment vessel, module pool bay vapor space - outside containment and under the bioshield, RXB 24′-0″′ thru 145′-6″ Elevation	Harsh	Electrical	I	1E	A
Reactor Building Cranes							
CRN-0001	Reactor Building crane	RXB 100′-0″′ thru 145′-6″ Elevation	Harsh	Electrical Mechanical	I	N/A	B

Notes:

1. EQ Categories:

- a - Equipment that will experience the environmental conditions of design basis accidents for which it must function to mitigate said accidents, and that will be qualified to demonstrate operability in the accident environment for the time required for accident mitigation with safety margin to failure.
- b - Equipment that will experience the environmental conditions of design basis accidents through which it need not function for mitigation of said accidents, but through which it must not fail in a manner detrimental to plant safety or accident mitigation, and that will be qualified to demonstrate the capability to withstand the accident environment for the time during which it must not fail with safety margin to failure.

Table 3.14-2: Equipment Qualification - Common Equipment ITAAC

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	The Seismic Category I equipment, including its associated supports and anchorages, withstands design basis seismic loads without loss of its safety-related function(s) during and after a safe shutdown earthquake.	i. A type test, analysis, or a combination of type test and analysis will be performed of the Seismic Category I equipment, including its associated supports and anchorages.	i. A seismic qualification record form exists and concludes that the Seismic Category I equipment listed in Table 3.14-1, including its associated supports and anchorages, will withstand the design basis seismic loads and perform its safety function during and after a safe shutdown earthquake.
		ii. An inspection will be performed of the Seismic Category I as-built equipment, including its associated supports and anchorages.	ii. The Seismic Category I equipment listed in Table 3.14-1, including its associated supports and anchorages, is installed in its design location in a Seismic Category I structure in a configuration bounded by the equipment's seismic qualification record form.
2.	The Class 1E electrical equipment located in a harsh environment, including its connection assemblies, withstands the design basis harsh environmental conditions experienced during normal operations, anticipated operational occurrences, DBA, and post-accident conditions and performs its function for the period of time required to complete the function.	i. A type test or a combination of type test and analysis will be performed of the Class 1E electrical equipment, including its connection assemblies.	i. An equipment qualification record form exists and concludes that the Class 1E electrical equipment listed in Table 3.14-1, including its connection assemblies, performs its function under the environmental conditions specified in the equipment qualification record form for the period of time required to complete the function.
		ii. An inspection will be performed of the Class 1E as-built electrical equipment, including its connection assemblies.	ii. The Class 1E electrical equipment listed in Table 3.14-1, including its connection assemblies, is installed in its design location in a configuration bounded by the EQ record form.

3.15 Human Factors Engineering

3.15.1 Design Description

System Description

The human factors engineering (HFE) program design process is employed to design the control rooms and the human-system interfaces (HSIs) and associated equipment while relating the high-level goal of plant safety into individual, discrete focus areas for the design.

The HFE and control room design team establish design guidelines, define program-specific design processes, and verify that the guidelines and processes are followed. The scope of the HFE program includes the following:

- location and accessibility requirements for the control rooms and other control stations
- layout requirements of the control rooms, including requirements regarding the locations and design of individual displays and panels
- basic concepts and detailed design requirements for the information displays, controls, and alarms for HSI control stations
- coding and labeling conventions for control room components and plant displays
- HFE design requirements and guidelines for the screen-based HSI, including the actual screen layout and the standard dialogues for accessing information and controls
- requirements for the physical environment of the control rooms (e.g., lighting, acoustics, heating, ventilation, and air conditioning)
- HFE requirements and guidelines regarding the layout of operator work stations and work spaces
- corporate policies and procedures regarding the verification and validation of the design of HSI

The HFE program applies to the design of the main control room (MCR) and the remote shutdown station. The HSI of the technical support center, the emergency operations facility, and local control stations (LCS) are derivatives of the main control room (MCR) HSI, and only their impact on licensed operator workload is assessed. The design of local control station is accomplished concurrently with the applicable system design and follows guidelines established by the HFE and control room design team.

Design Commitments

- The MCR design incorporates HFE principles that reduce the potential for operator error.
- The as-built MCR HSI is consistent with the final design specifications validated by the integrated system validation test.

3.15.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.15-1 contains the inspections, tests, and analyses for the HFE.

Table 3.15-1: Human Factors Engineering Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	The MCR design incorporates HFE principles that reduce the potential for operator error.	An integrated system validation test will be performed in accordance with the Verification and Validation Implementation Plan.	An Integrated System Validation Report exists and concludes that acceptance criteria associated with each test scenario are satisfied upon initial performance of the scenarios or upon remediation of failures.
2.	The as-built main control room HSI is consistent with the final design specifications validated by the integrated system validation test.	An inspection will be performed of the as-built configuration of MCR HSI.	The as-built configuration of main control room HSI consistent with the as-designed configuration of main control room HSI as modified by the Integrated System Validation Report.

3.16 Physical Security System

3.16.1 Design Description

System Description

The NuScale Power Plant physical security system design provides the capabilities to detect, assess, impede and delay threats up to and including the design basis threat, and to provide for defense-in-depth through the integration of systems, technologies, and equipment.

Design Commitments

- Vital equipment within the Reactor Building (RXB) and Control Building (CRB) will be located in a vital area.
- Access to vital equipment within the RXB and CRB will require passage through at least two physical barriers.
- The external walls, doors, ceiling, and floors in the main control room (MCR), central alarm station (CAS), and the last access control function for access to the protected area will be bullet-resistant.
- An access control system will be installed and designed for use by individuals who are authorized access to vital areas within the RXB and CRB without escort.
- Unoccupied vital areas within the RXB and CRB will be designed with locking devices and intrusion-detection devices that annunciate in the CAS.
- The CAS will be located inside the protected area and will be designed so that the interiors is not visible from the perimeter of the protected area.
- Security alarm devices, including transmission lines to annunciators, will be tamper-indicating and self-checking, and alarm annunciation indicates the type of alarm and its location.
- Intrusion-detection and assessment systems for the RXB and CRB will be designed to provide visual display and audible annunciation of alarms in the CAS.
- Intrusion detection systems' recording equipment will record onsite security alarm annunciations, including each alarm, false alarm, alarm check, and tamper indication and the type of alarm, location, alarm circuit, date, and time.
- Emergency exits in the vital area boundaries within the RXB and CRB will be alarmed with intrusion-detection devices and secured by locking devices that allow prompt egress during an emergency.
- The CAS will have landline telephone service with the control room and local law enforcement authorities.
- The CAS will be capable of continuous communication with on-duty security force personnel.
- Non-portable communications equipment in the CAS will remain operable from an independent power source in the event of the loss of normal power.

3.16.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.16-1 contains the inspections, tests, and analyses for physical security system.

Table 3.16-1: Physical Security System Inspections, Tests, Analyses, and Acceptance Criteria

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	Vital equipment will be located only within a vital area.	All vital equipment locations will be inspected.	Vital equipment is located only within a vital area.
2.	Access to vital equipment requires passage through at least two physical barriers.	All vital equipment physical barriers will be inspected.	Vital equipment is located within a protected area such that access to the vital equipment requires passage through at least two physical barriers.
3.	The external walls, doors, ceiling, and floors in the MCR and CAS will be bullet-resistant.	Type test, analysis, or a combination of type test and analysis of the external walls, doors, ceiling, and floors in the MCR and CAS, will be performed.	A report exists and concludes that the walls, doors, ceilings, and floors in the MCR and CAS are bullet-resistant.
4.	An access control system will be installed and designed for use by individuals who are authorized access to vital areas within the nuclear island and structures without escort.	The access control system will be tested.	The access control system is installed and provides authorized access to vital areas within the nuclear island and structures only to those individuals with authorization for unescorted access.
5.	Unoccupied vital areas within the nuclear island and structures will be designed with locking devices and intrusion detection devices that annunciate in the CAS.	Tests, inspections, or a combination of tests and inspections of unoccupied vital areas' intrusion detection equipment and locking devices will be performed.	Unoccupied vital areas within the nuclear island and structures are locked and alarmed and intrusion is detected and annunciated in the CAS.
6.	The CAS will be located inside the protected area and will be designed so that the interior is not visible from the perimeter of the protected area.	The CAS will be inspected.	The CAS is located inside the protected area, and the interior of the alarm station is not visible from the perimeter of the protected area.
7.	Security alarm devices, including transmission lines to annunciators, will be tamper-indicating and self-checking, and alarm annunciation indicates the type of alarm and its location.	All security alarm devices and transmission lines in the RXB and CRB will be tested.	Security alarm devices, within the nuclear island and structures including transmission lines to annunciators, are tamper-indicating and self-checking; an automatic indication is provided when failure of the alarm system or a component occurs or when the system is on standby power; the alarm annunciation indicates the type of alarm and location.
8.	Intrusion detection and assessment systems within the nuclear island and structures will be designed to provide visual display and audible annunciation of alarms in the CAS.	Intrusion detection and assessment systems in the RXB and CRB will be tested.	The intrusion detection systems, within the nuclear island and structures provide a visual display and audible annunciation of all alarms in the CAS.
9.	Intrusion detection systems' recording equipment will record security alarm annunciations within the nuclear island and structures including each alarm, false alarm, alarm check, and tamper indication, and the type of alarm, location, alarm circuit, date, and time.	The intrusion detection systems' recording equipment in the RXB and CRB will be tested.	Intrusion detection systems' recording equipment is capable of recording each security alarm annunciation within the nuclear island and structures, including each alarm, false alarm, alarm check, and tamper indication and the type of alarm, location, alarm circuit, date, and time.

Table 3.16-1: Physical Security System Inspections, Tests, Analyses, and Acceptance Criteria (Continued)

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
10.	Emergency exits through the vital area boundaries will be alarmed with intrusion detection devices and within the nuclear island and structures are secured by locking devices that allow prompt egress during an emergency.	Tests, inspections, or a combination of tests and inspections of emergency exits through vital area boundaries within the nuclear island and structures will be performed.	Emergency exits through the vital area boundaries within the nuclear island and structures are alarmed with intrusion detection devices and secured by locking devices that allow egress during an emergency.
11.	The CAS will have a landline telephone service with the control room and local law enforcement authorities.	Tests, inspections, or a combination of tests and inspections of the CAS's landline telephone service will be performed.	The CAS is equipped with landline telephone service with the control room and local law enforcement authorities.
12.	The CAS will be capable of continuous communication with on-duty security force personnel.	Tests, inspections, or a combination of tests and inspections of the CAS's continuous communication capabilities will be performed.	The CAS is capable of continuous communication with on-duty watchmen, armed security officers, armed responders, or other security personnel who have responsibilities within the physical protection program and during contingency response events.
13.	Nonportable communications equipment in the CAS will remain operable from an independent power source in the event of the loss of normal power.	Tests, inspections, or a combination of tests and inspections of the nonportable communications equipment will be performed.	All nonportable communication devices in the CAS remain operable from an independent power source in the event of the loss of normal power.

3.17 Radiation Monitoring - NuScale Power Modules 1 - 6

3.17.1 Design Description

System Description

The scope of this section is automatic actions of various systems based on radiation monitoring. Automatic actions of systems based on radiation monitoring are nonsafety-related functions. The systems actuated by these automatic radiation monitoring functions are shared by NuScale Power Modules (NPMs) 1 through 6.

Design Commitments

- The containment flooding and drain system (CFDS) automatically responds to a high-radiation signal from 6A-CFD-RT-1007 to mitigate a release of radioactivity.
- The balance-of-plant drain system (BPDS) automatically responds to a high-radiation signal from 6A-BPD-RIT-0552 to mitigate a release of radioactivity.
- The BPDS automatically responds to a high-radiation signal from 6A-BPD-RIT-0529 to mitigate a release of radioactivity.
- The BPDS automatically responds to a high-radiation signal from 6A-BPD-RIT-0705 to mitigate a release of radioactivity.

3.17.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.17-2 contains the inspections, tests, and analyses for radiation monitoring -- NuScale Power Modules 1 - 6.

Table 3.17-1: Radiation Monitoring - Automatic Actions for NuScale Power Modules 1 - 6

Radiation Monitor ID(s)	Variable Monitored	Actuated Component(s)	Component ID(s)	Component Action(s)
6A-CFD-RT-1007	CFDS containment drain separator gaseous discharge to Reactor Building heating ventilation and air conditioning system	1. CFDS containment drain separator gaseous discharge isolation valve	1. 6A-CFD-AOV-0112	1. Close
6A-BPD-RIT-0552	6A condensate polishing system regeneration skid waste effluent	1. North chemical waste water sump pump A 2. North chemical waste water sump pump B 3. North chemical water sump to BPDS collection tank 4. North chemical water sump to liquid radioactive waste system (LRWS) isolation valve	1. 6A-BPD-P-0012A 2. 6A-BPD-P-0012B 3. 6A-BPD-FCV-0162 4. 6A-BPD-FCV-0163	1. Stop 2. Stop 3. Close 4. Close
6A-BPD-RIT-0529	BPDS north turbine building floor drains	1. North waste water sump pump 2. North waste water sump pump 3. North waste water sump to BPDS collection tank 4. North waste water sump to LRWS isolation valve	1. 6A-BPD-P-0002A 2. 6A-BPD-P-0002B 3. 6A-BPD-FCV-0531 4. 6A-BPD-FCV-0532	1. Stop 2. Stop 3. Close 4. Close
6A-BPD-RIT-0705	BPDS auxiliary blowdown cooler condensate	1. North waste water sump pump 2. North waste water sump pump 3. North waste water sump to BPDS collection tank 4. North waste water sump to LRWS isolation valve	1. 6A-BPD-P-0002A 2. 6A-BPD-P-0002B 3. 6A-BPD-FCV-0531 4. 6A-BPD-FCV-0532	1. Stop 2. Stop 3. Close 4. Close

Table 3.17-2: Radiation Monitoring - Inspections, Tests, Analyses, and Acceptance Criteria for NuScale Power Modules 1-6

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	The CFDS automatically responds to a high-radiation signal from 6A-CFD-RT-1007 to mitigate a release of radioactivity.	A test will be performed of the CFDS high-radiation signal.	Upon initiation of a real or simulated CFDS high-radiation signal listed in Table 3.17-1, the CFDS automatically aligns/actuates the identified components to the positions identified in the table.
2.	The BPDS automatically responds to a high-radiation signal from 6A-BPD-RIT-0552 to mitigate a release of radioactivity.	A test will be performed of the BPDS high-radiation signal.	Upon initiation of a real or simulated BPDS high-radiation signal listed in Table 3.17-1 the BPDS automatically aligns/actuates the identified components to the positions identified in the table.
3.	The BPDS automatically responds to a high-radiation signal from 6A-BPD-RIT-0529 to mitigate a release of radioactivity.	A test will be performed of the BPDS high-radiation signal.	Upon initiation of a real or simulated BPDS high-radiation signal listed in Table 3.17-1, the BPDS automatically aligns/actuates the identified components to the positions identified in the table.
4.	The BPDS automatically responds to a high-radiation signal from 6A-BPD-RIT-0705 to mitigate a release of radioactivity.	A test will be performed of the BPDS high-radiation signal.	Upon initiation of a real or simulated BPDS high-radiation signal listed in Table 3.17-1, the BPDS automatically aligns/actuates the identified components to the positions identified in the table.

3.18 Radiation Monitoring - NuScale Power Modules 7 - 12

3.18.1 Design Description

System Description

The scope of this section is automatic actions of various systems based on radiation monitoring. Automatic actions of systems based on radiation monitoring are nonsafety-related functions. The systems actuated by these automatic radiation monitoring functions are shared by NuScale Power Modules (NPMs) 7 through 12.

Design Commitments

- The containment flooding and drain system (CFDS) automatically responds to a high-radiation signal from 6B-CFD-RT-1007 to mitigate a release of radioactivity.
- The balance-of-plant drain system (BPDS) automatically responds to a high-radiation signal from 6B-BPD-RIT-0551 to mitigate a release of radioactivity.
- The BPDS automatically responds to a high-radiation signal from 6B-BPD-RIT-0530 to mitigate a release of radioactivity.

3.18.2 Inspections, Tests, Analyses, and Acceptance Criteria

Table 3.18-2 contains the inspections, tests, and analyses for radiation monitoring of NuScale Power Modules 7 - 12.

Table 3.18-1: Radiation Monitoring - Automatic Actions For NuScale Power Modules 7 - 12

Radiation Monitor ID(s)	Variable Monitored	Actuated Component(s)	Component ID(s)	Component Action(s)
6B-CFD-RT-1007	CFDS containment drain separator gaseous discharge to Reactor Building heating ventilation and air conditioning system	1. CFDS containment drain separator gaseous discharge isolation valve	1. 6B-CFD-AOV-0112	1. Close
6B-BPD-RIT-0551	6B condensate polishing system regeneration skid waste effluent	1. South chemical waste water sump pump A 2. South chemical waste water sump pump B 3. South chemical water sump to BPDS collection tank 4. South chemical water sump to liquid radioactive waste system (LWRS) isolation valve	1. 6B-BPD-P-0014A 2. 6B-BPD-P-0014B 3. 6B-BPD-FCV-0171 4. 6B-BPD-FCV-0172	1. Stop 2. Stop 3. Close 4. Close
6B-BPD-RIT-0530	BPDS south turbine building floor drains	1. South waste water sump pump 2. South waste water sump pump 3. South waste water sump to BPDS collection tank 4. South waste water sump to liquid radioactive waste system isolation valve	1. 6B-BPD-P-0005A 2. 6B-BPD-P-0005B 3. 6B-BPD-FCV-0533 4. 6B-BPD-FCV-0534	1. Stop 2. Stop 3. Close 4. Close

Table 3.18-2: Radiation Monitoring Inspections, Tests, Analyses, and Acceptance Criteria For NuScale Power Modules 7 - 12

No.	Design Commitment	Inspections, Tests, Analyses	Acceptance Criteria
1.	The CFDS automatically responds to a high-radiation signal from 6B-CFD-RT-1007 to mitigate a release of radioactivity.	A test will be performed of the CFDS high-radiation signal.	Upon initiation of a real or simulated CFDS high-radiation signal listed in Table 3.18-1, the CFDS automatically aligns/actuates the identified components to the positions identified in the table.
2.	The BPDS automatically responds to a high-radiation signal from 6B-BPD-RIT-0551 to mitigate a release of radioactivity.	A test will be performed of the BPDS high-radiation signal.	Upon initiation of a real or simulated BPDS high-radiation signal listed in Table 3.18-1, the BPDS automatically aligns/actuates the identified components to the positions identified in the table.
3.	The BPDS automatically responds to a high-radiation signal from 6B-BPD-RIT-0530 to mitigate a release of radioactivity.	A test will be performed of the BPDS high-radiation signal.	Upon initiation of a real or simulated BPDS high-radiation signal listed in Table 3.18-1, the BPDS automatically aligns/actuates the identified components to the positions identified in the table.

CHAPTER 4 INTERFACE REQUIREMENTS

4.0 Interface Requirements

As noted in10 CFR 52.47(a)(25), identification of the interface requirements is to be met by those portions of the plant for which the application does not seek certification. Also, 10 CFR 52.47(a)(26) requires justification that compliance with the interface requirements be verifiable through inspection, testing (either in the plant or elsewhere), or analysis. The method to be used for verification of interface requirements must be included as part of the proposed Inspections, Tests, Analyses, and Acceptance Criteria required by 10 CFR 52.47 (b)(1).

In additiion, 10 CFR 52.79(d)(2) requires that if the combined license application references a standard design certification, then the Final Safety Analysis Report must demonstrate that the interface requirements established for the design under § 52.47 have been met.

This section provides the Tier 1 material for interface items. No Tier 1 information is provided for the conceptual design portions that are combined license applicant scope.

4.1 Site-Specific Structures

Failure of any of the site-specific structures not within the scope of the NuScale Power Plant certified design will not cause any of the Seismic Category I structures within the scope of the NuScale Power Plant-certified design to fail.

CHAPTER 5 SITE PARAMETERS

5.0 Site Parameters

The NuScale Power Plant design certification may be deployed over a wide variety of sites; therefore, it is necessary to specify a set of design parameters that bound the site conditions that are suitable for NuScale Power Plant operation. A site for construction of a NuScale Power Plant is acceptable if the site-specific characteristics fall within the design parameter values specified in Table 5.0-1 and Figure 5.0-1 through Figure 5.0-4. In case of deviation from these parameters, justification may be provided that the proposed facility is acceptable at the proposed site.

Table 5.0-1: Site Design Parameters

Site Characteristic/Parameter	NuScale Design Parameter
Nearby Industrial, Transportation, and Military Facilities	
External hazards on plant structures, systems, and components (SSC) (e.g., explosions, fires, release of toxic chemicals and flammable clouds, pressure effects) on plant SSC	No external hazards
Aircraft hazards on plant SSC	No aircraft hazards
Meteorology	
Maximum precipitation rate	19.4 in. per hour 6.3 in. for a 5-minute period
Normal roof snow load	50 psf
Extreme roof snow load	75 psf
100-year return period 3-second wind gust speed	145 mph (Exposure Category C) with an importance factor of 1.15 for Reactor Building, Control Building, and Radioactive Waste Building
Design Basis Tornado • maximum horizontal wind speed • maximum translational speed • maximum rotational speed • maximum radius of rotational speed • maximum pressure differential • maximum rate of pressure drop	 230 mph 46 mph 184 mph 150 ft 1.2 psi 0.5 psi/sec
Tornado missile spectra	Table 2 of Regulatory Guide 1.76, Revision 1, Region 1.
Maximum wind speed design basis hurricane	290 mph
Hurricane missile spectra	Tables 1 and 2 of Regulatory Guide1.221, Revision 0.
Summer outdoor design dry bulb temperature	115°F
Winter outdoor design dry-bulb temperature	-40°F
Summer outdoor wet bulb temperature coincident non-coincident	 80°F 81°F
Accident release χ/Q values at security owner controlled area fence 0-2 hr 2-8 hr 8-24 hr 24-96 hr 96-720 hr	 5.72E-04 s/m^3 4.85E-04 s/m^3 2.14E-04 s/m^3 2.15E-04 s/m^3 1.95E-04 s/m^3
Accident release χ/Q values at main control room/ technical support center door and heating ventilation and air conditioning intake (approximately 112 feet from source) 0-2 hr 2-8 hr 8-24 hr 1-4 day 4-30 day	<u>Door</u> / <u>Heating Ventilation and Air Conditioning Intake</u> 6.50E-03 s/m^3 / 6.50E-03 s/m^3 5.34E-03 s/m^3 / 5.34E-03 s/m^3 2.32E-03 s/m^3 / 2.32E-03 s/m^3 2.37E-03 s/m^3 / 2.37E-03 s/m^3 2.14E-03 s/m^3 / 2.14E-03 s/m^3
Hydrologic Engineering	
Maximum flood elevation Probable maximum flood and coincident wind wave and other effects on maximum flood level	1 foot below the baseline plant elevation
Maximum elevation of groundwater	2 feet below the baseline plant elevation

Table 5.0-1: Site Design Parameters (Continued)

Site Characteristic/Parameter	NuScale Design Parameter
Geology, Seismology, and Geotechnical Engineering	
Ground motion response spectra/safe shutdown earthquake	See Figure 5.0-1 and Figure 5.0-2 for horizontal and vertical certified seismic design response spectra. and See Figure 5.0-3 and Figure 5.0-4 for horizontal and vertical high frequency certified seismic design response spectra.
Fault displacement potential	No fault displacement potential
Minimum soil bearing capacity (Q_{ult}) beneath safety-related structures	75 ksf
Lateral soil variability	Uniform site (± 20 degree dip)
Soil angle of internal friction	30 degrees
Minimum coefficient of static friction (all interfaces between basemat and soil)	0.58
Minimum shear wave velocity	≥ 1000 fps at bottom of foundation
Maximum settlement for the Reactor Building, Control Building, and Radioactive Waste Building: • total settlement • tilt settlement • differential settlement (between Reactor Building and Control Building)	 No limit 1 inch per 50 feet in any direction No limit
Slope failure potential	No slope failure potential

Figure 5.0-1: NuScale Horizontal Certified Seismic Design Response Spectra 5% Damping

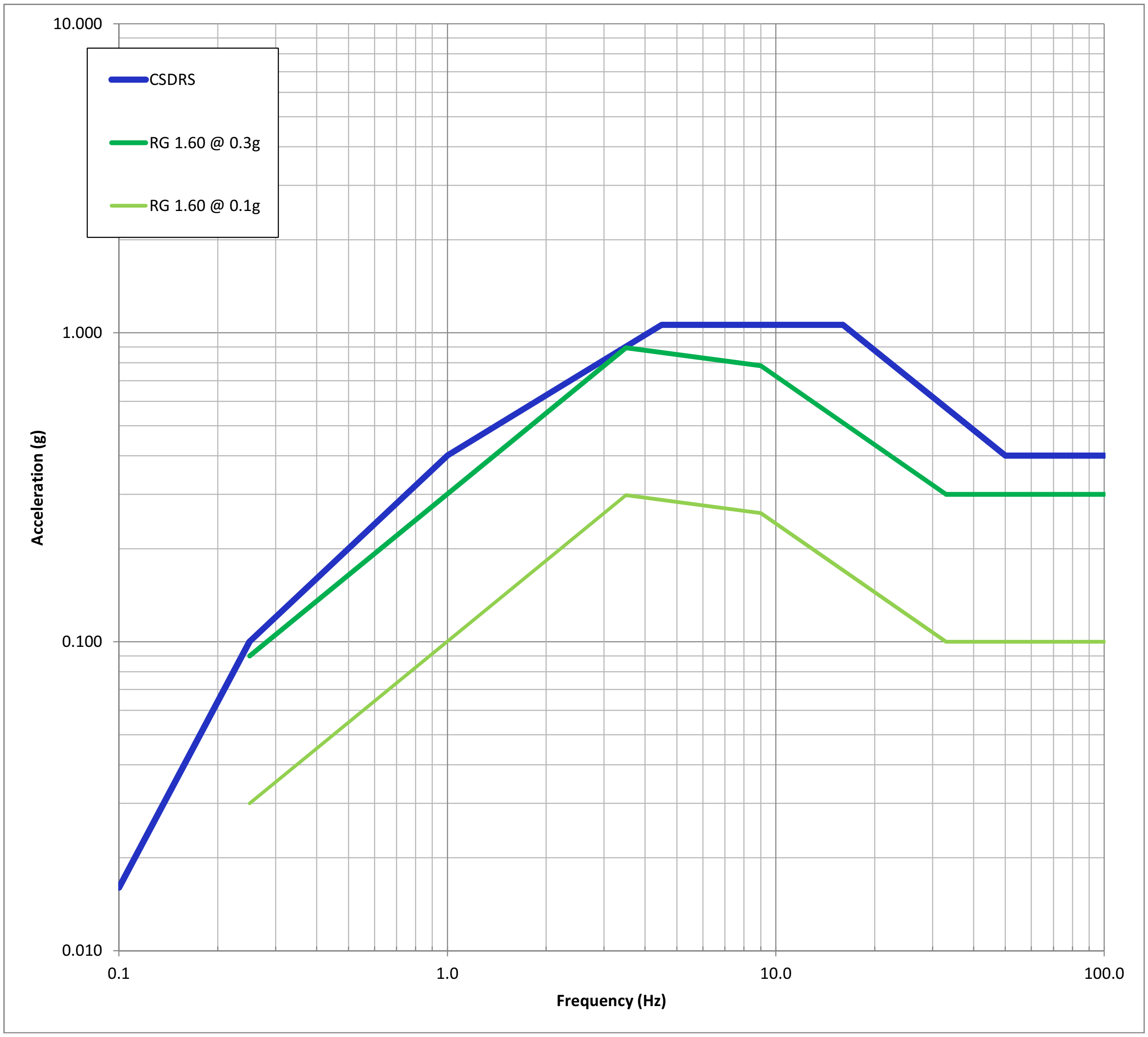


Figure 5.0-2: NuScale Vertical Certified Seismic Design Response Spectra 5% Damping

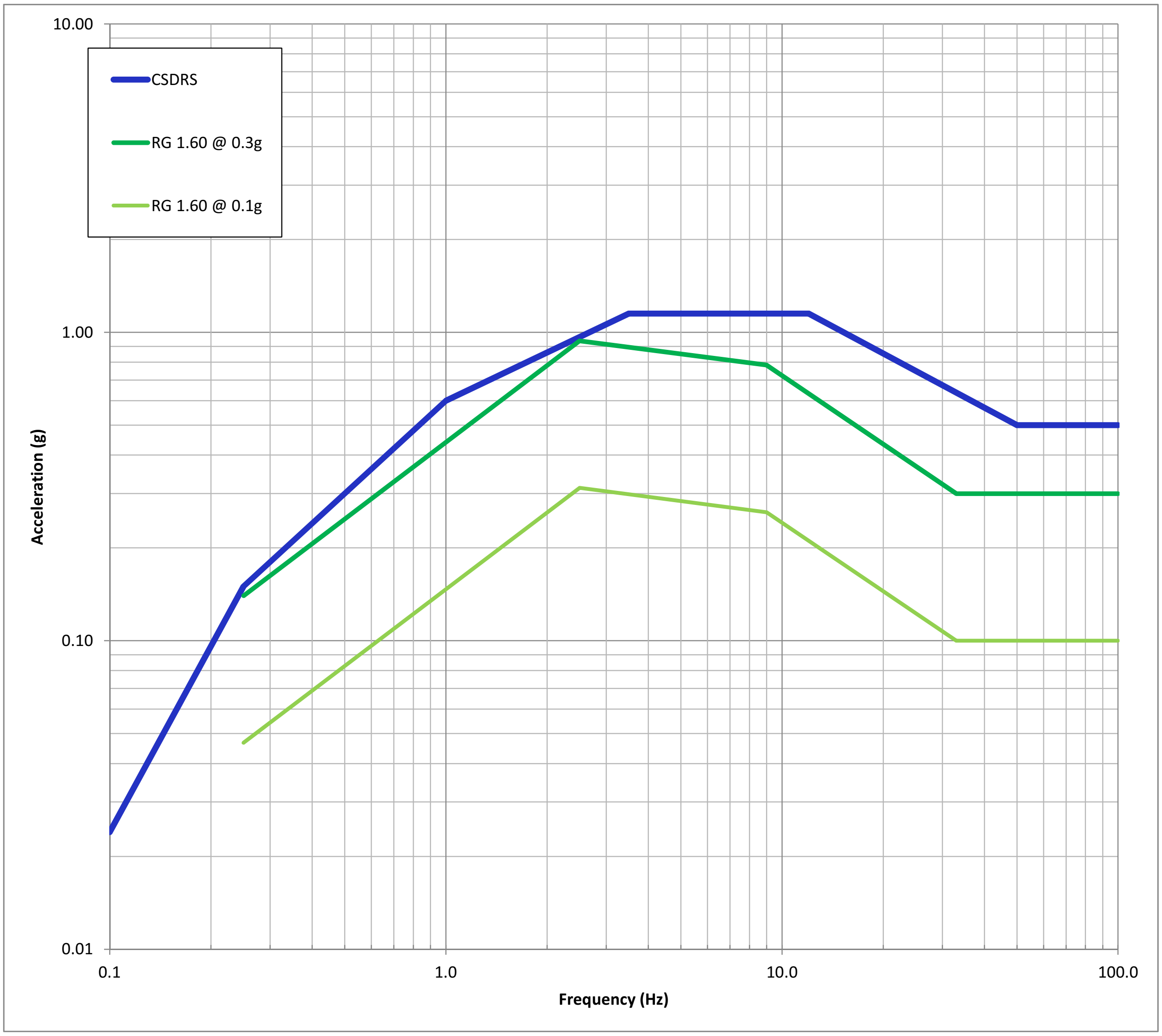


Figure 5.0-3: NuScale Horizontal Certified Seismic Design Response Spectra - High Frequency 5% Damping

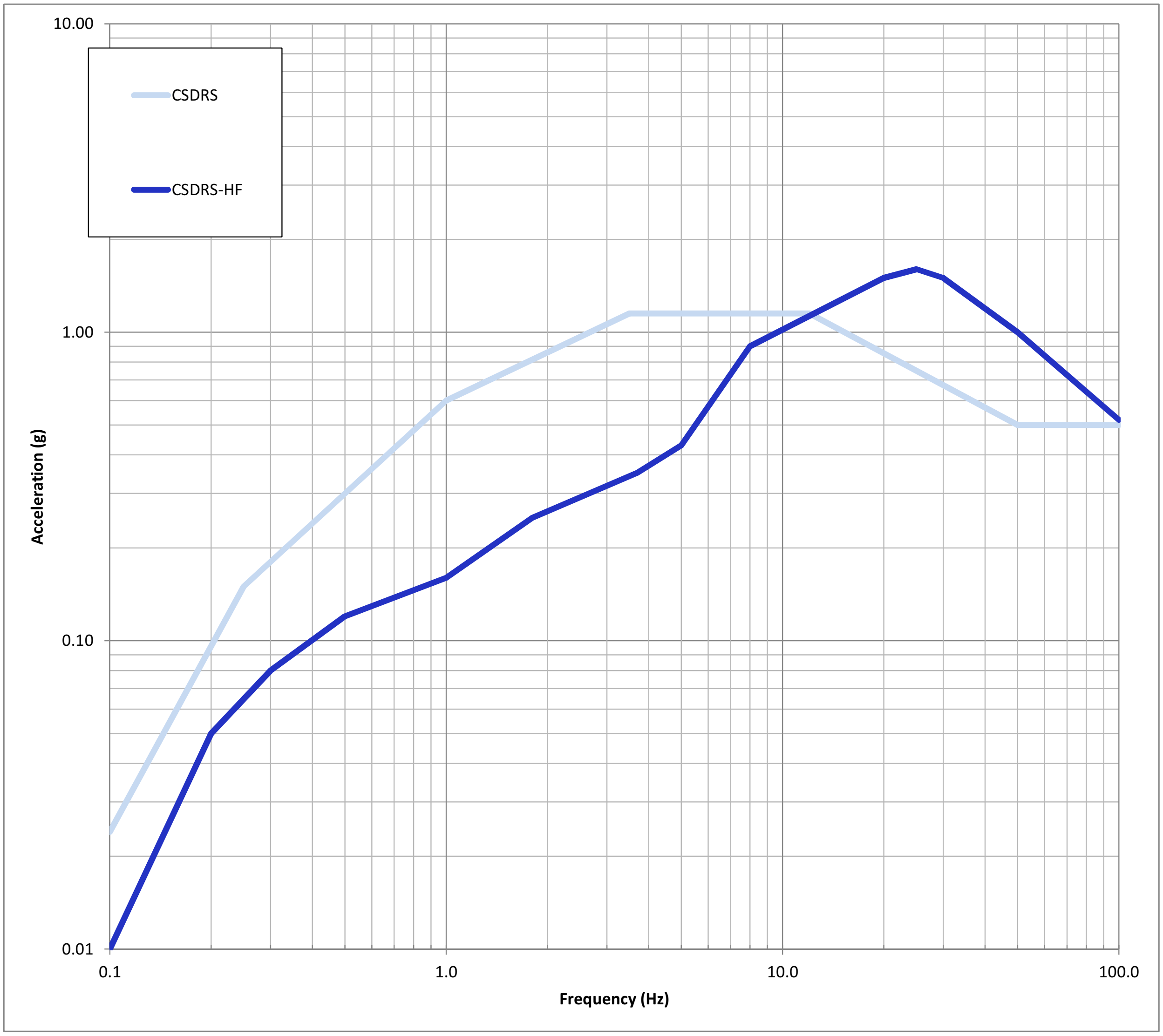


Figure 5.0-4: NuScale Vertical Certified Seismic Design Response Spectra - High Frequency 5% Damping