16 TECHNICAL SPECIFICATIONS

This chapter of the final safety evaluation report (FSER) documents the U.S. Nuclear Regulatory Commission (NRC) staff's (hereinafter referred to as the staff) review of Chapter 16, "Technical Specifications," of the NuScale Power, LLC (hereinafter referred to as the applicant), Design Certification Application (DCA), Part 2, "Final Safety Analysis Report (FSAR)" and the referenced proposed generic technical specifications (GTS) and associated GTS bases (Bases) in DCA Part 4. Together, these portions of the DCA constitute the information related to technical specifications (TS) in the NuScale DCA. The staff's regulatory findings documented in this report are based on Revision 5 of the DCA, dated July 29, 2020 (Agencywide Document Access and Management System (ADAMS), Accession No. ML20225A071). The precise parameter values, as reviewed by the staff in this safety evaluation, are provided by the applicant in the DCA using the English system of measure. Where appropriate, the NRC staff converted these values for presentation in this safety evaluation to the International System (SI) units of measure based on the NRC's standard convention. In these cases, the SI converted value is approximate and is presented first, followed by the applicant-provided parameter value in English units within parentheses. If only one value appears in either SI or English units, it is directly quoted from the DCA and not converted.

Title 10 of the *Code of Federal Regulations* (10 CFR) 50.36(a)(1) requires that each license authorizing operation of a utilization facility (i.e., an operating license or a combined license (COL)) issued by the Commission contain TS that set forth the safety limits (SLs), limiting safety system settings (LSSSs), limiting conditions for operation (LCOs), and other limitations on facility operation that are necessary for adequate protection of public health and safety. In addition, 10 CFR 50.36(a)(1) requires that each application for an operating license or a COL include a "summary statement of the bases or reasons for such TS."

In 10 CFR 50.36(a)(2), the NRC requires that each applicant for a design certification include in its application proposed GTS in accordance with the requirements of this section (i.e., 10 CFR 50.36, "Technical Specifications") for the portion of the plant that is within the scope of the DCA but does not explicitly require including GTS Bases. Because the staff needs to find that the rationale for each GTS requirement is consistent with the proposed design, as described in DCA Part 2, it is customary for a design certification applicant to include a summary statement of the bases or reasons for the proposed GTS (i.e., Bases) in DCA Part 4, using the formatting conventions and applicable contents of the standard TS (STS) Bases.

In 10 CFR 50.36a(a)(1), the NRC requires, among other things, that each applicant for a design certification include TS that require that "[o]perating procedures developed pursuant to Section 50.34a(c) for the control of effluents be established and followed and that the radioactive waste system, pursuant to Section 50.34a, be maintained and used."

The regulations in 10 CFR 52.47(a)(11) and 10 CFR 52.79(a)(30) state that a design certification applicant and a COL applicant, respectively, are to propose TS prepared in accordance with 10 CFR 50.36 and 10 CFR 50.36a, "Technical Specifications on Effluents from Nuclear Power Reactors." COL applicants that reference a certified design are to propose plant-specific TS and Bases, which would include the GTS and Bases approved during the design certification review. The COL applicant may propose deviations from the approved GTS or Bases prior to issuance of the COL by requesting an exemption from the associated appendix to 10 CFR Part 52, "Licenses, Certifications, and Approvals for Nuclear Power Plants," that codifies the certified design. A holder of a COL may propose changes to the plant-specific

TS in accordance with 10 CFR 50.90, "Application for Amendment of License, Construction Permit, or Early Site Permit."

16.1 Introduction

The staff review of the GTS and Bases is for completeness and correctness in regard to NRC requirements and conformance with applicable guidance, and for consistency with related portions of the NuScale DCA Part 2. In DCA Part 2, Tier 2, Chapter 16, and in DCA Part 4, the applicant proposed GTS and Bases in accordance with 10 CFR 50.36, 10 CFR 50.36a, and 10 CFR 52.47(a)(11). The GTS are derived from the analyses and evaluations in NuScale DCA Part 2.

16.2 Summary of Application

DCA Part 2 contains the Tier 1 and Tier 2 information of the NuScale DCA. DCA Part 2, Tier 2, Chapter 16, addresses the following topics related to the proposed GTS and Bases. However, the GTS and Bases, which are provided in Part 4 of the DCA, are neither Tier 1 nor Tier 2 information.

GTS Content: Most GTS requirements are written to provide operating limitations on an individual NuScale Power Module (NPM), or unit. Operability requirements on some systems (e.g., the reactor pool) and limits on the values of monitored variables (e.g., the reactor pool water level, temperature, and boron concentration) apply to multiple NPMs. The limitations on such systems and variables are applied individually and concurrently to the operation of each applicable NPM. In DCA Part 2, Tier 2, Section 16.1.1, "Introduction to Technical Specifications," the applicant stated the following:

> The [GTS] content differs from the [Standard Technical Specifications (STS)] as necessary to reflect technical differences between large light water reactor (LWR) designs and the NuScale Power Plant design.

The GTS and Bases are formatted consistent with STS, such as NUREG-1431, "Standard Technical Specifications—Westinghouse Plants," Revision 4, issued April 2012 (W-STS); NUREG-1432, "Standard Technical Specifications—Combustion Engineering Plants," Revision 4, issued April 2012 (CE-STS); and NUREG-2194, "Standard Technical Specifications for Westinghouse Advanced Passive 1000 Plants," Revision 0, issued April 2016 (W-AP1000-STS). They are also written consistent with the pressurized-water reactor (PWR) and boiling-water reactor (BWR) owner groups' Technical Specification Task Force (TSTF) guidelines in TSTF-GG-05-01, Revision 1, "Writer's Guide for Plant-Specific Improved Technical Specifications" (writer's guide).

Selection Criteria for LCOs: Technical Report (TR)-1116-52011-NP, Revision 3, "Technical Specifications Regulatory Conformance and Development," dated November 15, 2019 (Regulatory Conformance and Development Report) (ADAMS Accession No. ML19319C787), which the applicant submitted as part of the DCA, documents the application of the LCO selection criteria of 10 CFR 50.36(c)(2)(ii) to the NuScale design and safety analyses of design-basis accidents (DBAs), anticipated operational occurrences (AOOs), and transients. The Regulatory Conformance and Development Report provides the basis for including the LCOs chosen for the GTS and not including LCOs for systems typically addressed by an LCO in STS.

Completion Times and Surveillance Frequencies: The GTS-required action completion times are proposed consistent with those completion times provided in STS for similar conditions in which the associated LCO is not met. Likewise, the applicant indicated that GTS surveillance requirement (SR) performance frequencies (test intervals) are proposed consistent with the frequencies of similar SRs in the STS. However, the staff noted that specific frequency values were not provided for GTS SR frequencies included in the proposed GTS Subsection 5.5.11, "Surveillance Frequency Control Program." The DCA did not include program documentation listing surveillance frequencies; such documentation is specified by GTS Subsection 5.5.11. The applicant stated the initial surveillance frequencies and the basis for each frequency in DCA Part 2, Tier 2, Table 16.1-1, "Surveillance Frequency Control Program Base Frequencies." The plant-specific TS issued with a COL referencing the NuScale design will include GTS Subsection 5.5.11. The COL holder will incorporate the information in Table 16.1-1 of DCA Part 2 in the documentation specified by plant-specific TS Subsection 5.5.11 for implementing the surveillance frequency control program (SFCP).

Consideration of TSTF Traveler Changes to STS: Section 4.2 of the Regulatory Conformance and Development Report states that information regarding travelers available to NuScale through June 30, 2018, was considered by NuScale during preparation of the GTS.

DCA Part 2, Tier 1: There are no DCA Part 2, Tier 1, entries for this area of review. The applicant provided proposed GTS and Bases for the NuScale design in DCA Part 2, Tier 2, Chapter 16, and DCA Part 4, summarized here, in part, as follows.

The applicant provided the proposed GTS and Bases for the staff's review and approval in accordance with 10 CFR 50.36 and 10 CFR 50.36a. In its DCA, the applicant stated that it had largely developed the GTS and Bases using W-STS, CE-STS, and W-AP1000-STS. In support of DCA Part 2, Tier 2, Chapter 16, the DCA references the Regulatory Conformance and Development Report.

DCA Part 2, Tier 2: Although Chapter 16 in DCA Part 2 is Tier 2 information, the referenced GTS and Bases in DCA Part 4 are not.

Inspection, Test, Analysis and Acceptance Criteria (ITAAC): There are no ITAAC for this area of review.

Technical Reports: As noted above, the applicant submitted the Regulatory Conformance and Development Report as part of the DCA.

Combined License Information: DCA Part 2, Tier 2, Chapter 16, lists COL Information Item 16.1-1, which will account for all instances of bracketed site-specific information in the GTS and Bases. It also lists COL Information Item 16.1-2, which will require preparation and maintenance of an owner-controlled requirements manual that includes owner-controlled limits and requirements described in the Bases of the plant-specific TS or as otherwise specified in the FSAR; and COL Information Item 16.1-3 on the Bases discussion about using assumed conservative time interval values (allocations) for sensor response times to satisfy the SR to verify the channel response time is within limits for module protection system (MPS) instrumentation channels.

16.3 Regulatory Basis

The "Design-Specific Review Standard [DSRS] for the NuScale SMR [Small Modular Reactor] Design," Chapter 16.0, "Technical Specifications" (ADAMS Accession No. ML15355A312), which was derived from NUREG-0800, “Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition” (SRP), Chapter 16, “Technical Specifications,” Revision 3, issued March 2010, describes the relevant requirements of the NRC’s regulations for this area of review, the associated acceptance criteria, and the review interfaces with other DSRS and SRP sections.

Section 182a. of the Atomic Energy Act of 1954, as amended, requires applicants for licenses to operate nuclear power plants to state the following:

> ...such technical specifications, including information of the amount, kind, and source of special nuclear material required, the place of the use, the specific characteristics of the facility, and such other information as the Commission may, by rule or regulation, deem necessary in order to enable it to find that the utilization of special nuclear material will be in accord with the common defense and security and will provide adequate protection to the health and safety of the public. Such technical specifications shall be a part of any license issued.

In 10 CFR 50.36, the NRC established its regulatory requirements related to the content of TS. In doing so, the NRC placed emphasis on those matters related to the prevention of accidents and the mitigation of accident consequences. As recorded in the Statements of Consideration, “Technical Specifications for Facility Licenses; Safety Analysis Reports” (Volume 33 of the *Federal Register* (FR*)*, page 18610 (33 FR 18610), December 17, 1968), the NRC noted that applicants were expected to incorporate into their TS “...those items that are directly related to maintaining the integrity of the physical barriers designed to contain radioactivity.” Accordingly, 10 CFR 50.36(c) requires that TS contain (1) SLs and LSSSs, (2) LCOs, (3) SRs, (4) design features, and (5) administrative controls.

In 10 CFR 50.36(c)(2)(ii), the NRC requires that an LCO be established in TS for each item meeting one or more of the following four criteria (referred to as LCO selection criteria):

> (A) *Criterion 1.* Installed instrumentation that is used to detect, and indicate in the control room, a significant abnormal degradation of the reactor coolant pressure boundary.
>
> (B) *Criterion 2.* A process variable, design feature, or operating restriction that is an initial condition of a design basis accident or transient analysis that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.
>
> (C) *Criterion 3*. A structure, system, or component that is part of the primary success path and which functions or actuates to mitigate a design basis accident or transient that either assumes the failure of or presents a challenge to the integrity of a fission product barrier.
>
> (D) *Criterion 4.* A structure, system, or component which operating experience or probabilistic risk assessment has shown to be significant to public health and safety.

In accordance with 10 CFR Part 50, “Domestic Licensing of Production and Utilization Facilities,” Appendix A, “General Design Criteria for Nuclear Power Plants,” General Design Criterion (GDC) 17, “Electric Power Systems”; GDC 21, “Protection System Reliability and Testability”; GDC 34, “Residual Heat Removal”; GDC 35, “Emergency Core Cooling”; GDC 38, “Containment Heat Removal”; GDC 41, “Containment Atmosphere Cleanup”; and GDC 44, “Cooling Water,” those structures, systems, and components (SSCs) important to safety need to have sufficient independence, redundancy, and testability to perform their safety functions.

In 10 CFR 50.36a, the NRC requires that TS contain procedures for control of radioactive effluents.

In 10 CFR 52.47(a)(11), the NRC requires that a design certification applicant propose TS prepared in accordance with 10 CFR 50.36 and 10 CFR 50.36a.

For the reasons discussed in detail below, the STS documents noted above include the acceptance criteria adequate to meet the above requirements. The STS for PWR designs currently in operation or under construction in the United States appear in four NRC documents: NUREG-1430, “Standard Technical Specifications—Babcock and Wilcox Plants,” Revision 4, issued April 2012; NUREG-1431; NUREG-1432; and NUREG-2194. For each document, Volume 1 contains the Specifications, and Volume 2 contains the associated Bases. The STS include Bases for SLs, LSSSs, LCOs, and associated requirements for applicability, actions, and surveillances. For the reasons discussed below, guidance documents applicable to the NuScale proposed GTS and Bases mostly include portions of the model STS in NUREG-1431 (W-STS), NUREG-1432 (CE-STS), and NUREG-2194 (W-AP1000-STS).

The STS reflect the detailed effort used to apply the criteria discussed in the “Interim Policy Statement on Technical Specification Improvements for Nuclear Power Reactors” (52 FR 3788, February 6, 1987), to generic system functions, which were published in a “Split Report” and issued to the nuclear steam supply system vendor owners’ groups in May 1988 (see SER Section 16.4.1.6). In addition, extensive discussions during the development of the STS ensured that the application of the TS criteria and the joint industry and staff plant-specific improved TS writer's guide (which also applies to STS and GTS) would consistently reflect detailed system configurations and operating characteristics for all nuclear steam supply system designs. As such, Bases documents include an abundance of information on the STS model requirements necessary to adequately protect public health and safety.

On July 22, 1993, the NRC issued its “Final Commission Policy Statement on Technical Specifications Improvements for Nuclear Power Reactors” (58 FR 39132), expressing the view that satisfying the guidance in the policy statement also satisfies Section 182a. of the Atomic Energy Act of 1954, as amended, and 10 CFR 50.36. In the final policy statement, the NRC described the safety benefits of the STS and encouraged licensees, to the extent applicable, to use the STS for plant-specific TS amendments and for complete conversions to improved TS. The NRC published major revisions to the STS in 1995 (Revision 1), 2001 (Revision 2), 2004 (Revision 3), and 2012 (Revision 4). The W-AP1000-STS, published in April 2016 (Revision 0), incorporated (1) selected applicable TSTF travelers approved since issuance of W-STS, Revision 2, and (2) improvements to the COL plant-specific TS approved for Vogtle Electric Generating Station, Units 3 and 4, into Revision 19 of the GTS and Bases, which are included in the AP1000 design certification rule, Appendix D, “Design Certification Rule for the AP1000 Design,” to 10 CFR Part 52.

The format and content of proposed GTS and Bases prepared for a DCA may use applicable provisions of the STS and STS Bases to the extent practicable to realize the safety benefits of standardization, taking into account design-specific characteristics. Before design approval, the staff reviews the DCA in detail to verify that the applicant includes sufficient technical justification for any appropriate deviation from conventions and precedents presented in STS, as well as any deviation in content based on design-specific characteristics.

Generic changes to STS, known as TSTF travelers, which the NRC has approved since the issuance of STS, Revision 4, are considered needed improvements or corrections to STS. The staff recommends that design certification applicants consider such travelers, where applicable, for inclusion, with suitable design-related modifications, in the proposed GTS and Bases, to further realize the safety benefits of standardization. Section 16.4.11 of this SER chapter discusses the disposition of TSTF travelers.

16.4 Technical Evaluation

The staff evaluated the GTS according to the guidance in DSRS Chapter 16 to confirm that they will preserve the validity of the plant design, as described in NuScale DCA Part 2, by ensuring that the plant will be operated (1) within the required conditions bounded by the NuScale DCA Part 2, and (2) with operable equipment that is essential to prevent NuScale postulated design-basis events or mitigate their consequences.

The staff also reviewed the GTS Bases to verify that their technical content, level of detail, and format are consistent with the STS Bases and that they accurately provide the technical basis for each provision in GTS Chapter 2 and Chapter 3, consistent with DCA Part 2. Note that references to a Bases subsection for a Specification subsection are prefixed with an uppercase letter “B” (e.g., the Bases for GTS Subsection 3.3.1 are labeled Subsection B 3.3.1). Each Bases subsection includes several sections, which are labeled: Background, Applicable Safety Analyses, Limiting Condition for Operation (LCO), Applicability, Actions, Surveillance Requirements (SRs), and References.

The staff’s review of the GTS and Bases included the following 11 topics of evaluation:

(1) Application of LCO Selection Criteria

(2) Use and Application (GTS Chapter 1), Definitions (Section 1.1), Logical Connectors (Section 1.2), Completion Times (Section 1.3), and Frequency (Section 1.4)

(3) SLs (GTS Chapter 2)

(4) LCO and SR Use and Applicability (GTS Chapter 3, Section 3.0)

(5) LCO Statements (GTS Chapter 3, Sections 3.1 to 3.8)

(6) Applicability Statements (GTS Chapter 3, Sections 3.1 to 3.8)

(7) Action Requirements (GTS Chapter 3, Sections 3.1 to 3.8)

(8) SRs (GTS Chapter 3, Sections 3.1 to 3.8) (For instrumentation Channel Calibration SRs, the following parameter values are required to be calculated in accordance with the NRC-approved instrumentation setpoint methodology referenced in GTS Subsection 5.5.10, “Setpoint Program”: (1) the limiting trip setpoints, which are the LSSS and derived from the safety analysis analytical limits, (2) the nominal trip setpoints, which are derived from the limiting trip setpoints; and (3) the acceptance criteria for Channel Calibration SRs. The setpoint program requires maintaining the current values of these parameters in a document controlled under 10 CFR 50.59, “Changes, Tests and Experiments,” and in accordance with the approved setpoint methodology.)

(9) Design Features (GTS Chapter 4, Sections 4.1 to 4.3)

(10) Administrative Controls (GTS Chapter 5, Sections 5.1 to 5.7)

(11) TSTF Traveler Disposition

16.4.1 Application of Limiting Condition for Operation Selection Criteria

The applicant evaluated the NuScale design and safety analyses against the LCO selection criteria in 10 CFR 50.36(c)(2)(ii) and determined the LCOs that must be established for the NuScale design. Each subsection of the GTS Bases discusses the applicable section of the safety analyses and states the LCO selection criterion that each of these LCOs satisfies. The applicant also summarized a comparison of the selected LCOs to those LCOs included in W-STS, CE-STS, and W-AP1000-STS in Regulatory Conformance and Development Report, Table B-1, “Comparison of Standard Technical Specifications with NuScale Generic Technical Specifications.”

For each LCO listed under Criterion 2 or 3, the Bases document describes the principal DBA or transient analysis that credits the specified SSC or parameter limit. The staff compared the Bases for consistency with accident and transient analysis descriptions in DCA Part 2, Tier 2, Chapter 15, “Transient and Accident Analyses.” As stated in DCA Part 2, Tier 2, Table 15.0-1, “Design Basis Events,” the safety analysis considers design-basis events in the following categories classified according to their expected frequency of occurrence: postulated accident, infrequent event, and AOO. The special event of an anticipated transient without scram is also considered. Unless otherwise pointed out, design-basis events cited in this SER subsection are designated as AOO, which is the most common category.

16.4.1.1 Limiting Conditions for Operation Required by Criterion 1—Installed Instrumentation that Is Used To Detect, and Indicate in the Control Room, a Significant Abnormal Degradation of the Reactor Coolant Pressure Boundary

- LCO 3.4.7 Reactor Coolant System (RCS) Leakage Detection Instrumentation

This LCO requires two of the three RCS leakage detection methods to be operable and, like STS, it is the only LCO satisfying Criterion 1. For the leakage detection instrumentation to be operable, the non-safety-related containment evacuation system (CES) must be in operation and must maintain a low pressure in the containment vessel. Each of the three detection methods has sufficient sensitivity and response time to provide control room operators an early warning of the detection of significant degradation of the reactor coolant pressure boundary (RCPB), which results in reactor coolant leakage into containment. By alerting operators to take effective remedial measures as soon after occurrence as practical, this instrumentation minimizes the potential for propagation to gross failure of the RCPB.

Since no other NuScale system is designed or credited for detection of RCPB leakage within the containment vessel, and the proposed LCO is consistent with the STS, the staff finds that the GTS satisfy Criterion 1.

16.4.1.2 Limiting Conditions for Operation Required by Criterion 2—A Process Variable, Design Feature, or Operating Restriction that Is an Initial Condition of a Design-Basis Accident or Transient Analysis that Either Assumes the Failure of or Presents a Challenge to the Integrity of a Fission Product Barrier

For each LCO for a process variable, design feature, or operating restriction listed below, the staff compared, for consistency, the Bases discussion of the applicable safety analyses and the DCA Part 2, Tier 2, description of each postulated accident, infrequent event, and AOO for which the process variable, design feature, or operating restriction is an initial condition. The staff finds that the following LCOs satisfy Criterion 2.

- LCO 3.1.1 Shutdown Margin (SDM)

The minimum required SDM is assumed as an initial condition process variable for all safety analyses, including analyses of inadvertent boron dilution (DCA Part 2, Tier 2, Section 15.4.6.3.4, “Input Parameters and Initial Conditions”), uncontrolled control rod assembly (CRA) withdrawal from subcritical or low-power condition (DCA Part 2, Tier 2, Section 15.4.1.3.2), and CRA ejection (DCA Part 2, Tier 2, Section 15.4.8). The LCO on SDM ensures that specified acceptable fuel design limits are not exceeded for normal operation and AOOs, with the assumption of the highest worth CRA stuck out of the core on a reactor trip.

- LCO 3.1.2 Core Reactivity

This LCO establishes the core reactivity behavior prior to exceeding 5-percent rated thermal power (RTP) and prior to exceeding a fuel burnup of 60 effective full-power days (EFPDs) after beginning operation at RTP following initial fuel loading or refueling. The LCO normalizes the predicted change in RCS boron concentration to the beginning of the refueling cycle measured steady-state RCS critical boron concentration, so that core reactivity relative to predicted values can be continually monitored and evaluated as core conditions change during the operating cycle. This LCO protects the validity of the accident and transient analysis initial condition assumption that the core is operating within acceptable design limits by comparing predicted and measured steady-state RCS critical boron concentrations to ensure the measured reactivity[1] is maintained within 1-percent above or below the predicted reactivity (i.e., to ensure that a reactivity balance within ±1% $\Delta k/k$ of the normalized predicted values is maintained). This LCO must be met in Mode 1.

- LCO 3.1.3 Moderator Temperature Coefficient (MTC)

This LCO ensures that the MTC is maintained within the upper and lower limits specified in the core operating limits report (COLR). In Mode 1, the upper limit (least negative value) on the MTC must be maintained to ensure that any core overheating accidents will not violate the design assumptions of the accident analysis. The limits must also be maintained to ensure startup and subcritical accidents, such as the uncontrolled CRA withdrawal from zero power, will not violate the assumptions of the accident analysis. The lower moderator temperature

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[1] The effective multiplication factor, k_{eff}, equals the neutron production from fission in one neutron population generation divided by the sum of the preceding neutron population generation’s absorption by the fuel and leakage from the core. If $k_{eff} = 1.0$, the core is said to be critical and the neutron population from generation to generation stays the same; if $k_{eff} > 1.0$, the core is said to be supercritical and the neutron population increases; and if $k_{eff} < 1.0$, the core is said to be subcritical and the neutron population decreases. For power reactors, core reactivity is the deviation of k_{eff} from one and equals $(k_{eff} - 1)/k_{eff}$; reactivity is expressed as a dimensionless number with units of percent of k_{eff} (% $\Delta k/k$).

coefficient limit (most negative value) must be maintained in Modes 1 and 2, and in Mode 3 with any RCS temperature greater than or equal to 93.3 degrees Celsius (C) (200 degrees Fahrenheit (F)), to ensure that core overcooling accidents at the end of cycle will not violate the assumptions of the accident analysis.

- LCO 3.1.4 Rod Group Alignment Limits

In Mode 1, complying with the requirements that all shutdown bank and regulating bank CRAs be operable and that individual CRA positions be within six steps of their shutdown or regulating group position, ensures that the CRA groups maintain the correct core power distribution and satisfy the SDM requirements of LCO 3.1.1. These CRA alignment limits protect the validity of the initial conditions assumed in the analysis of CRA misalignment accidents.

- LCO 3.1.5 Shutdown Bank Insertion Limits

In Mode 1, complying with shutdown bank CRA group insertion limits protects initial assumptions in all safety analyses that assume shutdown bank CRA insertion upon reactor trip. These insertion limits protect assumptions of initial core power distribution, available SDM, ejected shutdown CRA worth, and initial reactivity insertion rate.

- LCO 3.1.6 Regulating Bank Insertion Limits

In Mode 1 with $k_{eff} \geq 1.0$, complying with regulating bank CRA group insertion limits protects initial assumptions in the safety analyses for loss-of-coolant accidents (LOCAs), loss of flow, ejected CRA, or other accidents that assume regulating bank CRA insertion upon reactor trip. These insertion limits protect assumptions of initial core power and fuel burnup distributions, available SDM, ejected regulating CRA worth, and initial reactivity insertion rate.

- LCO 3.1.7 Rod Position Indication

In Mode 1, the CRA position indication systems are required to be operable to determine CRA positions and thereby ensure compliance with the CRA alignment and power-dependent insertion limits. CRA positions must be known with sufficient accuracy to verify the core is operating within the required withdrawal and insertion sequences for the shutdown bank and regulating bank CRA groups, CRA group position overlap limits, design core power distribution peaking limits, ejected CRA reactivity addition worth limit, and minimum SDM (the reactivity addition needed to reach criticality after a reactor trip).

- LCO 3.1.9 Boron Dilution Control (chemical and volume control system (CVCS) demineralized water isolation valve operability, boric acid storage tank boron concentration limits, and RCS CVCS makeup flowrate limits)

In Modes 1, 2, and 3, this LCO ensures that the boron addition system is not a source of reactor coolant boron dilution and that the flowrate for the makeup pump demineralized water flow path does not exceed the COLR-specified flowrate assumed in the analysis of the inadvertent decrease in RCS boron concentration AOO (DCA Part 2, Tier 2, Section 15.4.6). The Applicable Safety Analyses section of Bases Subsection B 3.1.9 states, "The boron concentration in the boric acid storage tank satisfies Criterion 2 of 10 CFR 50.36(c)(2)(ii)."

DCA Part 2, Tier 2, Section 15.4.6.3.4, states, "A minimum makeup temperature of 40 degrees F [4.4 degrees C] is assumed for the analysis of boron dilution of the RCS during Modes 1 through 3." In a public meeting teleconference with NuScale on September 4, 2018

(ADAMS Accession Nos. ML18275A306 and ML18274A071), the applicant pointed out that a makeup flow with water at or near this temperature is very unlikely because of the location of the demineralized water storage tank in the reactor building. Based on the reasonable expectation of ambient temperatures always exceeding 4.4 degrees C (40 degrees F) in the vicinity of the demineralized water storage tank, the staff agrees with the applicant that this temperature assumption need not be included in LCO 3.1.9 under Criterion 2 because this limit is not necessary to preclude RCS injection of makeup water with temperature below 4.4 degrees C (40 degrees F) in Modes 1, 2, and 3.

- LCO 3.2.1 Enthalpy Rise Hot Channel Factor ($F_{\Delta H}$)

DCA Part 2, Tier 2, Section 4.3.2.2.1, “Power Distribution—Definitions,” states the following:

> The maximum enthalpy rise hot channel factor, $F_{\Delta H}$, is defined as the ratio of the maximum integrated fuel rod power to the average fuel rod power. The limit on $F_{\Delta H}$ is established to ensure that the fuel design criteria are not exceeded, and the accident analysis assumptions remain valid. This limit ensures that the design basis value for the [critical heat flux (CHF) ratio (CHFR)] is met for normal operation, anticipated operational occurrences, and infrequent events. The $F_{\Delta H}$ limit is representative of the coolant flow channel with the maximum enthalpy rise. This channel has the highest power input to the coolant and therefore the highest probability for CHF.
>
> The NuScale design limit for $F_{\Delta H}$ is 1.50 and is based on the safety analysis. …
>
> The heat flux hot channel factor (or total peaking factor), F_Q, is the ratio of maximum local heat flux on the surface of a fuel rod to the average fuel rod heat flux for the entire core. The maximum F_Q value is used to calculate the peak linear heat generation rate (LHGR). The maximum value of F_Q is used to ensure the specified acceptable fuel design limit for fuel centerline melting is not exceeded.

DCA Part 2, Tier 2, Section 4.3.2.2.2, “Power Distribution—Radial Power,” indicates that $F_{\Delta H}$ is an indication of radial flux peaking.

DCA Part 2, Tier 2, Section 4.3.2.2.6, “Power Distribution—Limiting Power Distributions,” in part, states the following:

> The radial power distribution is primarily determined by the cycle design. For each cycle core design, a limit is imposed on the maximum allowed $F_{\Delta H}$. This design limit is then conservatively applied in the subchannel analysis as described in Section 4.4. Except for events in Section 15.4 (Reactor and Power Distribution Anomalies) that do not involve CRA motion, radial power distributions are held constant through the evolution of the transient. Additionally, for Section 15.4 events that do involve CRA motion the radial power shapes account for the possible radial asymmetry of the event and radial power information specific to each event is provided for the subchannel analysis.
>
> The specific assumptions related to power distribution used in the steady state and accident analysis for power distribution are described in more detail in Section 4.4 and Chapter 15. The values of $F_{\Delta H}$ and F_z [Axial Peaking Factor, F_z, is the maximum relative power at any axial point in a fuel rod, divided by the

> average power of the fuel rod] are conservatively selected for use in the transient analysis such that they are expected to be bounding for all cycles. If the calculated power distributions for a given cycle are not bounded by the values assumed in the accident analysis, the core design is revised to bring the calculated power distribution within the bounding value or the transient analysis is reperformed.
>
> The limiting power distributions are confirmed during operation by technical specifications that require operation within the [Axial Offset (AO)] window and within the [power dependent insertion limits (PDILs)]. In addition, the fixed in-core flux measurements and resulting power distribution that continuously display in the control room provide further assurance that the power distributions both axially and radially are not deviating from those expected and assumed in the analysis.

The limiting value for $F_{\Delta H}$ is specified in the COLR and is an initial condition of all design-basis event analyses for which limits on the initial core power distribution are assumed. This LCO is applicable in Mode 1 with thermal power ≥ 25% RTP.

- LCO 3.2.2 AXIAL OFFSET (AO)

Axial offset is the ratio of the difference in power between the top half of the core and the bottom half of the core to the total core power. This parameter is an indication of axial flux peaking, and the limiting values specified in the COLR are initial conditions of all design-basis event analyses for which limits on the initial core power distribution are assumed. This LCO is applicable in Mode 1 with thermal power ≥ 25% RTP.

DCA Part 2, Tier 2, Section 4.3.2.2.9, "Power Distribution—Monitoring," states the following (emphasis added):

> During normal operation, the [incore instrumentation system] is used to synthesize core-wide three-dimensional power distributions. These power distributions are compared to predicted core power distributions to verify the core is operating as designed. *Axial power distributions are continuously monitored to validate the [Axial Offset] operating window, and actions required by the technical specifications are initiated based on this information.* Also, power distributions from the [incore instrumentation system] are used to calibrate the ex-core neutron flux detectors. When the rod position indication system is not working properly, the [incore instrumentation system] has the capability to determine the relative position of a stuck or misaligned control rod.

DCA Part 2, Tier 2, Section 4.3.2.2.1, states the following (emphasis added):

> The heat flux hot channel factor (or total peaking factor), F_Q, is the ratio of maximum local heat flux on the surface of a fuel rod to the average fuel rod heat flux for the entire core. The maximum F_Q value is used to calculate the peak linear heat generation rate (LHGR). *The maximum value of F_Q is used to ensure the specified acceptable fuel design limit for fuel centerline melting is not exceeded.*

The staff observed that, even though the limit on maximum F_Q is used to ensure that none of the fuel design criteria are exceeded, the currently proposed NuScale GTS Section 3.2 does not include an LCO for F_Q. In previous reactor design reviews, the staff has relied upon such an LCO to establish a finding that the reactor unit will be operated within the bounds of the safety analyses. By letter dated June 12, 2018 (ADAMS Accession No. ML18163A417), the applicant provided the following explanation, which the staff found acceptable:

> The heat flux hot channel factor (F_Q) is used in the NuScale design to calculate the peak linear heat generation rate to ensure that the specified acceptable fuel design limit for fuel centerline melting is not exceeded. The NuScale design is characterized by a relatively low linear heat rate (kW/ft) compared to the PWR operating fleet and has substantial margin to fuel centerline melting at normal power levels. F_Q is not used as an initial condition for any transient or design basis accident, including loss of coolant accident. As a result, a Limiting Condition for Operation for F_Q is not needed in the NuScale design. FSAR Sections 4.3 and 4.4 are modified to clarify this point.

The staff concludes that an LCO for F_Q is not needed to ensure that the core SL for peak fuel centerline temperature is not violated in the event of a postulated accident.

- LCO 3.4.1 RCS Pressure, Temperature, and Flow Resistance Critical Heat Flux (CHF) Limits

The limits of this LCO protect initial condition assumptions of the DCA Part 2, Tier 2, Chapter 15, safety analyses. This LCO is applicable in Mode 1.

- LCO 3.4.2 RCS Minimum Temperature for Criticality

This LCO protects the SDM required by LCO 3.1.1. This LCO is applicable in Mode 1.

- LCO 3.4.3 RCS Pressure and Temperature (P/T) Limits

This LCO protects the RCPB and must be met at all times.

- LCO 3.4.5 RCS Operational LEAKAGE

The leakage limits ensure that RCPB degradation will be detected and corrected before the flaw results in a LOCA. This LCO must be met in Modes 1 and 2, and in Mode 3 with RCS hot temperature at or above 93.3 degrees C (200 degrees F).

- LCO 3.4.8 RCS Specific Activity

The dose equivalent iodine (I)-131 and the dose equivalent Xe-133 activity limits are consistent with the design-basis failed-fuel fraction assumed in the design of radiation shielding in spaces with piping and vessels containing reactor coolant that are accessible to plant operators. These activity limits are also consistent with the assumed initial RCS specific activity in the accident radiological dose consequence analyses in DCA Part 2, Tier 2, Chapter 15. These activity limits reflect a specific activity resulting from expected fuel pin cladding defects that are much less severe than typically considered in W-STS. With these much smaller specific activity limits, the contribution of the assumed initial RCS specific activity to dose consequences of DBAs, such as a steam generator (SG) tube rupture, is also much smaller.

- LCO 3.4.9 Steam Generator (SG) Tube Integrity

This LCO, in conjunction with the SG program of GTS Subsection 5.5.4, ensures the SG tubes are maintained such that a postulated accident involving a SG tube failure (SGTF) (double-ended failure of a single tube) is unlikely to occur. The safety analyses of postulated accidents and AOOs other than an SGTF assume the maintenance of tube structural integrity. SER Section 16.4.9.3 gives an additional evaluation of the SG tube requirements of GTS Subsections 3.4.9 and 5.5.4.

- LCO 3.5.3 Ultimate Heat Sink (UHS)

In Modes 1, 2, and 3, this LCO protects the UHS bulk average temperature upper limit of 43.3 degrees C (110 degrees F), which is assumed and credited, directly or indirectly, as an initial condition in postulated accidents that require the operation of the decay heat removal system (DHRS) and the emergency core cooling system (ECCS), for both LOCA and non-LOCA design-basis events. This LCO also protects the UHS bulk average temperature lower limit of 18.3 degrees C (65 degrees F) assumed in the long-term cooling analyses.

In Mode 4, this LCO protects the minimum reactor pool level of 20.7 meters (m) (68 feet (ft)), which ensures the buoyancy assumed in the reactor building crane analysis and design to ensure the crane’s single-failure-proof capability during movement of an NPM by not loading the crane above its single-failure-proof capacity.

In Mode 5, or during irradiated fuel movement within the spent fuel pool, this LCO ensures the initial condition assumptions of the analysis of a postulated fuel handling accident during irradiated fuel movement are satisfied (DCA Part 2, Tier 2, Section 15.0.3.8.5). The minimum reactor pool water level of 19.8 m (65 ft) (in Condition A) ensures the assumption of 7.0 m (23 ft) of water above the weir wall, which is the most limiting, most shallow location of a dropped fuel assembly.

DCA Part 2, Tier 2, Section 15.4.6.3.4, “Input Parameters and Initial Conditions,” for the analysis of an inadvertent decrease in reactor pool boron concentration AOO (DCA Part 2, Tier 2, Section 15.4.6) states, “The minimum possible reactor pool volume is used to provide a limiting time to loss of shutdown margin for Mode 5.”

- LCO 3.7.3 In-Containment Secondary Piping Leakage

At the staff’s request, the applicant proposed this LCO in a letter dated December 20, 2018 (ADAMS Accession No. ML18354B172). The purpose of Subsection 3.7.3 is to place a limit on secondary piping leakage inside the containment vessel. This limit serves as a leak-before-break (LBB) criterion to ensure that, when such leakage above the specified limit is discovered, operators can take appropriate action before the integrity of an affected main steam or feedwater line is impaired.

In the Background section of Bases Subsection B 3.7.3, the applicant stated the following:

> LBB is an argument which allows elimination of design for dynamic load effects of postulated pipe breaks. The fundamental premise of LBB is that the materials used in nuclear plant piping are strong enough that even a large through wall crack leaking well in excess of rates detectable by present leak detection systems would remain stable and would not result in a double-ended guillotine break under maximum loading conditions. The benefit of LBB is the elimination

of pipe whip restraints, jet impingement effects, and internal system blowdown loads.

The staff agrees with this description of the LBB issue and the following passage in the Applicable Safety Analyses section of Bases Subsection B 3.7.3:

> This specification has been included in TS because if a seismic event occurs when the in-containment secondary leakage is greater than the LCO limit, a main steam or feedwater pipe break could occur. This could result in an adverse interaction between the affected in-containment secondary system piping and other safety related equipment located inside the containment.

The applicant also added the 72-hour base frequency for SR 3.7.3.1 in DCA Part 2, Tier 2, Chapter 16, Table 16.1-1, because it will be included in the SFCP of GTS Subsection 5.5.11. SER Section 16.4.8.3 gives the staff's evaluation of the SFCP. DCA Part 2, Tier 2, Table 16.1-1, provides the following basis for this frequency:

> The 72-hour Frequency is a reasonable interval to trend LEAKAGE and recognizes the importance of early leakage detection in assuring detection of a condition that may be indicative of not meeting the leak-before-break criteria applicable to the in-containment secondary piping.

The staff finds that the above basis for establishing LCO 3.7.3 is acceptable because it will ensure a COL applicant or holder will not relocate this operational limitation from the plant-specific TS to a licensee-controlled document in the future for not explicitly meeting any of the LCO selection criteria.

- LCO 3.8.2 Decay Time

In Mode 5, this LCO ensures irradiated fuel movement within the reactor vessel does not occur until 48 hours after reactor shutdown as assumed by the fuel handling postulated accident analysis.

Based on the above evaluation, the staff finds that the proposed GTS satisfy 10 CFR 50.36(c)(2)(ii)(B), Criterion 2.

16.4.1.3 Limiting Conditions for Operation Required by Criterion 3—A Structure, System, or Component that Is Part of the Primary Success Path and which Functions or Actuates To Mitigate a Design-Basis Accident or Transient that Either Assumes the Failure of or Presents a Challenge to the Integrity of a Fission Product Barrier

For each LCO subsystem and instrumentation function listed below, the staff compared for consistency the Bases discussion of the applicable safety analyses and the DCA Part 2, Tier 2, description of each postulated accident, infrequent event, and AOO that credits the subsystem or function. The staff finds that the following LCOs satisfy Criterion 3.

- LCO 3.1.9 Boron Dilution Control (CVCS DWSI valve operability, boric acid storage tank boron concentration limits, and CVCS makeup pump flow path flowrate limit)

This LCO requires two CVCS demineralized water supply isolation (DWSI) valves to be operable to ensure that there will be redundant means available to automatically terminate an inadvertent boron dilution event in Modes 1, 2, and 3. This LCO also ensures that the boron addition system is not a source of reactor coolant boron dilution and that makeup pump flow does not exceed the COLR-specified flowrate assumed in the analysis of an inadvertent decrease in RCS boron concentration (boron dilution event), which is an AOO (DCA Part 2, Tier 2, Section 15.4.6). In discussing the applicable safety analyses, Bases Subsection B 3.1.9 states, “CVCS demineralized water isolation valves satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).” The staff concludes that the CVCS DWSI valves satisfy Criterion 3 because the analysis of an inadvertent boron dilution event credits them with automatically terminating the event.

- LCO 3.3.1 Module Protection System (MPS) Instrumentation

Each MPS instrumentation Function with its Modes of Applicability for each supported reactor trip system (RTS) or engineered safety features (ESF) actuation system (ESFAS) logic and actuation Function is listed in Table 16.4.1-1 of this SER. For each supported Function, one or more of the events crediting the MPS Function are also listed, including a reference to the section of DCA Part 2, Tier 2, describing each event. In Table 16.4.1-1, this SER uses italics to denote requirements included in GTS Subsection 3.3.1 for MPS instrumentation Functions. Regular font denotes requirements included in GTS Subsection 3.3.2 for RTS Logic and Actuation Functions; requirements included in GTS Subsection 3.3.3 for ESF Logic and Actuation Functions; and references to safety analyses described in DCA Part 2, Tier 2, Chapter 15.

By letter dated April 15, 2019 (ADAMS Accession No. ML19105B292), the applicant revised the ESFAS design by changing which MPS instrumentation Functions initiate partial trip signals to the ESF actuation coincidence logic divisions for the DHRS and ECCS ESFAS Functions. The previous MPS instrumentation Functions for DHRS actuation, which resulted in secondary system isolation (SSI) but also an unnecessary automatic RCS cooldown, were redesignated to initiate a new ESFAS Function, SSI, with one exception. The DHRS actuation on low pressurizer pressure with RCS hot temperature greater than the T-4 interlock was removed because the reactor trip on low pressurizer pressure above T-4 Function provides adequate RCS subcooled margin protection. The letter also removed the MPS instrumentation Function for ECCS actuation on low reactor pressure vessel (RPV) riser level because no analyzed event relied on this ECCS initiation. The ESFAS Functions listed in Table 16.4.1-1 and Table 16.4.1-3 reflect these changes as implemented in DCA Revision 3.

The May 20, 2020, update to DCA Revision 4 (ADAMS Accession No. ML20141L787) added the low RCS pressure - ECCS ESFAS instrumentation Function for ECCS actuation (Function No. 23.a of GTS Table 3.3.1-1) to ensure that ECCS actuation occurs before significant accumulation of water with reduced boron concentration can occur in the containment. This ensures an unanalyzed reactivity transient will not occur during small loss of coolant events in the containment following initiation of coolant flow from containment through the reactor recirculation valves (RRVs) into the RPV downcomer and through the core.

In DCA Part 7, Section 5, the applicant requested an exemption from GDC 33, which requires a system to supply reactor coolant makeup for protection against small breaks in the reactor coolant pressure boundary. The NuScale design's CVCS is a reactor coolant makeup system; however, it is not a safety related system. To justify this exemption, the applicant demonstrated that the underlying purpose of GDC 33 is met using only safety related systems. DCA Part 2, Tier 2, Section 6.3.1, describes how the ECCS actuation instrumentation setpoints are chosen to support this justification. The staff’s evaluation of the ECCS design and how it satisfies the underlying purpose of GDC 33 is provided in Sections 6.3 and 9.3 of this report. In those sections, the staff identified that the low RCS pressure ECCS actuation and the low ELVS voltage ECCS actuation including the 24-hour time delay were used, in part, to demonstrate that the ECCS design was sufficient to meet the underlying purpose of GDC 33.

The ECCS actuation on low ac voltage to the ELVS battery chargers is not included as a TS LCO-required MPS instrumentation Function in generic TS Table 3.3.1-1 because no FSAR Chapter 15 accident or transient analysis that assumes ECCS automatic actuation depends upon or credits the low ac voltage to the ELVS battery chargers instrumentation ECCS actuation signal as part of the event response success path. This Function is modeled in some events (e.g., return to power) because it would be part of the transient progression and was included because ECCS actuation, depending on the timing, could increase the severity of predicted unit conditions. Therefore, the staff concludes that the ECCS actuation on low ac voltage to ELVS battery chargers MPS instrumentation Function signal does not satisfy any of the LCO selection criteria of 10 CFR 50.36(c)(2)(ii), even though it is credited to partially justify an exemption to GDC 33.

Table 16.4.1-1 MPS (RTS and ESFAS) Instrumentation Functions

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	*APPLICABLE MODES*		
1. High Power Range Linear Power			
a. RTS • Loss of feedwater heating (15.1.1, 10.4.7.2) • Decrease in feedwater temperature AOO (15.1.1.2) (5% RTP penalty added) (Table 15.1-1) • Increase in feedwater flow AOO (15.1.2.2) (5% RTP penalty added) • Increase in steam flow AOO (nonlimiting CHFR 125% steam flow case) (15.1.3.2) (5% RTP penalty added) • Steam piping failures inside and outside containment vessel (15.1.5.2) (5% RTP penalty added) • Uncontrolled CRA withdrawal from a subcritical or low-power or startup condition (at 25% RTP for startup conditions) (15.4.1.2) • Uncontrolled CRA withdrawal at power (15.4.2.2) • Control rod misoperation (system malfunction or operator error) (15.4.3.2) • Spectrum of rod ejection accidents (15.4.8.2.4)	*1*	*2(a)*	*3(a)*
b. DWSI • Inadvertent decrease in RCS boron concentration (15.4.6.2) • DWSI designed to occur when Function 1.a, RTS, occurs.	*1*	*2(a)*	*3(a)*
(a) When capable of CRA withdrawal.			
2. High Power Range Positive and Negative Rate			
a. RTS • Decrease in feedwater temperature AOO *(not credited)* (15.1.1.2) • Increase in feedwater flow AOO *(not credited)* (15.1.2.2) • Increase in steam flow AOO *(not credited)* (15.1.3.2) • Steam piping failures inside & outside containment vessel (*not credited*) (15.1.5.2) • Uncontrolled CRA withdrawal at power (15.4.2.2) • Spectrum of rod ejection accidents (15.4.8.2.4)	*1(b)*	-	-

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	*APPLICABLE MODES*		
b. DWSI • DWSI designed to occur when Function 2.a, RTS, occurs. *(b) With power above the N-2H Interlock.*	*1(b)*	-	-
3. High Intermediate Range Log Power Rate			
a. RTS • Uncontrolled CRA withdrawal from a subcritical or low power or startup condition (15.4.1.2)	*1(c)*	*2(a)*	*3(a)*
b. DWSI • DWSI designed to occur when Function 3.a, RTS, occurs. *(a) When capable of CRA withdrawal.* *(c) With power below the N-2L interlock.*	*1(c)*	*2(a)*	*3(a)*
4. High Source Range Count Rate			
a. RTS • Uncontrolled CRA withdrawal from a subcritical or low-power or startup condition (15.4.1.2)	*1(d)*	*2(a)*	*3(a)*
b. DWSI • DWSI designed to occur when Function 4.a, RTS, occurs. *(a) When capable of CRA withdrawal.* *(d) When Intermediate Range Log Power less than N-1 interlock.*	*1(d)*	*2(a)*	*3(a)*
5. High Source Range Log Power Rate			
a. RTS • Uncontrolled CRA withdrawal from a subcritical or low-power or startup condition (15.4.1.2)	*1(d)*	*2(a)*	*3(a)*
b. DWSI • DWSI designed to occur when Function 5.a, RTS, occurs. *(a) When capable of CRA withdrawal.* *(d) When Intermediate Range Log Power less than N-1 interlock.*	*1(d)*	*2(a)*	*3(a)*
6. High Subcritical Multiplication			
a. DWSI • Inadvertent decrease in RCS boron concentration (15.4.6.2) *(d) When Intermediate Range Log Power less than N-1 interlock.*	*1(d)*	*2*	*3*
7. High-Pressurizer Pressure			
a. RTS • Rod ejection accident—maximum RCS pressure case, (15.4.8, Table 15.4-21) • Increase in steam flow AOO (15.1.3.2) • Loss of external load AOO (15.2.1.2) • Turbine trip AOO (15.2.2.1) • Loss of condenser vacuum AOO (15.2.3.1) • Closure of main steam isolation valves (MSIVs) AOO (15.2.4.2)	*1*	*2(a)*	*3(a)*

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	APPLICABLE MODES		
• Loss of nonemergency alternating current (AC) power to the station auxiliaries (15.2.6.2, Table 15.2-15, RCS Overpressurization, Table 15.2-16, SG Peak Pressure) • Loss of normal feedwater flow AOO (15.2.7.2, 10.4.7.2) • Feedwater system pipe breaks inside and outside of containment (15.2.8.1) • Inadvertent DHRS actuation (15.2.9, 10.4.7.2) • Uncontrolled CRA withdrawal at power (15.4.2.2) • Control rod misoperation (15.4.3.2) • Spectrum of rod ejection accidents (15.4.8.2.4) • CVCS malfunction AOO (15.5.1.2) (no pressurizer spray flow) • Failure of small lines carrying primary coolant outside containment (CVCS makeup line break + loss of normal AC) infrequent event (15.6.2.3.3, CVCS letdown line break + loss of normal AC, Table 15.6-3 maximum RPV pressure) • LOCAs resulting from a spectrum of postulated piping breaks within the RCPB postulated accident (15.6.5.3.3) • SGTF postulated accident—limiting RPV pressure (15.6.3.3.3, Table 15.6-7)			
b. DHRS [2] • Increase in steam flow AOO (15.1.3.2) • Loss of feedwater flow (15.2.7, 10.4.7.2) • Loss of external load AOO (15.2.1.2) • Turbine trip AOO (15.2.2.1) • Loss of condenser vacuum AOO (15.2.3.1) • Closure of MSIV(s) AOO (15.2.4.2) • Loss of nonemergency AC power to the station auxiliaries (15.2.6.2, Table 15.2-15, RCS Overpressurization, Table 15.2-16, SG Peak Pressure) • Loss of normal feedwater flow AOO (15.2.7.2) • Uncontrolled CRA withdrawal from a subcritical or low-power or startup condition (15.4.1.2) • Feedwater system pipe breaks inside and outside of containment (15.2.8.1) • Uncontrolled CRA withdrawal at Power (15.4.2.2) • Control rod misoperation (15.4.3.2) • Failure of small lines carrying primary coolant outside containment (CVCS makeup line break + loss of normal AC) infrequent event (15.6.2.3.3, CVCS letdown line break + loss of normal AC, Table 15.6-3 maximum RPV pressure) • CVCS malfunction AOO (15.5.1.2) (Table 15.5-2 limiting RCS pressure, no pressurizer spray) • SGTF postulated accident—limiting RPV pressure (15.6.3.3.3, Table 15.6-7), limiting SG pressure (Table 15.6-8)	*1*	*2*	*3(e)*

[2] DHRS actuation includes isolation of each feedwater line using the feedwater isolation valve (FWIV) and the feedwater regulating valve (FWRV), and each main steamline using the MSIVs and the main steam isolation bypass valves.

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	APPLICABLE MODES		
• LOCAs resulting from a spectrum of postulated piping breaks within the RCPB postulated accident (15.6.5.3.3)			
c. Pressurizer Heater Trip (PHT) • Uncontrolled CRA withdrawal at power (15.4.2.2) • Failure of small lines carrying primary coolant outside containment infrequent event (15.6.2.3.3, Table 15.6-3 maximum RPV pressure) • SGTF postulated accident—limiting RPV pressure (15.6.3.3.3, Table 15.6-7), limiting SG pressure (Table 15.6-8) • Pressurizer heaters are tripped on all automatic DHRS actuation signals.	*1*	*2(f)*	*3(f)*
d. DWSI • DWSI designed to occur when Function 7.a, RTS, occurs.	*1*	*2(a)*	*3(a)*
e. SSI • Loss of external load AOO (15.2.1.2) • CVCS malfunction AOO (15.5.1.2) (Table 15.5-2 limiting RCS pressure, no pressurizer spray) • Events listed under DHRS actuation	*1*	*2*	*3(e)*
(a) When capable of CRA withdrawal. *(e) When not PASSIVELY COOLED.* *(f) With pressurizer heater breakers closed.*			
8. Low-Pressurizer Pressure • *Designed to detect and mitigate primary coolant carrying pipe high-energy line break outside containment and protect RCS subcooled margin to protect against flow instability events (Table 15.0-7)*			
a. RTS • Decrease in feedwater temperature AOO (15.1.1.2) • Steamline break outside containment (15.1.5, 10.4.7.2) • Increase in steam flow AOO (15.1.3.2) • Steam piping failures inside and outside containment vessel (15.1.5.2) • Failure of small lines carrying primary coolant outside containment infrequent event (15.6.2.3.2/3) • SGTF postulated accident (15.6.3.3.2,10.4.7.2) • LOCAs resulting from a spectrum of postulated piping breaks within the RCPB postulated accident (15.6.5.3.3) • Subcooled margin protection above T-4	*1(g)*	-	-
b. DWSI • DWSI designed to occur when Function 8.a, RTS, occurs. • Subcooled margin protection above T-4	*1(g)*	-	-
(g) With narrow range RCS hot temperature above the T-4 interlock			

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	APPLICABLE MODES		
9. Low Low Pressurizer Pressure			
• *Designed to detect and mitigate primary coolant carrying pipe high-energy line break outside containment and protect RCS subcooled margin to protect against flow instability events (Table 15.0-7)*			
a. RTS • Decrease in RCS inventory that causes a slow RCS depressurization (15.9.3.6) beginning of cycle; trip occurs before loss of riser inlet subcooling leading to flow oscillations or instability • Subcooled margin protection below T-4	*1*	*2(a)*	*3(a)*
b. CVCS Isolation (CVCSI) • Double-ended CVCS letdown or makeup line break outside containment with coincident loss of normal AC power (15.6.2.3.3) • Failure of primary coolant carrying piping outside containment (Table 15.6-1) • Subcooled margin protection below T-4	*1*	*2*	*3(a)*
c. DWSI • DWSI is designed to occur when Function 9.a, RTS, occurs. • Subcooled margin protection below T-4	*1*	*2(a)*	*3(a)*
d. SSI • Increase in steam flow AOO (15.1.3.2) • Detect and mitigate primary high-energy line breaks outside containment • SGTF postulated accident (15.6.3) • Protect the reactor coolant subcooled margin against instability events below T-4	*1*	*2*	*3(a)*
(a) When capable of CRA withdrawal.			
Note: Wide Range RCS Hot Temperature Interlock T-5 bypasses Functions 9.b, CVCSI, and 9.d, SSI, when at least 3 of 4 wide range RCS Hot Temperature channels are < 216 °C (420 °F) and RT-1 interlock is active (both divisional reactor trip breakers (RTBs) are open). T-5 and RT-1 both active also bypasses Function 9.c, DWSI actuation, which is designed to occur when Function 9.a, RTS, occurs.			
10. High Pressurizer Level			
a. RTS • Inadvertent DHRS actuation AOO (15.2.9, 10.4.7.2) • Loss of feedwater flow AOO (15.2.7, 10.4.7.2) • CVCS malfunction AOO (15.5.1.2) (Table 15.5-1 limiting SG pressure, pressurizer spray available)	*1*	*2(a)*	*3(a)*
b. CVCSI • CVCS malfunction AOO (15.5.1.2) (Table 15.5-1 limiting SG pressure, pressurizer spray available) • CVCS malfunction AOO (15.5.1.2) (Table 15.5-2 limiting RCS pressure, no pressurizer spray)	*1*	*2*	*3*

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	*APPLICABLE MODES*		
• Increased RCS inventory events and inadvertent operation of the module heatup system are terminated by isolation of RCS injection line (5.2.2.2.2)			
c. DWSI • DWSI is designed to occur when Function 10.a, RTS, occurs.	*1*	*2(a)*	*3(a)*
(a) When capable of CRA withdrawal.			
11. Low Pressurizer Level			
• *Provides inventory protection for RPV* below *216 °C (420 °F); see response (ADAMS Accession No. ML19105B293) to RAI 512-9634, Question 16-60, Subquestion 70 (Numbered Subquestion 77 in response).*			
a. RTS • Decrease in feedwater temperature AOO (15.1.1.2) • Steam piping failures inside and outside containment (15.1.5.2, 10.4.7.2) • Failure of small lines carrying primary coolant outside containment infrequent event (15.6.2.3.2) • SGTF postulated accident (15.6.3,10.4.7.2), Table 15.6-6 limiting mass release • LOCAs resulting from a spectrum of postulated piping breaks within the RCPB postulated accident (15.6.5.3.3)	*1*	*2(a)*	*3(a)*
b. PHT • SGTF (15.6.3,10.4.7.2, Table 15.6-6 limiting mass release, Table 15.6-7 limiting RPV pressure, Table 15.6-8 limiting SG pressure)	*1*	*2(f)*	*3(f)*
c. DWSI • DWSI is designed to occur when Function 11.a, RTS, occurs.	*1*	*2(a)*	*3(a)*
(a) When capable of CRA withdrawal. *(f) With pressurizer heater breakers closed.*			
12. Low Low Pressurizer Level			
a. Containment Isolation System (CIS) • Decrease in feedwater temperature AOO (15.1.1.2, Table 15.1-1) • SGTF postulated accident (15.6.3,10.4.7.2) • LOCAs resulting from a spectrum of postulated piping breaks within the RCPB postulated accident (15.6.5.3.3)	*1*	*2*	*3(h)*
b. CVCSI • Decrease in feedwater temperature AOO (15.1.1.2, Table 15.1-1) • Failure of small lines carrying primary coolant outside containment infrequent event (15.6.2.3.2)	*1*	*2*	*3(h)*
c. SSI • SGTF postulated accident (15.6.3) (Table 15.6-6 SGTF limiting mass release) • Events listed under DHRS actuation	*1*	*2*	*3(h)*

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	*APPLICABLE MODES*		
(h) With RCS temperature above the T-2 interlock and containment water level below the L-1 interlock.			
13. High Narrow Range RCS Hot Temperature			
a. RTS • Decrease in feedwater temperature AOO (15.1.1.3, Table 15.1-1) • Increase in steam flow AOO—limiting CHFR 114% steam flow case (15.1.3.2) • Increase in steam flow AOO *(*15.1.3.2) • Loss of normal feedwater flow AOO (15.2.7.2) • Inadvertent operation of DHRS AOO (15.2.9.2, Table 15.2-31) • Uncontrolled CRA withdrawal at power (15.4.2.2) • Control rod misoperation (15.4.3.2) • Spectrum of rod ejection accidents (15.4.8.2.4)	*1*	*-*	*-*
b. DHRS • Decrease in feedwater temperature AOO (15.1.1.2) (Table 15.1-1 limiting minimum CHFR) • Increase in steam flow (15.1.3.2) • Increase in steam flow AOO *(*15.1.3.2) • Loss of normal feedwater flow AOO (15.2.7.2) • Inadvertent operation of DHRS AOO (15.2.9.2) • Uncontrolled CRA withdrawal at power (15.4.2.2) • Control rod misoperation (15.4.3.2)	*1*	*2*	*3(e)*
c. PHT • Uncontrolled CRA withdrawal at power (15.4.2.2) • Pressurizer heaters are tripped on all automatic DHRS actuation signals.	*1*	*2(f)*	*3(f)*
d. DWSI • DWSI is designed to occur when Function 13.a, RTS, occurs.	*1*	*-*	*-*
e. SSI • Decrease in feedwater temperature AOO (15.1.1.2) (Table 15.1-1 limiting minimum CHFR) *(e) When not PASSIVELY COOLED.* *(f) With pressurizer heater breakers closed.*	*1*	*2*	*3(e)*
14. Low RCS Flow			
a. DWSI • Inadvertent decrease in RCS boron concentration (15.4.6.2)	*1*	*2*	*3*
15. Low Low RCS Flow • *Table 15.0-7—designed to ensure flow remains measurable and positive during low-power startup conditions*			
a. RTS • Failure of the non-safety-related module heatup system during startup condition reducing RCS flow (9.3.4)	*1*	*2(a)*	*3(a)*
b. CVCSI • CVCS malfunction—limiting minimum CHFR (no pressurizer spray) (Table 15.5-3 Sequence of Events)	*1*	*2(a)*	*3(a)*

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	APPLICABLE MODES		
• Rupture of CVCS makeup or letdown line outside containment (15.6.2.2)			
c. DWSI • DWSI is designed to occur when Function 15.a, RTS, occurs. *(a) When capable of CRA withdrawal.*	*1*	*2(a)*	*3(a)*
16. High Main Steam Pressure			
a. RTS • Loss of external load AOO (15.2.1.2; limiting minimum CHFR) • Turbine trip AOO (15.2.2.1) • Loss of condenser vacuum AOO (15.2.3.1) • Closure of MSIV(s) AOO (15.2.4.2) • Increase in feedwater flow AOO (15.1.2.2, 10.4.7.2) *(5% RTP penalty added)* • Inadvertent DHRS actuation (one valve opens, turbine load controller ineffective; turbine bypass not credited) (15.2.9.2, 10.4.7.2) • SGTF (15.6.3, 10.4.7.2) • Loss of nonemergency AC power to the station auxiliaries (15.2.6—Table 15.2-17, Limiting Minimum CHFR) • Spectrum of rod ejection accidents (15.4.8.2.4) • Failure of small lines carrying primary coolant outside containment infrequent event (15.6.2.3.2) (CVCS letdown line break with loss of normal AC, Table 15.6-1, Maximum Mass Release)	*1*	*2(a)*	-
b. DHRS • Decrease in feedwater temperature AOO (15.1.1.2) • Increase in feedwater flow AOO (15.1.2.2) • Loss of external load AOO (15.2.1.2; limiting minimum CHFR) • Turbine trip AOO (15.2.2.1) • Loss of condenser vacuum AOO (15.2.3.1) • Closure of MSIV(s) AOO (15.2.4.2) • Loss of nonemergency AC power to the station auxiliaries (15.2.6, Table 15.2-17, Limiting Minimum CHFR) • CVCS malfunction AOO (15.5.1.2) (Table 15.5-1 limiting SG pressure, pressurizer spray available) • Failure of small lines carrying primary coolant outside containment infrequent event (15.6.2.3.2) • SGTF postulated accident (Table 15.6-6 SGTF limiting mass release), limiting SG pressure (Table 15.6-8) • Double-ended CVCS letdown line break outside containment with coincident loss of normal AC power (15.6.2.3.3) • Failure of primary coolant carrying piping outside containment (Table 15.6-1)	*1*	*2*	*3(e)*

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	*APPLICABLE MODES*		
c. PHT • Pressurizer heaters are tripped on all automatic DHRS actuation signals.	*1*	*2(f)*	*3(f)*
d. DWSI • DWSI is designed to occur when Function 16.a, RTS, occurs.	*1*	*2(a)*	-
e. SSI • CVCS malfunction AOO (15.5.1.2) (Table 15.5-1 limiting SG pressure, pressurizer spray available)	*1*	*2*	*3(e)*
(a) When capable of CRA withdrawal. *(e) When not PASSIVELY COOLED.* *(f) With pressurizer heater breakers closed.*			
17. Low Main Steam Pressure			
a. RTS • Increase in steam flow AOO (15.1.3.2) • Steam piping failures inside and outside containment (15.1.5.2) • Inadvertent DHRS actuation AOO (15.2.9.2, 10.4.7.2) • Steamline break outside containment (15.1.5, 10.4.7.2)	*1(b)*	-	-
b. DWSI • DWSI is designed to occur when Function 17.a, RTS, occurs.	*1(b)*	-	-
c. SSI • Increase in steam flow AOO (15.1.3.2) • Feedwater system pipe breaks inside and outside of containment (15.2.8.1)	*1(b)*	-	-
(b) With power above the N-2H Interlock.			
18. Low Low Main Steam Pressure			
a. RTS • Steamline break outside containment (15.1.5, 10.4.7.2) during low-power startup conditions	*1*	*2(a)*	*3(a)*
b. DWSI • DWSI is designed to occur when Function 18.a, RTS, occurs.	*1*	*2(a)*	*3(a)*
c. SSI • Steamline break outside containment (15.1.5, 10.4.7.2)	*1*	*2(i)*	*3(i)*
(a) When capable of CRA withdrawal. *(i) With containment water level below the L-1 interlock.*			
19. High Steam Superheat			
a. RTS • Decrease in feedwater temperature AOO (15.1.1.2) • Increase in feedwater flow AOO *(not* credited*)* (15.1.2.2) (Table 15.1-4 limiting minimum CHFR) • Increase in steam flow AOO *(not credited)* (15.1.3.2) • Steam piping failures inside and outside containment (15.1.5.2) • Feedwater system pipe breaks inside and outside of containment (15.2.8.1)	*1*	-	-

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	*APPLICABLE MODES*		
• Inadvertent DHRS actuation (one valve opens, turbine load controller ineffective; turbine bypass not credited) (15.2.9.2) • Spectrum of rod ejection accidents (15.4.8.2.4) • Failure of primary coolant carrying piping outside containment (Table 15.6-1) • Double-ended CVCS letdown line break outside containment with coincident loss of normal AC power (15.6.2.3.3)			
b. DWSI • DWSI is designed to occur when Function 19.a, RTS, occurs.	*1*	-	-
c. SSI • Decrease in feedwater temperature AOO (15.1.1.2) • Increase in feedwater flow (15.1.2) (Table 15.1-4 limiting minimum CHFR) • Feedwater system pipe breaks inside and outside of containment (15.2.8.1) • Double-ended CVCS letdown line break outside containment with coincident loss of normal AC power (15.6.2.3.3) • Failure of primary coolant carrying piping outside containment (Table 15.6-1)	*1*	-	-
20. Low Steam Superheat			
a. RTS • Steam piping failures inside and outside containment (5.1.5.2)	*1(j)*	-	-
b. DWSI • DWSI is designed to occur when Function 20.a, RTS, occurs.	*1(j)*	-	-
c. SSI • Increase in feedwater flow AOO (15.1.2.2)	*1(k)*	-	-
(j) With power above the N-2H interlock or V-1 interlock not active (both FWIVs open). *(k) With containment [water] level below the L-1 interlock with reactor power above the N-2H interlock, or with containment water level below the L-1 interlock with the V-1 interlock not active (both FWIVs open).*			
21. High Narrow Range Containment Pressure			
a. RTS • Main steamline break inside containment postulated accident (6.2.1.4.4, 15.1.5.1) • Feedwater line break postulated accident (6.2.1.4.4, 15.1.5.1) • Feedwater system pipe breaks inside and outside of containment (15.2.8.1) • Steam piping failures inside and outside containment (15.1.5.2) • Loss of containment vessel vacuum, or containment vessel flooding (15.1.6.2) • LOCAs resulting from a spectrum of postulated piping breaks within the RCPB postulated accident (15.6.5.3.3) • Inadvertent operation of ECCS—reactor recirculation valve (RRV) opens with loss of normal AC and direct current (DC) power (reactor vent valve (RVV) opening bounds reactor safety valve (RSV) opening) AOO (15.6.6.3.2/3)	*1*	*2(a)*	*3(a)*

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	*APPLICABLE MODES*		
b. CIS • Main steamline break inside containment postulated accident (15.1.5.1) • Feedwater system pipe breaks inside and outside of containment (15.2.8.1) • Inadvertent operation of ECCS (RVV opening bounds RSV opening) AOO (15.6.6.3.2) • LOCA (Table 15.6-12)	*1*	*2*	*3(l)*
c. CVCSI • RCS or secondary leaks above the allowable limits to protect RCS inventory and ECCS function by isolating part of the boundary (15.6.5)	*1*	*2*	*3(l)*
d. DWSI • DWSI is designed to occur when Function 21.a, RTS, occurs.	*1*	*2(a)*	*3(a)*
e. SSI • Main steamline break inside containment postulated accident (6.2.1.4.4, 15.1.5.1) • Feedwater line break postulated accident (6.2.1.4.4, 15.1.5.1) • Feedwater system pipe breaks inside and outside of containment (15.2.8.1) • Inadvertent operation of ECCS (RVV opening bounds RSV opening) AOO (15.6.6.3.2/3)	*1*	*2*	*3(m)*
(a) When capable of CRA withdrawal. *(l) With RCS temperature above the T-3 interlock.* *(m) With RCS temperature above the T-3 interlock and containment water level below the L-1 interlock.*			
22. High Containment Water Level			
a. ECCS • LOCAs resulting from a spectrum of postulated piping breaks within the RCPB postulated accident (15.6.5.3.3) • Inadvertent operation of ECCS (RVV opening bounds RSV opening) AOO (15.6.6.3.2)	*1*	*2*	*3(n)*
(n) With RCS temperature above the T-3 interlock or pressurizer water level below the L-2 interlock.			
23. Low RCS Pressure - ECCS			
a. ECCS • LOCAs resulting from a spectrum of postulated piping breaks within the RCPB postulated accident (15.6.5.3.3) • Inadvertent operation of ECCS (RVV opening bounds RSV opening) AOO (15.6.6.3.2)	*1(o)*	*2(o)*	*-*

(o) With RCS temperature above the T-6 interlock.

MPS INSTRUMENTATION FUNCTION SUPPORTED RTS AND ESFAS LOGIC AND ACTUATION FUNCTION(S)	*APPLICABLE MODES*		
24. High RCS Pressure—Low Temperature Overpressure Protection (LTOP)			
a. LTOP • Low temperature overpressure events, limiting event is spurious actuation of the pressurizer heaters (5.2.2.2.2)	-	-	*3(p)*
(p) With wide range RCS cold temperature below the LTOP enable temperature specified in the PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR) (T-1 interlock) and more than one reactor vent valve closed.			
25. Low AC Voltage to Low Voltage AC Electrical Distribution System (ELVS) Battery Chargers			
a. RTS • SGTF postulated accident (with loss of highly reliable DC power and normal AC power (15.6.3.3.2)	*1*	*2(a)*	*3(a)*
b. DHRS • SGTF postulated accident (with loss of highly reliable DC power and normal AC power (15.6.3.3.2)	*1*	*2*	*3(e)*
c. CIS • SGTF postulated accident (with loss of highly reliable DC power and normal AC power (15.6.3.3.2)	*1*	*2*	*3*
d. CVCSI • SGTF postulated accident (with loss of highly reliable DC power and normal AC power (15.6.3.3.2)	*1*	*2*	*3*
e. DWSI • DWSI is designed to occur when Function 24.a, RTS, occurs.	*1*	*2(a)*	*3(a)*
f. PHT • Pressurizer heaters are tripped on all automatic DHRS actuation signals.	*1*	*2(f)*	-
g. SSI • SGTF postulated accident (with loss of highly reliable DC power and normal AC power (15.6.3.3.2)	*1*	*2*	*3(e)*
(a) When capable of CRA withdrawal. *(e) When not PASSIVELY COOLED.* *(f) With pressurizer heater breakers closed.*			
26. High Under-the-Bioshield Temperature			
a. RTS • High-energy line breaks under the bioshield (3.6)	*1*	*2(a)*	*3(a)*
b. CIS • High-energy line breaks under the bioshield (3.6)	*1*	*2*	*3*
c. CVCSI • High-energy line breaks under the bioshield (3.6)	*1*	*2*	*3*
d. DWSI • DWSI is designed to occur when Function 25.a, RTS, occurs.	*1*	*2(a)*	*3(a)*
e. SSI • High-energy line breaks under the bioshield (3.6)	*1*	*2*	*3(e)*
(a) When capable of CRA withdrawal. *(e) When not PASSIVELY COOLED.*			

- LCO 3.3.2 Reactor Trip System (RTS) Logic and Actuation

The following MPS instrumentation functions initiate an RTS actuation. In Table 16.4.1-2, this SER uses italics to denote requirements included in GTS Subsection 3.3.1 for MPS instrumentation Functions. Regular font denotes requirements included in GTS Subsection 3.3.2 for the RTS Logic and Actuation Function and discussions of interlocks referenced in footnotes in Table 3.3.1-1.

Table 16.4.1-2 RTS Logic and Actuation Function

RTS LOGIC AND ACTUATION FUNCTION *ASSOCIATED MPS INSTRUMENTATION FUNCTIONS*	APPLICABLE MODES		
LCO 3.3.2 **Reactor Trip System**	1	2(a)	3(a)
(a) When capable of CRA withdrawal.			
1.a. High Power Range Linear Power	*1*	*2(a)*	*3(a)*
2.a. High Power Range Positive and Negative Rate	*1(b)*	-	-
3.a. High Intermediate Range Log Power Rate	*1(c)*	*2(a)*	*3(a)*
4.a. High Source Range Count Rate	*1(d)*	*2(a)*	*3(a)*
5.a. High Source Range Log Power Rate	*1(d)*	*2(a)*	*3(a)*
7.a. High Pressurizer Pressure	*1*	*2(a)*	*3(a)*
8.a. Low Pressurizer Pressure	*1(g)*	-	-
9.a. Low Low Pressurizer Pressure	*1*	*2(a)*	*3(a)*
10.a. High Pressurizer Level	*1*	*2(a)*	*3(a)*
11.a. Low Pressurizer Level	*1*	*2(a)*	*3(a)*
13.a. High Narrow Range RCS Hot Temperature	*1*	-	-
15.a. Low Low RCS Flow	*1*	*2(a)*	*3(a)*
16.a. High Main Steam Pressure	*1*	*2(a)*	-
17.a. Low Main Steam Pressure	*1(b)*	-	-
18.a. Low Low Main Steam Pressure	*1*	*2(a)*	*3(a)*
19.a. High Steam Superheat	*1*	-	-
20.a. Low Steam Superheat	*1(j)*	-	-
21.a. High Narrow Range Containment Pressure	*1*	*2(a)*	*3(a)*
24.a. Low AC Voltage to Low Voltage AC Electrical Distribution System Battery Chargers	*1*	*2(a)*	*3(a)*
25.a. High Under-the-Bioshield Temperature	*1*	*2(a)*	*3(a)*

(a) When capable of CRA withdrawal.

(b) With power above the N-2H Interlock.

The power range linear power interlock N-2H automatically bypasses (enables) MPS RTS Function 2.a below (above) 15% RTP (bypass requires 3 of 4 channels < 15% RTP).

(c) With power below the N-2L interlock.

The power range linear power interlock N-2L automatically bypasses (enables) MPS RTS Function 3.a above (below) 15% RTP (bypass requires 3 of 4 channels > 15% RTP).

The power range linear power permissive N-2L allows manual bypass of (automatically enables) MPS RTS Function 1.a, High-1 above (below) 15% RTP (permissive requires 3 of 4 channels > 15% RTP).

RTS LOGIC AND ACTUATION FUNCTION *ASSOCIATED MPS INSTRUMENTATION FUNCTIONS*	APPLICABLE MODES
(d) When Intermediate Range Log Power less than N-1 interlock.	
The intermediate range log power permissive N-1 allows manual bypass of (automatically enables) MPS RTS Functions 4.a and 5.a above (below) 1E5 cps (one decade above channel lower range limit).	
(g) With narrow range RCS hot temperature above the T-4 interlock.	
The narrow range RCS hot temperature interlock T-4 automatically enables (bypasses) MPS RTS Function 8.a above (below) 316 °C (600 °F).	
(j) With power above the N-2H Interlock or V-1 interlock not active (both FWIVs open).	
The power range linear power interlock N-2H automatically bypasses MPS RTS Function 20.a and ESFAS Function 20.b below 15% RTP (bypass requires 3 of 4 channels < 15% RTP) provided V-1 is active.	
The FWIV closed interlock V-1 automatically bypasses MPS RTS Function 20.a, and ESFAS Function 20.b when at least one FWIV does not indicate open provided N-2H is active.	
The power range linear power interlock N-2H automatically enables MPS RTS Function 20.a and ESFAS Function 20.b above 15% RTP (enable requires 2 of 4 channels ≥ 15% RTP).	
The FWIV closed interlock V-1 automatically enables MPS RTS Function 20.a and ESFAS Function 20.b when both FWIVs indicate open (V-1 interlock not active).	

- LCO 3.3.3 Engineered Safety Features Actuation System (ESFAS) Logic and Actuation

The following listed MPS instrumentation functions initiate the indicated ESFAS Logic and Actuation Functions. In Table 16.4.1-3, this SER uses italics to denote requirements included in GTS Subsection 3.3.1 for MPS instrumentation Functions. Regular font denotes requirements included in GTS Subsection 3.3.3 for the ESFAS Logic and Actuation Functions and discussions of interlocks referenced in footnotes in Table 3.3.1-1.

Table 16.4.1-3 ESFAS Logic and Actuation Functions

ESFAS LOGIC AND ACTUATION FUNCTION *ASSOCIATED MPS INSTRUMENTATION FUNCTION(S)*	APPLICABLE MODES		
1. **Emergency Core Cooling System** (ECCS)	1	2	3(a)
(a) When not PASSIVELY COOLED.			
22.a. High Containment Water Level	*1*	*2*	*3(n)*
23.a. Low RCS Pressure - ECCS	*1(o)*	*2(o)*	-
(n) With RCS temperature above the T-3 interlock or pressurizer water level below the L-2 interlock.			
(o) With RCS temperature above the T-6 interlock.			

ESFAS LOGIC AND ACTUATION FUNCTION *ASSOCIATED MPS INSTRUMENTATION FUNCTION(S)*	APPLICABLE MODES		
• With containment pressure > 6.9 kPa (absolute) (1 psia) (P-1 interlock not active), the wide range RCS hot temperature (T_{hot}) interlock T-6, with 2 of 4 T_{hot} channels > 246 °C (475 °F), automatically enables MPS ESFAS Function 23.a • With containment pressure > 6.9 kPa (absolute) (1 psia) (P-1 interlock not active), the wide range RCS hot temperature (T_{hot}) interlock T-6, with 3 of 4 T_{hot} channels < 246 °C (475 °F), automatically bypasses MPS ESFAS Function 23.a			
2. **Decay Heat Removal System** (DHRS)	1	2	3(a)
(a) When not PASSIVELY COOLED			
7.b. High Pressurizer Pressure	*1*	*2*	*3(e)*
13.b. High Narrow Range RCS Hot Temperature	*1*	*2*	*3(e)*
16.b. High Main Steam Pressure	*1*	*2*	*3(e)*
25.b. Low AC Voltage to Low Voltage AC Electrical Distribution System Battery Chargers	*1*	*2*	*3(e)*
(e) When not PASSIVELY COOLED.			
3. **Containment Isolation System** (CIS)	1	2	3
12.a. Low Low Pressurizer Level	*1*	*2*	*3(h)*
21.b. High Narrow Range Containment Pressure	*1*	*2*	*3(l)*
25.c. Low AC Voltage to Low Voltage AC Electrical Distribution System Battery Chargers	*1*	*2*	*3*
26.b. High Under-the-Bioshield Temperature	*1*	*2*	*3*
(h) With [wide range] RCS [hot] temperature above the T-2 interlock and containment water level below the L-1 interlock. • With L-1 interlock not active, and RT-1 permissive active, the wide range RCS hot temperature interlock T-2 automatically bypasses (enables) MPS ESFAS Function 12.a below (above) 93.3 °C (200 °F) (bypass requires 3 of 4 channels < 93.3 °C (200 °F)). • With L-1 interlock active, or RT-1 permissive not active, the T-2 interlock automatically enables MPS ESFAS Function 12.a, even with 3 of 4 channels of wide range RCS hot temperature < 93.3 °C (200 °F).			
(l) With RCS temperature above the T-3 interlock. • T-3 interlock is active when 3 of 4 channels of wide range RCS hot temperature are < 177 °C (350 °F), and automatically bypasses MPS ESFAS Function 21.b. • T-3 interlock is not active when 2 or more channels of wide range RCS hot temperature are > 177 °C (350 °F), and automatically enables MPS ESFAS Function 21.b.			
4. **Demineralized Water Supply Isolation** (DWSI)	1	2	3
1.b. High Power Range Linear Power	*1*	*2(a)*	*3(a)*
2.b. High Power Range Positive and Negative Rate	*1(b)*	*-*	*-*

ESFAS LOGIC AND ACTUATION FUNCTION *ASSOCIATED MPS INSTRUMENTATION FUNCTION(S)*	APPLICABLE MODES		
3.b. High Intermediate Range Log Power Rate	*1(c)*	*2(a)*	*3(a)*
4.b. High Source Range Count Rate	*1(d)*	*2(a)*	*3(a)*
5.b. High Source Range Log Power Rate	*1(d)*	*2(a)*	*3(a)*
6.a. High Subcritical Multiplication	*1(d)*	*2*	*3*
7.d. High Pressurizer Pressure	*1*	*2(a)*	*3(a)*
8.b. Low Pressurizer Pressure	*1(g)*	*-*	*-*
9.c. Low Low Pressurizer Pressure	*1*	*2(a)*	*3(a)*
10.c. High Pressurizer Level	*1*	*2(a)*	*3(a)*
11.c. Low Pressurizer Level	*1*	*2(a)*	*3(a)*
13.d. High Narrow Range RCS Hot Temperature	*1*	*-*	*-*
14.a. Low RCS Flow	*1*	*2*	*3*
15.c. Low Low RCS Flow	*1*	*2(a)*	*3(a)*
16.d. High Main Steam Pressure	*1*	*2(a)*	*-*
17.b. Low Main Steam Pressure	*1(b)*	*-*	*-*
18.b Low Low Main Steam Pressure	*1*	*2(a)*	*3(a)*
19.b. High Steam Superheat	*1*	*-*	*-*
20.b. Low Steam Superheat	*1(j)*	*-*	*-*
21.d. High Narrow Range Containment Pressure	*1*	*2(a)*	*3(a)*
25.e. Low AC Voltage to Low Voltage AC Electrical Distribution System Battery Chargers	*1*	*2(a)*	*3(a)*
26.d. High Under-the-Bioshield Temperature	*1*	*2(a)*	*3(a)*

(a) When capable of CRA withdrawal.

(b) With power above the N-2H interlock.

The power range linear power interlock N-2H automatically bypasses (enables) MPS ESFAS Functions 2.b and 17.b below (above) 15% RTP (bypass requires 3 of 4 channels < 15% RTP).

(c) With power below the N-2L interlock.

The power range linear power interlock N-2L automatically bypasses (enables) MPS ESFAS Function 3.b above (below) 15% RTP (bypass requires 3 of 4 channels > 15% RTP).

The power range linear power permissive N-2L allows manual bypass of (automatically enables) MPS ESFAS Function 1.b, High-1 above (below) 15% RTP (permissive requires 3 of 4 channels > 15% RTP).

(d) When Intermediate Range Log Power less than N-1 interlock.

The intermediate range log power permissive N-1 allows manual bypass of (automatically enables) MPS ESFAS Functions 4.b and 5.b above (below) 1E5 cps (one decade above channel lower range limit) (permissive requires 3 of 4 channels > 1E5 cps).

The intermediate range log power interlock N-1 automatically bypasses (enables) MPS ESFAS Function 6.a above (below) 1E5 cps (bypass requires 3 of 4 channels > 1E5 cps).

(g) With narrow range RCS hot temperature above the T-4 interlock.

The narrow range RCS hot temperature interlock T-4 automatically enables (bypasses) MPS ESFAS Function 8.b above (below) 316 °C (600 °F).

ESFAS LOGIC AND ACTUATION FUNCTION *ASSOCIATED MPS INSTRUMENTATION FUNCTION(S)*	APPLICABLE MODES

(j) With power above the N-2H Interlock or V-1 interlock not active (both FWIVs open).

The power range linear power interlock N-2H automatically bypasses MPS RTS Function 20.a, and ESFAS Function 20.b below 15% RTP (bypass requires 3 of 4 channels < 15% RTP) provided at least one FWIV does not indicate open (V-1 interlock active).

The FWIV closed interlock V-1 automatically bypasses MPS RTS Function 20.a and ESFAS Function 20.b when at least one FWIV does not indicate open provided power is below N-2H interlock (N-2H active).

The power range linear power interlock N-2H automatically enables MPS RTS Function 20.a, and ESFAS Function 20.b above 15% RTP (enable requires 2 of 4 channels ≥ 15% RTP).

The FWIV closed interlock V-1 automatically enables MPS RTS Function 20.a and ESFAS Function 20.b when both FWIVs indicate open (V-1 interlock not active).

Note: Wide Range RCS Hot Temperature Interlock, T-5, together with the Reactor Tripped Interlock, RT-1, bypasses DWSI actuation, which is designed to occur when any of the above MPS Functions that also cause RTS actuation, occurs. This T-5 plus RT-1 joint interlock is active when at least 3 of 4 wide range RCS Hot Temperature channels are < 216 °C (420 °F) and both divisional RTBs indicate open. However, this joint interlock is not used to modify any MODE 3 applicability of any MPS Function.

5.	**CVCS Isolation** (CVCSI)	1	2	3
9.b.	*Low Low Pressurizer Pressure*	*1*	*2*	*3(a)*
10.b.	*High Pressurizer Level*	*1*	*2*	*3*
12.b.	*Low Low Pressurizer Level*	*1*	*2*	*3(h)*
15.b.	*Low Low RCS Flow*	*1*	*2(a)*	*3(a)*
21.c.	*High Narrow Range Containment Pressure*	*1*	*2*	*3(l)*
25.d	*Low AC Voltage to Low Voltage AC Electrical Distribution System Battery Chargers*	*1*	*2*	*3*
26.c	*High Under-the-Bioshield Temperature*	*1*	*2*	*3*

(a) When capable of CRA withdrawal.

(h) With [wide range] RCS [hot] temperature above the T-2 interlock and containment water level below the L-1 interlock.

- With L-1 interlock not active (< 13.7 m (45 ft)), and RT-1 permissive active,
  the wide range RCS hot temperature interlock T-2 automatically bypasses (enables) MPS ESFAS Function 12.b
  below (above) 93.3 °C (200 °F) (bypass requires 3 of 4 channels < 93.3 °C (200 °F).
- With L-1 interlock active (> 13.7 m (45 ft)), or RT-1 permissive not active,
  the T-2 interlock automatically enables MPS ESFAS Function 12.b, even with 3 of 4 channels of wide range RCS hot temperature < 93.3 °C (200 °F).

(l) With RCS temperature above the T-3 interlock.

ESFAS LOGIC AND ACTUATION FUNCTION *ASSOCIATED MPS INSTRUMENTATION FUNCTION(S)*	APPLICABLE MODES		
• T-3 interlock is active when 3 of 4 channels of wide range RCS hot temperature are < 177 °C (350 °F), and automatically bypasses MPS ESFAS Function 21.c. • T-3 interlock is not active when 2 or more channels of wide range RCS hot temperature are > 177 °C (350 °F), and automatically enables MPS ESFAS Function 21.c. *Note: Wide Range RCS Hot Temperature Interlock T-5 bypasses Function 9.b, CVCSI on Low Low Pressurizer Pressure, when at least 3 of 4 wide range RCS Hot Temperature channels are < 216 °C (420 °F) and RT-1 interlock is active (both divisional RTBs are open).*			
6. **Pressurizer Heater Trip**	1	2(b)	3(b)
(b) With pressurizer heater breakers closed.			
7.c. High Pressurizer Pressure	*1*	*2(f)*	*3(f)*
11.b. Low Pressurizer Level	*1*	*2(f)*	*3(f)*
13.c. High Narrow Range RCS Hot Temperature	*1*	*2(f)*	*3(f)*
16.c. High Main Steam Pressure	*1*	*2(f)*	*3(f)*
25.f. Low AC Voltage to Low Voltage AC Electrical Distribution System Battery Chargers	*1*	*2(f)*	-
(f) With pressurizer heater breakers closed.			
7. **Low Temperature Overpressure Protection** (LTOP)	-	-	3(c)
(c) With wide range RCS cold temperature below the LTOP enable temperature specified in the PTLR (T-1 interlock) and more than one reactor vent valve closed.			
24.a High RCS Pressure—Low Temperature Overpressure Protection	-	-	*3(p)*
(p) With wide range RCS cold temperature below the LTOP enable temperature specified in the PTLR (T-1 interlock) and more than one reactor vent valve closed. With at least 3 of 4 wide range RCS cold temperature channels above the T-1 interlock setpoint (the nil ductility transition (NDT) temperature) 163 °C (325 °F), T-1 is active and the LTOP actuation Function is automatically bypassed. Below T-1, the LTOP actuation Function is automatically enabled. The LTOP actuation Function opens the closed reactor vent valves on 2 of 4 MPS high wide range RCS pressure channels with indication above the LTOP setpoint, which is calculated for each channel as a function of wide range RCS cold temperature, as indicated by DCA Part 2, Tier 2, Figure 5.2-4 “Variable LTOP Setpoint”; and Table 5.2-10, “LTOP Pressure Setpoint as Function of Cold Temperature.”			
8. **Secondary System Isolation (SSI)**	1	2	3
7.e. High Pressurizer Pressure	*1*	*2*	*3(e)*
9.d. Low Low Pressurizer Pressure	*1*	*2*	*3(a)*
12.c. Low Low Pressurizer Level	*1*	*2*	*3(h)*
13.e. High Narrow Range RCS Hot Temperature	*1*	*2*	*3(e)*
16.e. High Main Steam Pressure	*1*	*2*	*3(e)*

ESFAS LOGIC AND ACTUATION FUNCTION *ASSOCIATED MPS INSTRUMENTATION FUNCTION(S)*	APPLICABLE MODES		
17.c. Low Main Steam Pressure	*1(b)*	-	-
18.c. Low Low Main Steam Pressure	*1*	*2(i)*	*3(i)*
19.c. High Steam Superheat	*1*	-	-
20.c. Low Steam Superheat	*1(k)*		
21.e. High Narrow Range Containment Pressure	*1*	*2*	*3(m)*
25.e. Low AC Voltage to Low Voltage AC Electrical Distribution System Battery Chargers	*1*	*2*	*3(e)*
26.e. High Under-the-Bioshield Temperature	*1*	*2*	*3(e)*

(a) When capable of CRA withdrawal.

(b) With power above the N-2H interlock.

(e) When not PASSIVELY COOLED.

(h) With RCS temperature above the T-2 interlock and containment water level below the L-1 interlock.

(i) With containment water level below the L-1 interlock.

(k) With containment water level below the L-1 interlock with reactor power above the N-2H interlock, or with containment water level below the L-1 interlock with the V-1 interlock not active (both FWIVs open).

(m) With RCS temperature above the T-3 interlock and containment water level below the L-1 interlock.

Note: Wide Range RCS Hot Temperature Interlock T-5 bypasses Function 9.d, SSI on Low Low Pressurizer Pressure, when at least 3 of 4 wide range RCS Hot Temperature channels are < 216 °C (420 °F) and RT-1 interlock is active (both divisional RTBs are open).

- LCO 3.4.4 Reactor Safety Valves (RSVs)

The two RSVs must be operable to provide RCS overpressure protection in Modes 1 and 2, and in Mode 3 above the T-1 interlock setpoint, which is specified in the PTLR referenced by GTS Subsection 5.6.4, "PTLR."

In discussing the applicable safety analyses, Bases Subsection B 3.4.4 lists the DCA Part 2, Tier 2, Chapter 15, analyses that credit the functioning of the two RSVs for overpressure protection not only of the RCS but also the SG system. One RSV, in conjunction with the MPS, can prevent RCS pressure from exceeding the RCS pressure SL of 15.755 megapascals (MPa) (absolute) (2,285 pound-force per square inch (psia)). The RSV minimum relief capacity is based on a postulated overpressure transient of a turbine trip without turbine bypass capability.

- LCO 3.4.6 Chemical and Volume Control System (CVCS) Isolation Valves

This LCO addresses the CVCSI function of the eight containment isolation valves (CIVs) in the CVCS. During normal conditions with the NPM in MODE 1, 2, or 3, the two valves in each of the three flow paths of RCS injection, RCS discharge, and pressurizer spray are normally open, and the two valves in the RPV high point degasification line are normally closed. All of the valves receive an ESFAS signal to close (CIS and CVCSI) on two of four channels of any of the MPS Functions of LCO 3.3.1, as listed above in Table 16.4.1-3 under Function 3, CIS, and

Function 5, CVCSI. These MPS Functions generate trip signals to the two ESF Logic and Actuation divisions, which close the CVCSI valves.

The CVCSI Function's actuated devices, the eight CVCS CIVs, are required to be operable in Modes 1, 2, and 3 to provide mitigation of pressurizer overfill event, SGTF postulated accident, CVCS postulated break outside containment event, and reverse RCS flow event, which are considered possible in these modes, and the automatic closure of these valves is assumed in the safety analyses of these events.

- LCO 3.4.10 Low Temperature Overpressure Protection (LTOP) Valves

This LCO was added with the submission of Revision 1 of the DCA to capture the LTOP function of the three ECCS RVVs. SER Section 16.4.5 gives the staff's evaluation of GTS Subsection 3.4.10.

- LCO 3.5.1 Emergency Core Cooling System (ECCS)—Operating

This LCO ensures the normally closed RVVs and RRVs will automatically open to mitigate the postulated LOCAs and the postulated SGTF accident when the unit is initially in Mode 1, Mode 2, or Mode 3 and not passively cooled. The ECCS, in combination with the required water level in the containment vessel, can also be used to conduct passive cooling in Mode 3 maintaining a safe-shutdown condition.

- LCO 3.5.2 Decay Heat Removal System (DHRS)

This LCO ensures the normally closed DHRS parallel actuation valves for each SG will automatically open, and that the normally open MSIVs and FWIVs will automatically close to establish a natural circulation flow of DHRS water through the SG tubes, which transfers energy from the reactor coolant to the DHRS water flowing in the SG tubes, through the main steam header plenum to the inlets of the DHRS heat exchangers in the reactor building pool, which rejects the energy to the UHS, then to the outlet of the DHRS heat exchangers back to the feedwater SG inlet plenum, and again through the SG tubes. The DHRS passively removes core decay heat during non-LOCA events and cools down the RCS to the safe-shutdown condition of Mode 3 with passive cooling in operation, assuming the secondary heat sink is unavailable because of a concurrent loss of AC power to the condensate and feedwater system and the circulating water system. The DHRS is relied upon to provide a passive means of decay heat removal in Modes 1 and 2 and must remain operable in Mode 3 until passive cooling is placed in operation, which can be done by placing the DHRS in operation.

- LCO 3.5.3 Ultimate Heat Sink

In Modes 1, 2, and 3, the minimum reactor pool water level of 20.7 m (68 ft) (in Condition A) provides margin above the minimum level required to support DHRS and ECCS operation in response to LOCA and non-LOCA design-basis events.

- LCO 3.6.1 Containment

The containment vessel functions to limit the release of fission products to the outside environment in the event of a postulated DBA involving fuel damage. In the NuScale design, it is also an integral component of the ECCS system and is used in two methods of passive cooling.

- LCO 3.6.2 Containment Isolation Valves (CIVs)

The CIVs automatically close in response to a CIS actuation signal and provide mitigation of the DBA involving a main steamline break inside containment (DCA Part 2, Tier 2, Section 15.1.5.1).

- LCO 3.7.1 Main Steam Isolation Valves (MSIVs)

The MSIVs, including the backup MSIVs, automatically close in response to a CIS actuation signal, an SSI actuation signal (for affected SGs), and a DHRS actuation signal to mitigate the DBA involving a main steamline break outside containment (DCA Part 2, Tier 2, \ Section 15.1.5.1).

- LCO 3.7.2 Feedwater Isolation

The FWIVs and the FWRVs automatically close in response to a CIS actuation signal, an SSI actuation signal (for affected SGs), and a DHRS actuation signal to mitigate DBAs involving an SGTF, and a feedwater system pipe break, both inside and outside containment. (DCA Part 2, Tier 2, Sections 15.6.3 and 15.2.8)

- LCO 3.8.1 Nuclear Instrumentation (refueling neutron flux [monitoring] channels)

In Mode 5, two of the three refueling neutron flux channels must be operable to ensure that redundant monitoring capability is available to detect changes in core reactivity during removal of the upper reactor vessel assembly and during movement of an irradiated fuel assembly in the reactor vessel. Each channel must provide visual indication in the control room. In addition, at least one of the two required channels must provide an operable audible count rate function to alert the operators to the initiation of a boron dilution event.

Based on its evaluation of the DCA rationale for identifying the operability of SSCs specified by the above listed LCOs as meeting Criterion 3, the staff finds that the GTS satisfy 10 CFR 50.36(c)(2)(ii)(C), Criterion 3.

16.4.1.4 Limiting Conditions for Operation Required by Criterion 4—A Structure, System, or Component which Operating Experience or Probabilistic Risk Assessment Has Shown To Be Significant to Public Health and Safety

The following LCOs require operability of SSCs that provide backup to other LCO-required SSCs, and their inclusion in the GTS enhances the safe operation of the NPM. Therefore, the staff finds that these LCOs satisfy Criterion 4.

- LCO 3.3.4 [RTS and ESF System] Manual Actuation Functions
- LCO 3.3.5 Remote Shutdown Station (RSS) [Monitoring Instrumentation]

The staff concludes that designating the operability of the SSCs specified by the above-listed LCOs as meeting Criterion 4 is beneficial to safety. Therefore, the staff finds that the GTS satisfy 10 CFR 50.36(c)(2)(ii)(D), Criterion 4.

16.4.1.5 Limiting Conditions for Operation Required by None of the Criteria

The following LCO specifies which LCO requirements may be suspended while conducting testing of the reactor, because physics testing requires exceeding the excepted LCO restrictions. This LCO also specifies other restrictions to ensure plant safety during physics testing. LCO 3.0.7 addresses physics testing by providing rules for entering and exiting the physics testing LCO and by providing an exception to LCO 3.0.1.

- LCO 3.1.8 PHYSICS TESTS Exceptions

Because this LCO and the associated LCO 3.0.7 are consistent with W-STS and the NuScale physics testing, the staff finds that including LCO 3.0.7 and LCO 3.1.8 in the GTS is acceptable.

16.4.1.6 Non-Limiting Conditions for Operation-Required SSCs, Functions, and Process Variables Typically Addressed by Limiting Conditions for Operation in W-STS, CE-STS, or W-AP1000-STS

The staff reviewed the NuScale design as described in DCA Part 2 to confirm that omission of certain SSCs and parameter limits typically included in TS is justified.

- *LCO not* required *because parameter is implicitly ensured to be within limits by another LCO*

Containment Vessel Atmosphere Temperature and Pressure

STS Section 3.6 usually includes LCOs on containment temperature and pressure. The staff notes that, in the NuScale design, a very low containment vessel internal pressure is required for leakage detection instrumentation operability. Therefore, meeting LCO 3.4.7 maintains the initial value of containment vessel pressure in MODES 1 and 2, and in MODE 3 above 93.3 degrees C (200 degrees F), which is an assumption in the accident analysis. Accordingly, an LCO directly tied to the assumed initial value of containment vessel pressure is not necessary under Criterion 2. In addition, accident analysis conclusions are insensitive to the initial mass and energy content and the temperature of the containment vessel atmosphere because of the near-vacuum initial pressure of the containment vessel. Therefore, an LCO to ensure the validity of the initial value assumption for the containment vessel atmosphere temperature is also unnecessary. For these reasons, the staff finds that omitting explicit LCOs for initial containment pressure and temperature is acceptable.

- *LCO not required because system is classified as not safety-related in NuScale design*

Electrical Power (Includes Offsite (Preferred) AC Electrical Power Sources; Onsite Alternating AC (Standby) Electrical Power Sources; Onsite DC Electrical Power Sources (Batteries); Battery Chargers; DC-to-AC Inverters; Battery Parameters; AC and DC Electrical Power Distribution Systems)

SER Chapter 8, “Electric Power,” provides the staff’s evaluation of electrical power systems in the NuScale design.

Control Room Habitability (Includes Bottled Air System; Radioactivity Filtration System; Control Room Envelope Passive Cooling System; Control Room Normal HVAC System, Control Room Envelope Air Temperature and Humidity Limits; Control Room Envelope Boundary Unfiltered Inleakage Limit; Automatic Initiation of Control Room Isolation Mode and Bottled Air System on Detection of High Radiation in Outside Air Intake and on Detection of Toxic Gas.)

SER Chapters 6, “Engineered Safety Features,” and 9, “Auxiliary Systems,” provide the staff’s evaluation of standby and normal heating, ventilation, and air conditioning systems, respectively.

- *LCO not required because system or component is not part of the NuScale Design*

RCS Loops (external to the RPV)
Pressurizer Power-Operated Relief Valves
Containment Purge Supply and Exhaust Ventilation System and Isolation Dampers

- *LCO not required because the 1988 Split Report’s rationale for including an optional system is not satisfied* [3]

<u>Postaccident Monitoring Instrumentation</u>

DCA Part 2, Tier 2, Section 7.1.1.2.2, “Post-Accident Monitoring,” states the following, in part:

> The post-accident monitoring (PAM) is a nonsafety-related function. The PAM instrumentation includes the required functions, range and accuracy for each variable monitored. The selection of each type of variable follows the guidance provided in [Institute of Electrical and Electronics Engineers] IEEE [Standard] Std 497-2002, “IEEE Standard Criteria for Accident Monitoring Instrumentation for Nuclear Power Generating Stations” (Reference 7.1-11), as modified by [Regulatory Guide] RG 1.97, Revision 4 [“Criteria for Accident Monitoring Instrumentation for Nuclear Power Plants,” issued June 2006].
>
> [PAM Type B and C variables] and their type classification are based on their accident management function as identified in abnormal operating procedures, emergency operating procedures, and emergency procedure guidelines. Since the abnormal and emergency operating procedures and guidelines have not been developed, NuScale developed an approach to identify PAM variables as described below. [SER Chapter 7 gives the staff’s evaluation of the alternate approach for selecting PAM variables.] ...
>
> ... The NuScale reactor design has no Type A variables because there are no operator actions credited in any Chapter 15 anticipated operational occurrence, infrequent event, or [postulated] accident, nor the station blackout or anticipated transient without scram analysis.

The Regulatory Conformance and Development Report, in Table B-1, indicates that no Type A PAM variables were identified. DCA Part 2, Tier 2, Section 7.1.5.1.14, “Guideline 14—Manual Operator Action,” begins by stating the following:

> The critical safety functions are accomplishing or maintaining containment integrity, fuel assembly heat removal, and reactivity control; however, there are no Type A accident monitoring variables. Type A variables provide information

[3] Thomas E. Murley, Director, Office of Nuclear Reactor Regulation, to Walter S. Wilgus, Chairman, The B&W Owners Group, “NRC Staff Review of Nuclear Steam Supply Vendors Owners Groups’ Application of The Commission’s Interim Policy Statement Criteria to Standard Technical Specifications,” May 9, 1988, ADAMS Accession No. ML11264A057.

essential for the direct accomplishment of critical safety functions that require manual action.

In discussing the applicable safety analyses, Bases Subsection B 3.8.1 states the following:

> The audible count rate from the refueling neutron flux channels provides prompt and definite indication of any change in reactivity. The count rate increase is proportional to subcritical multiplication and allows operators to promptly recognize any change in reactivity. Prompt recognition of unintended reactivity changes is consistent with the assumptions of the safety analysis and is necessary to assure sufficient time is available to initiate action before SHUTDOWN MARGIN is lost (Ref. 1). The refueling neutron flux channels satisfy Criterion 3 of 10 CFR 50.36(c)(2)(ii).

Since PAM instrumentation does not address postulated events during refueling operations, proposed LCO 3.8.1 is adequate to ensure sufficient time is available for control room operators to initiate action to terminate a reactivity transient in MODE 5 before SDM is lost.

DCA Part 2, Tier 2, Section 7.1, identifies Type B and Type C PAM variables; however, the DCA does not address the option of not including an LCO for equivalent (non-Type A, but Type B and C Category 1) variables described in the 1988 Split Report. That report states the following, in part:

> During the NRC Staff's review, several issues were raised concerning the proper interpretation or application of the criteria in the Commission's Interim Policy Statement. The NRC Staff has considered these issues and concluded the following:
>
> (5) Post-Accident Monitoring Instrumentation that satisfies the definition of Type A variables in Regulatory Guide 1.9, "Instrumentation for Water-cooled Nuclear Power Plants to Assess Plant and Environs Conditions During and Following an Accident," meets Criterion 3 and should be retained in Technical Specifications. Type A variables provide primary information (i.e., information that is essential for the direct accomplishment of the specified manual actions (including long-term recovery actions) for which no automatic control is provided and that are required for safety systems to accomplish their safety functions for DBAs or transients). Type A variables do not include those variables associated with contingency actions that may also be identified in written procedures to compensate for failures of primary equipment. Because only Type A variables meet Criterion 3, the STS should contain a narrative statement that indicates that individual plant Technical Specifications should contain a list of Post-Accident Instrumentation that includes Type A variables. Other Post-Accident Instrumentation (i.e., non-Type A Category I) is discussed on page 6.
>
> The staff reviewed the methodology and results provided by each Owners Group to verify that none of the requirements proposed for relocation contains constraints of prime importance in limiting the likelihood or severity of accident sequences that are commonly found to dominate risk. For the purpose of this application of the guidance in the Commission [Interim] Policy Statement, the staff agrees with the Owners Groups' conclusions except in two areas. First, the

> staff finds that the Remote Shutdown Instrumentation meets the Policy Statement criteria for inclusion in Technical Specifications based on risk; and second, the staff is unable to confirm the Owners Groups' conclusion that Category 1 Post-Accident Monitoring Instrumentation is not of prime importance in limiting risk. Recent PRAs have shown the risk significance of operator recovery actions which would require a knowledge of Category 1 variables. Furthermore, recent severe accident studies have shown significant potential for risk reduction from accident management. The Owners Groups should develop further risk-based justification in support of relocating any or all Category 1 variables from the Standard Technical Specifications.

By a letter dated October 18, 2017 (ADAMS Accession No. ML17291A482), the applicant addressed the above guidance from the Split Report and presented a risk-based justification for omitting an LCO for Type B and C PAM variables. The essential reason for concluding that control room indication of these variables is not a significant contributor to risk reduction is that no operator actions are necessary to manage the NPM automatic response to any design-basis event to place the NPM in a safe-shutdown condition with passive long-term decay heat removal and core cooling assured. SER Chapter 19 provides the staff finding that the NuScale probabilistic risk assessment (PRA) is acceptable, and based on this, the staff concludes the risk-based analysis of the Type B and C PAM variables is acceptable. In the letter, the applicant also pointed out that the PAM variables are displayed using the safety display and information system (SDIS), which is subject to what NuScale calls "augmented quality assurance (AQ-S)," which is addressed in DCA Part 2, Tier 2, Table 3.2-1, "Classification of Structures, Systems, and Components." This table states that all components of the SDIS have an "SSC classification" of B2 (non-safety-related, non-risk-significant); "Quality Assurance Program applicability" of AQ-S; and "Augmented Design Requirements" of (1) IEEE Std 497-2002, with "Corrigendum 1: Incorporation of User Feedback through 2005" (CORR 1), (2) electromagnetic and radiofrequency interference protection, (3) power from vital instrument bus, and (4) Seismic Classification I. AQ-S "indicates that the pertinent requirements of 10 CFR Part 50 Appendix B are applicable to non-safety-related SSCs classified as Seismic Category I or Seismic Category II in accordance with the quality assurance program."

The highly reliable DC power system—common (EDSS-C) powers the PAM instrumentation and the SDIS. The source of electrical supply to the EDSS-C battery chargers is the 480-volt AC low-voltage AC electrical distribution system, through the low-voltage AC electrical distribution system motor control centers, which can be powered by the backup diesel generators. A total of four 125-volt DC batteries and four battery chargers (two batteries and chargers in Division I and two batteries and chargers in Division II) are in the EDSS-C subsystem. Upon a loss of power to all battery chargers, both the Division I and Division II EDSS-C batteries are capable of supplying their connected plant loads for 72 hours. The primary function of the backup diesel generators is to provide backup electrical power to certain loads in the post-72-hour period following a station blackout event.

Based on the above design information, the staff concludes that there is reasonable assurance that the control room indication of PAM Type B and C variables will be available for 72 hours after a postulated accident, infrequent event, or AOO. The staff finds that omitting an LCO for PAM Type B and C variables is therefore acceptable, and that the NuScale design has no PAM Type A variables.

16.4.1.7 Support System with Operability Requirement Implied by Surveillance Requirement

The Class 1E isolation devices serve to isolate the Class 1E MPS, RTS Logic and Actuation, and ESFAS Logic and Actuation electrical circuits from non-Class 1E electrical power circuits. The Channel Calibration surveillances of SR 3.3.1.5, SR 3.3.2.3, and SR 3.3.3.3, respectively, verify the operability of these isolation devices each refueling cycle. Meeting these SRs is necessary to meet LCO 3.3.1 for MPS instrumentation Functions 1 through 26, LCO 3.3.2 for the RTS Logic and Actuation Function, and LCO 3.3.3 for ESFAS Logic and Actuation Functions 1 through 8.

Similarly, meeting SR 3.3.2.4 ("Verify each RTB actuates to the open position on an actual or simulated actuation signal") is necessary for meeting LCO 3.3.2, and meeting SR 3.3.3.4 ("Verify each pressurizer heater breaker actuates to the open position on an actual or simulated actuation signal") is necessary for meeting LCO 3.3.3, Function 6, PHT Logic and Actuation.

The staff finds that implicitly requiring these components to be operable by specifying Surveillances for them in the LCO subsections of the systems they support is acceptable because it is sufficient to ensure the operability of these components when the supported systems are required to be operable. In addition, this approach is consistent with the W-AP1000-STS implicit support system operability requirements in Surveillances of W-AP1000-STS LCO 3.3.15 for pressurizer heater circuit breakers, reactor coolant pump breakers, CVCS letdown isolation valves, feedwater pump breakers, and auxiliary spray and purification line isolation valves; and LCO 3.3.16 for reactor coolant pump breakers, CVCS letdown isolation valves, and spent fuel pool cooling system CIVs. None of these components have explicit LCO operability requirements, but each supports operability of a specified ESF actuation function in the AP1000 design.

Conclusion for Application of LCO Selection Criteria

Based on its review of Revision 2 of the Regulatory Conformance and Development Report; Revision 3 of DCA Part 2, Chapters 4, 5, 6, 7, 8, 9, 11, 12, 15, 16, and 19; and Revision 3 of DCA Part 4, the staff finds that the NuScale GTS include all of the LCOs required by the LCO selection criteria. Therefore, the staff concludes that the GTS satisfy 10 CFR 50.36(c)(2)(ii).

16.4.2 Use and Application (GTS Chapter 1), Definitions (Section 1.1), Logical Connectors (Section 1.2), Completion Times (Section 1.3), and Frequency (Section 1.4)

The GTS and Bases follow the STS in presenting defined terms in capitalized type. This SER section follows this convention in discussions of defined terms and their definitions.

16.4.2.1 Included W-STS or W-AP1000-STS Definitions with No Changes

The GTS include the following W-STS or W-AP1000-STS definitions without change:

ACTIONS

The proposed definition matches the W-STS definition and the W-AP1000-STS definition and is therefore acceptable.

DOSE EQUIVALENT I-131

The proposed definition matches the W-AP1000-STS definition and is therefore acceptable.

DOSE EQUIVALENT Xe-133

The proposed definition matches the W-AP1000-STS definition and is therefore acceptable.

INSERVICE TESTING PROGRAM

This defined term and definition ("The INSERVICE TESTING PROGRAM is the licensee program that fulfills the requirements of 10 CFR 50.55a(f)") match the change made to W-STS, Revision 4, by approved STS change traveler TSTF-545-A, Revision 3; therefore, this defined term and definition are acceptable.

PHYSICS TESTS

The proposed definition matches the W-AP1000-STS definition and is therefore acceptable.

RATED THERMAL POWER (RTP)

The proposed definition matches the W-AP1000-STS definition and is therefore acceptable.

THERMAL POWER

The proposed definition matches the W-AP1000-STS definition and is therefore acceptable.

16.4.2.2 Included W-STS or W-AP1000-STS Definitions with Proposed Changes

ACTUATION LOGIC TEST

SER Section 16.4.8.3 gives the staff's evaluation of the specified SRs for the ACTUATION LOGIC TEST and associated Bases. The definition, as initially proposed, departed from the definition of the ACTUATION LOGIC TEST in the W-AP1000-STS. Following several interactions with the applicant, the applicant revised the definition of ACTUATION LOGIC TEST and the following Bases subsections to consistently use the terms "self-test" and "self-testing": the Background section of Bases Subsection B 3.3.1, the Applicable Safety Analyses section of Bases Subsection B 3.3.1, and the Surveillance Requirements section of Bases Subsections B 3.3.2 and B 3.3.3. The descriptions of the MPS self-testing features in DCA Part 2 and DCA Part 4 GTS and Bases are clear, as is the scope of the part of the ACTUATION LOGIC TEST that uses the self-testing features. Therefore, these changes are acceptable.

The next-to-last sentence in the definition states, "The ACTUATION LOGIC TEST shall be conducted such that it provides component overlap with the actuated device." This is acceptable to the staff since the W-AP1000-STS definition includes this sentence. Regarding the part of the definition that states, "The ACTUATION LOGIC TEST may be performed by means of any series of sequential, overlapping, or total steps," the staff noted that this part of the sentence is included in the W-AP1000-STS definitions of CHANNEL CALIBRATION and CHANNEL OPERATIONAL TEST, but not ACTUATION LOGIC TEST. Based on the NuScale MPS design, the staff concludes that this sentence is also appropriate and acceptable for the ACTUATION LOGIC TEST definition.

The second part of the last sentence in the definition states, "…and each step must be performed within the Frequency in the Surveillance Frequency Control Program for the devices included in the step." As described below in the discussion of the CHANNEL OPERATIONAL TEST definition, this phrase is acceptable based on the recently approved STS change traveler TSTF-563, Revision 0, on adoption of an SFCP; therefore, it is acceptable for inclusion in the NuScale ACTUATION LOGIC TEST definition (as well as for the definitions of CHANNEL OPERATIONAL TEST and CHANNEL CALIBRATION).

By a letter dated September 26, 2017 (ADAMS Accession No. ML17269A210), the applicant explained why the ACTUATION LOGIC TEST definition includes the new phrase "to test digital computer hardware" but does not include the phrase "to test digital computer software." The applicant stated the following:

> The definition specifies testing of digital hardware only because there is no operating software in the installed system which performs a safety related function. A software development process is used to develop the logic which is implemented in the digital hardware [(field programmable gate arrays)]. The requirements for software development quality assurance are described in [DCA Part 2,] Tier 2, Section 7.2.1.

The staff finds this explanation is acceptable because field programmable gate arrays are digital hardware implementing the logic of the scheduling and bypass modules, scheduling and voting modules (SVMs), and equipment interface modules (EIMs) without use of software, as described in Section 7.2.15, "Capability for Test and Calibration," and TR-1015-18653-P-A, "Design of the Highly Integrated Protection System Platform Topical Report," Revision 2 (ADAMS Accession No. ML17256A890).

Based on the above discussions, the staff concludes that the ACTUATION LOGIC TEST definition is acceptable.

CHANNEL CALIBRATION

The proposed definition of CHANNEL CALIBRATION matches the W-STS definition and is consistent with recently approved STS change traveler TSTF-563, Revision 0. Therefore, the staff concludes that the CHANNEL CALIBRATION definition is acceptable.

CHANNEL CHECK

The applicant proposed changes to the W-STS definition of CHANNEL CHECK, as indicated in the following markup of the STS definition:

CHANNEL CHECK	A CHANNEL CHECK shall be the ~~qualitative assessment, by observation, of~~ verification through the absence of alarms from the automatic analog and binary process signal monitoring features used to monitor channel behavior during operation. Deviation beyond the established acceptance criteria is alarmed to allow appropriate action to be taken. This determination shall include, where possible, comparison of ~~the~~ channel indication and status to other indications or status derived from independent instrument channels measuring the

same parameter. This determination can be made using computer software or be performed manually.

The changes are consistent with the design features of the MPS and how the applicant intends this Surveillance to be performed; the CHANNEL CHECK is the principal means of monitoring channel performance and status between CHANNEL CALIBRATIONS. Therefore, the staff concludes that this definition is acceptable. SER Chapter 7 describes the capabilities of the digital platform and the self-testing features of the MPS.

CHANNEL OPERATIONAL TEST (COT)

The applicant proposed specifying a CHANNEL OPERATIONAL TEST only for LCO-required instrumentation functions implemented by the module control system. These are the RCS leakage detection instrumentation of the CES condensate monitor (two channels) and CES gaseous radioactivity monitor (one channel), which are required to be OPERABLE by LCO 3.4.7 in MODES 1 and 2, and in MODE 3 with RCS hot temperature at or greater than 93.3 degrees C (200 degrees F). The proposed CHANNEL OPERATIONAL TEST definition is consistent with the CHANNEL OPERATIONAL TEST definition in Revision 4 of the W-STS, with one exception. The applicant proposed to include a change consistent with the recently approved STS change traveler TSTF-563, Revision 0. This traveler adds a phrase to the last sentence of the CHANNEL OPERATIONAL TEST definition (as well as the definitions of ACTUATION LOGIC TEST and CHANNEL CALIBRATION). Since the proposed CHANNEL OPERATIONAL TEST definition includes this change by approved traveler TSTF-563, the staff concludes that the CHANNEL OPERATIONAL TEST definition is acceptable.

CORE OPERATING LIMITS REPORT (COLR)

The proposed definition matches the W-STS definition of the COLR, except that instead of the phrase "Plant operation within these parameter limits...," the GTS uses, "Module operation within these parameter limits...." Because "module operation" is equivalent to the intended meaning of "plant operation" and both include operation of the reactor core, the staff concludes that using "module" is only an administrative difference and is therefore acceptable.

LEAKAGE

The applicant's proposed definition of "Pressure Boundary LEAKAGE" matches the definition in the W-STS and is, therefore, acceptable. The applicant proposed to depart from the W-STS definitions of "identified LEAKAGE" and "unidentified LEAKAGE" by omitting references to leakage "such as that from pump seals or valve packing (except reactor coolant pump (RCP) seal water injection or leakoff), that is captured and conducted to collection systems or a sump or collecting tank"; this departure is appropriate because the leakage sources and associated leakage collection systems do not apply to the NPM design. Accordingly, this departure omits paragraph a.1 and revises paragraph a.2 of the W-STS definition of "identified LEAKAGE," as indicated in the markup provided below in the discussion of "pressure boundary LEAKAGE." The W-STS definition's paragraph a.2 reference to LEAKAGE "into the containment atmosphere" is also omitted from the GTS "identified LEAKAGE" definition's paragraph a.1. This is appropriate because only RCS LEAKAGE into containment, which is not pressure boundary LEAKAGE, can be collected and measured by RCS leakage detection instrumentation, such as the CES condensate monitor channels. Other than these differences, the applicant's definitions of "identified LEAKAGE" and "unidentified LEAKAGE" match the W-STS definitions of these terms. Thus, the staff concludes that the applicant's definitions are acceptable.

LEAKAGE — LEAKAGE shall be:

a. Identified LEAKAGE

~~1. LEAKAGE, such as that from pump seals or valve packing (except reactor coolant pump (RCP) seal water injection or leakoff), that is captured and conducted to collection systems or a sump or collecting tank,~~

~~2~~1. LEAKAGE ~~into the containment atmosphere~~ from sources that are both specifically located and known either not to interfere with the operation of leakage detection systems or not to be pressure boundary LEAKAGE, or

~~3~~2. Reactor Coolant System (RCS) LEAKAGE through a steam generator (SG) to the Secondary System (primary to secondary LEAKAGE),

b. Unidentified LEAKAGE

All LEAKAGE ~~(except RCP seal water injection or leakoff)~~ that is not identified LEAKAGE, and

c. Pressure Boundary LEAKAGE

LEAKAGE (except primary to secondary LEAKAGE) through a nonisolable fault in an RCS component body, pipe wall, or vessel wall.

OPERABLE—OPERABILITY

The NuScale GTS OPERABILITY definition is based on the W-STS definition with differences to account for the NuScale design. The NuScale design does not use the word “emergency” to describe the onsite electrical power system (sources and distribution) and does not use the phrase “seal water,” since an NPM has no reactor coolant pumps and therefore has no need for reactor coolant pump seal water. In addition to the word “channel,” NuScale uses the equivalent term “separation group” to describe a redundant MPS instrumentation loop. At the suggestion of the staff, the applicant revised the definition to more accurately reflect the NuScale design. Therefore, the staff finds the OPERABILITY definition, as quoted below, acceptable.

OPERABLE—OPERABILITY — A system, subsystem, separation group, channel, division, train, component, or device shall be OPERABLE or have OPERABILITY when it is capable of performing its specified safety function(s) and when all necessary attendant instrumentation, controls, electrical power, cooling water, lubrication, and other auxiliary equipment that are required for the system, subsystem, separation group, channel, division, train, component, or device to perform its specified safety function(s) are also capable of performing their related support function(s).

PRESSURE AND TEMPERATURE LIMITS REPORT

The proposed PTLR definition matches the W-STS definition except that it omits the W-STS definition's phrase, "and the low temperature overpressure protection arming temperature," which is also not included in the W-AP1000-STS PTLR definition; the AP1000 design uses the relief valves in the normal residual heat removal system suction line for LTOP and has no valve operator to "arm" at a particular RCS temperature. So, the AP1000 design certification applicant concluded that this phrase is not applicable. However, the NuScale LTOP functionality of the three RVVs is automatically enabled by the wide range RCS cold temperature interlock T-1 (two of four channels less than or equal to LTOP enabling temperature specified in the PTLR, approximately 163 degrees C (325 degrees F)). The T-1 interlock LTOP enabling temperature appears analogous to an "LTOP arming temperature" as used in the W-STS, which is based on a typical LTOP system design, such as the design implemented at Vogtle Electric Generating Station, Units 1 and 2. Therefore, the staff suggested adding an equivalent phrase, such as "and the low temperature overpressure protection enable temperature," to the NuScale GTS PTLR definition.

By a letter dated December 12, 2018 (ADAMS Accession No. ML18347A619), the applicant declined to incorporate the suggested changes into the PTLR definition, stating that "the LTOP arming temperature is established and maintained as specified in [generic] TS 5.5.10, and described in the Bases for LCO 3.3.1, 'Module Protection System.'" Taking the applicant's response into account, the staff finds that its suggested changes, though intended to promote consistency with the PTLR definition in other STS, are not necessary to ensure that the NuScale T-1 interlock LTOP enabling temperature will be correctly set and maintained to support OPERABILITY of the RVV LTOP Function, in accordance with SR 3.3.1.4, CHANNEL CALIBRATION. Therefore, the staff finds the PTLR definition acceptable.

SHUTDOWN MARGIN (SDM)

The applicant's originally proposed definition of SDM departed from the W-STS definition as indicated by the following markup of the W-STS definition:

SHUTDOWN MARGIN (SDM)

SDM shall be the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming:

a. Moderator temperature is 420°F [216 °C]; and

b. All ~~rod cluster control assemblies (RCCAs)~~ CRAs are fully inserted except for the single ~~RCCA~~ assembly of highest reactivity worth, which is assumed to be fully withdrawn. However, with all ~~RCCAs~~ CRAs verified fully inserted by two independent means, it is not necessary to account for a stuck ~~RCCA~~ CRA in the SDM calculation. With any ~~RCCA~~ CRA~~(s)~~ not capable of being fully inserted, the reactivity worth of ~~the RCCA~~ the affected CRA must be accounted for in the determination of SDM~~, and~~

~~b.~~ ~~In MODES 1 and 2, the fuel and moderator temperatures are changed to the [nominal zero power design level]~~.

The change in the order of parts a and b, and the use of CRA instead of rod cluster control assembly (RCCA), are editorial administrative changes to reflect NuScale nomenclature and the applicant's preferred presentation. Since the acronym "CRA" is previously defined in the definition of "MODE," not defining it upon its first use in this definition is acceptable. However, the staff suggested defining the acronym again for clarity. Also, subsequent use of the word "assembly" and "assemblies" should have been changed to "CRA" and "CRAs" to conform to the improved TS writer's guide convention concerning acronyms. Also, the W-STS definition does not appear to consider more than one RCCA to be incapable of being fully inserted; however, the W-AP1000-STS SDM definition does consider more than one uninsertable RCCA. Revision 1 of the DCA contained no justification of why NuScale needed to consider more than one CRA that cannot be fully inserted. Finally, the DCA did not justify using the minimum temperature for criticality, 21 degrees C (420 degrees F), in place of the statement, "In MODE 1, the fuel and moderator temperatures are changed to the [nominal zero power design level]." (Note that NuScale MODE 1 corresponds to W-STS MODES 1 and 2; and NuScale MODE 2 corresponds to W-STS MODE 3 with RCS average temperature ≥ 216 degrees C (420 degrees F)). The applicant resolved these issues by providing the following SDM definition:

SHUTDOWN MARGIN (SDM) — SDM shall be the instantaneous amount of reactivity by which the reactor is subcritical or would be subcritical from its present condition assuming:

a. Moderator temperature is 216 °C (420 °F); and

b. All control rod assemblies (CRAs) are fully inserted except for the single CRA of highest reactivity worth, which is assumed to be fully withdrawn. However, with all CRAs verified fully inserted by two independent means, it is not necessary to account for a stuck CRA in the SDM calculation. With any CRA not capable of being fully inserted, the reactivity worth of the affected CRA must be accounted for in the determination of SDM.

In SER Section 16.4.8.5, the staff describes the basis for concluding that this SDM definition is acceptable.

16.4.2.3 *NuScale-specific definitions*

The following defined terms and definitions are unique to NuScale because of design differences from large light-water PWRs. The staff concludes that these definitions are acceptable because they accurately reflect the NuScale design.

ACTUATION RESPONSE TIME

This defined term is defined as follows:

> The time from when the Module Protection System equipment interface module output initiates an actuation signal until the actuated valves or breakers reach their final actuated position.

It is used with CHANNEL RESPONSE TIME to define the TOTAL RESPONSE TIME. The staff discusses response times in SER Section 16.4.2.4.

AXIAL OFFSET (AO)

This defined term and definition (AXIAL OFFSET equals (power in top half of core minus power in bottom half of core) divided by (power in top half plus power in bottom half)) is similar to the W-STS defined term and definition of AXIAL FLUX DIFFERENCE, except that AXIAL FLUX DIFFERENCE is based on core power derived from excore power range neutron detectors. The AXIAL OFFSET is based on core power derived from the neutron detectors of the incore instrumentation system.

CHANNEL RESPONSE TIME

This defined term is defined as follows:

> The time from when the process variable exceeds its setpoint until the output from the channel analog logic reaches the input of the digital portion of the Module Protection System digital logic.

It is used with ACTUATION RESPONSE TIME to define the TOTAL RESPONSE TIME. The staff discusses response times in SER Section 16.4.2.4.

MODE—MODES

The operational MODE definition differs from the W-AP1000-STS definition:

MODE	A MODE shall correspond to any one inclusive combination of reactivity condition, reactor coolant temperature, control rod assembly (CRA) withdrawal capability, Chemical and Volume Control System (CVCS) and Containment Flood and Drain System (CFDS) configuration, reactor vent valve electrical isolation, and reactor vessel flange bolt tensioning specified in Table 1.1-1 with fuel in the reactor vessel.

The staff verified that this definition and associated Table 1.1-1, “MODES,” are appropriate for delineating practical ranges of the NPM operational states. Therefore, the staff finds the defined term MODE and its definition acceptable. SER Section 16.4.6, "Applicability Statements," gives the staff's evaluation of Table 1.1-1.

PASSIVELY COOLED—PASSIVE COOLING

This definition applies during MODES 2 and 3 when the secondary heat sink is not available for removal of core decay heat from the reactor coolant. Although there are three stated methods for achieving PASSIVE COOLING, they all transfer core decay heat to the reactor building pool, the UHS.

TOTAL RESPONSE TIME

This defined term is defined as follows:

> TOTAL RESPONSE TIME is the sum of the CHANNEL RESPONSE TIME, the allocated MPS digital time response, and the ACTUATION RESPONSE TIME. The TOTAL RESPONSE TIME is the time interval from when the monitored parameter exceeds its actuation setpoint at the channel sensor until the actuated component is capable of performing its safety function (i.e., the valves travel to their required positions, breakers are open, etc.)

The staff discusses response times in SER Section 16.4.2.4.

16.4.2.4 Response Time

The applicant proposed the three defined terms of CHANNEL RESPONSE TIME, ACTUATION RESPONSE TIME, and TOTAL RESPONSE TIME and their definitions in place of the W-STS defined terms of REACTOR TRIP SYSTEM (RTS) RESPONSE TIME and ENGINEERED SAFETY FEATURE (ESF) RESPONSE TIME and their definitions.

The staff reviewed material in Revision 3 of DCA Part 2, Tier 2, Chapter 7, related to RTS and ESFAS delay (or response) times, some of which is quoted below; italics are used to highlight that the stated RTS and ESFAS delay times, in both DCA Part 2, Tier 2, Table 7.1-6, "Design Basis Event Actuation Delays Assumed in the Plant Safety Analysis," and Table 15.0-7, "Analytical Limits and Time Delays," include RTB and pressurizer heater breaker opening times, respectively, but that the ESFAS delay times do not include valve stroke times. In Revision 2 of DCA Part 2, FSAR Section 7.1.1.2.1, "Fundamental Design Principles, Additional Design Considerations, Protection Systems," states the following (emphasis added):

> The ESFAS delays assumed in the plant safety analysis [e.g., Table 15.0-7, "Analytical Limits and Time Delays"] are a combination of sensor response time, MPS timing budget allocation, and actuation device delays. The sensor response delays are defined in Table 7.1-6. *The delay times in Table 7.1-6 associated with ESFAS signals don't include the delay times associated with the actuation device (e.g. valve stroke times) with the exception of opening the pressurizer heater breakers*.

Revision 3 of DCA Part 2, FSAR Section 7.1.4, "Predictability and Repeatability," states the following (emphasis added):

> The MPS response time analysis demonstrates that the MPS performs and completes its required safety functions in a predictable and repeatable manner.

> Section 7.7 of TR-1015-18653-P-A describes the calculation used to determine worst-case digital time response for an MPS channel.
>
> … The RTS timing analysis is defined from the point in time when the [monitored] process variable exceeds its predetermined setpoint to when the reactor trip breakers open. The MPS digital portion of the RTS function is accounted for in the safety analysis. *For the RTS protective function, the MPS response time is comprised of the analog input delay plus the digital time response delay plus the analog output delay and includes the time for the reactor trip breakers to open*.…
>
> *For the ESFAS protective functions, the actuation delays in Table 7.1-6 are assumed in the plant safety analysis and are defined as the time from when the monitored process variable exceeds the predetermined setpoint until the [equipment interface module] output is de-energized.* The MPS portion of the ESFAS functions is accounted for in the safety analysis. *This time allocation budget is comprised of the analog input delay plus the digital time response delay plus the analog output delay and is defined from the sensor input to the [safety function module] input terminals to the [equipment interface module] output command to the final actuation device*. *For the pressurizer heater trip function, this time requirement includes the time for the pressurizer heater trip breakers to open*.

The staff notes that the ACTUATION RESPONSE TIME includes the time after the equipment interface module output is deenergized until the valve or breaker is in the actuated safety position. With the exception of the opening time of the pressurizer heater breakers, the delay times stated in TR-1015-18653-P-A, Revision 2, omit the valve stroke time and breaker opening time. The ESF valve stroke times are not included in DCA Part 2, Tier 2, Table 15.0-7, because these assumed stroke time values are used by the INSERVICE TESTING PROGRAM as acceptance criteria for the valve exercise inservice test as listed in DCA Part 2, Tier 2, Table 3.9-1, "Summary of Design Transients." Revision 3 of DCA Part 2, Tier 2, Section 3.9.6.3.2, "Valve testing," under the heading "(3) Power-Operated Valve Tests," states, in part, the following:

> The inservice testing requirement for measuring stroke time for valves in the NuScale Power Plant may be completed in conjunction with a valve exercise inservice test. The exercise test identified in Table 3.9-16 includes the stroke time test.
>
> All NuScale safety-related, power-operated valves fail to their safety-related function position and are subject to a valve exercise inservice test and a fail-safe test.
>
> The valve exercise and fail-safe tests are intended to verify that the valve repositions to its safety-related position on loss of actuator power. The valve exercise test may satisfy this requirement if the exercise test removes actuator power from the valve.

Accordingly, each ACTUATION RESPONSE TIME surveillance for an ESF valve has a Surveillance Frequency of "In accordance with the INSERVICE TESTING PROGRAM."

Meeting each ACTUATION RESPONSE TIME surveillance for an ESF valve requires verifying the valve stroke time from its normal position to its safety position is within the safety analysis assumed stroke time value. All NuScale power-operated valves receive an actuation command signal from the equipment interface module output by removing electrical power from the actuation device for the valve.

For example, each ESF valve that utilizes the stored energy of a nitrogen-gas-filled accumulator (which is pressurized by opening the valve using the non-safety-related hydraulic actuator) automatically repositions when the command signal deenergizes the division's solenoid hydraulic vent valve, which opens to release the hydraulic lock keeping the valve in its normal open or closed position, and allowing the accumulator pressure to quickly reposition the valve to its safety position. DCA Part 2, Tier 2 Table 3.9-16 lists the ESF valves with this actuator design. The accumulator pressure of each of these valves is monitored with control room indication and low-pressure alarms; the associated system LCOs also have SRs to periodically verify proper accumulator pressure (SR 3.4.6.1 for CVCSI valves, SR 3.5.2.1 for DHRS actuation valves, SR 3.6.2.1 for CIVs, SR 3.7.1.1 for MSIVs, and SR 3.7.2.1 for FWIVs).

The valve stroke time limit for the three RVVs and two RRVs is the time at which the following two NPM conditions concurrently exist until each valve is open. These NPM conditions are when the inadvertent actuation block is released (which is when the pressure difference between the RPV and the containment vessel is below the inadvertent actuation block setpoint) and when the containment vessel water level is above the setpoint for the ECCS actuation on high containment water level Function, which deenergizes the output of the equipment interface module to the ECCS valve actuator. Depending upon the event being analyzed, the time at which both NPM conditions are satisfied can vary; if the reactor vessel to containment vessel differential pressure remains above the inadvertent actuation block release setpoint, the TOTAL RESPONSE TIME for ECCS actuation would not correspond to the time interval after the high containment water level setpoint is exceeded until the ECCS valve is open. In such cases, the DCA Part 2, Tier 2, Chapter 15, analyses show that any delay in automatically opening ECCS valves caused by the inadvertent actuation block not having cleared has no adverse effect on the analysis results. In the May 20, 2020, update to DCA Revision 4 (ADAMS Accession No. ML20141L787), the applicant reduced the containment water level setpoint for ECCS actuation so that the ECCS would actuate sooner during a LOCA scenario; along with this change, the applicant also reduced the RPV-containment differential pressure inadvertent actuation block release setpoint. Finally, the applicant added a new MPS instrumentation Function, low wide range RCS pressure - ECCS, which for certain small-break LOCA scenarios, will initiate ECCS before the high containment water level Function to preclude unanalyzed reactivity transients following restoration of reactor coolant flow after an extended period of DHRS operation for which redistribution of reactor coolant boron may have occurred. This low RCS pressure ECCS actuation is automatically bypassed when RCS hot temperature decreases to less than the T-6 interlock, approximately 246 degrees C (475 degrees F). However, the low RCS pressure ECCS actuation Function remains bypassed for non-LOCA events in which containment pressure remains below the new P-1 interlock (active below 1 psia). These design changes related to ECCS actuation do not invalidate the previous conclusion by the staff about the acceptability of the response times for the ECCS valves to open following a valid ECCS actuation signal, after the inadvertent actuation block has cleared.

The RVVs also automatically open on LTOP actuation on high wide range RCS pressure, provided at least two of four wide range RCS cold temperature channels indicate below the T-1 interlock (less than 163 degrees C (325 degrees F)); under these conditions the inadvertent actuation block is not active because the reactor vessel to containment vessel differential pressure is below the inadvertent actuation block release setpoint.

The surveillance statement for SR 3.3.1.3, which verifies the CHANNEL RESPONSE TIME is within limits for each MPS instrumentation function, which includes the monitored process variable sensor delay time, also requires verifying the TOTAL RESPONSE TIME. Likewise, the surveillance statement for each SR, which verifies the ACTUATION RESPONSE TIME is within limits, also requires verifying the TOTAL RESPONSE TIME.

In light of the foregoing discussion, the staff concludes that the total time assumed for the RTS or ESFAS response in the safety analyses is determined to be within the analysis assumptions through a combination of NRC-approved allocations and measurements of valve stroke times and breaker opening times.

Based on the above-cited information provided in DCA Parts 2 and 4, the above evaluation, and the proposed defined terms of CHANNEL RESPONSE TIME, ACTUATION RESPONSE TIME, and TOTAL RESPONSE TIME, as defined in GTS Section 1.1, and as used in the response time verification SRs, the staff concludes there is reasonable assurance that the response time of each RTS and ESFAS Function, from process sensor input to completion of device actuation, will be adequately verified to be within the safety analysis assumptions. Therefore, the staff finds the GTS defined terms and definitions for MPS automatic actuation response times are acceptable.

16.4.2.5 Omitted W-STS definitions

The following W-STS defined terms and definitions are not included in GTS because of NuScale design differences from large light-water PWRs, differences that include the use of digital instrumentation and control platforms. These differences are highlighted for terms that had been proposed in the initial version of the DCA but were subsequently removed from the GTS and Bases, by providing a markup of the W-STS definition. The staff concludes that omission of these definitions is acceptable.

AXIAL FLUX DIFFERENCE

Since the AXIAL FLUX DIFFERENCE is based on core power derived from excore power range neutron detectors, it is not applicable to the NuScale design, which uses a similar defined term and definition, AXIAL OFFSET. Therefore, omission of AXIAL FLUX DIFFERENCE is acceptable.

$\bar{E}$—AVERAGE DISINTEGRATION ENERGY

Approved STS change traveler TSTF-490-A, Revision 1, removed the AVERAGE DISINTEGRATION ENERGY definition in W-STS, Revision 4, Section 1.1. Consistent with this traveler, GTS Section 1.1 omits the defined term and definition of $\bar{E}$—AVERAGE DISINTEGRATION ENERGY, replaces the W-STS definition of the term DOSE EQUIVALENT I-131 with the W-AP1000-STS definition of this term, and includes the W-AP1000-STS defined term and definition of DOSE EQUIVALENT Xe-133. GTS Subsection 3.4.8, “RCS Specific Activity,” and associated Bases, use these two defined terms.

The proposed RCS specific activity limits in GTS Subsection 3.4.8 are consistent with the fuel defect level of 0.066 percent as assumed by the NuScale design-basis source term in the analyses of DBA radiological consequences, which is described in DCA Part 2, Tier 2, Section 15.0.3.

SER Section 12.2.4 gives the staff's finding that the limits in GTS Subsection 3.4.8 and Bases Subsection B 3.4.8 are acceptable.

MASTER RELAY TEST

This W-STS defined term is not applicable to the NuScale MPS because the NuScale MPS has no master relay.

QUADRANT POWER TILT RATIO

This W-STS defined term is not used to define limits on asymmetry of the reactor core radial power distribution in the NuScale design. Table B-1 of the Regulatory Conformance and Development Report, Revision 1, issued October 2018 (ADAMS Accession No. ML18305A964), states that W-STS LCO 3.2.4, "QUADRANT POWER TILT RATIO," is "not applicable to NuScale analysis methodology and design." The staff agrees with this statement. Therefore, the staff finds that omitting the QUADRANT POWER TILT RATIO in GTS Section 1.1 is acceptable.

STAGGERED TEST BASIS

The GTS do not use this defined term to modify any Surveillance Frequency because staggered testing of redundant subsystems, trains, or instrumentation channels provides no safety benefit in the NuScale design. The staff therefore finds that omitting STAGGERED TEST BASIS in GTS Section 1.1 is acceptable.

TRIP ACTUATING DEVICE OPERATIONAL TEST

The scope of testing applicable to the TRIP ACTUATING DEVICE OPERATIONAL TEST definition exceeds the testing needed by the NuScale design. The GTS do specify an equivalent test, which only applies to manual actuation functions; SR 3.3.4.1 requires performing an "actuation device operational test" for the nine manual functions for initiating RTS, ECCS, DHRS, CIS, DWSI, CVCSI, PHT, SSI, and LTOP. Also, if a TRIP ACTUATING DEVICE OPERATIONAL TEST with a pared down definition appropriate for this SR had been included in the GTS, this SR would have been the sole use of this defined term. The Bases for SR 3.3.4.1 provide an adequate description of the specified actuating device operational test. The staff therefore finds that omitting TRIP ACTUATING DEVICE OPERATIONAL TEST in GTS Section 1.1 is acceptable.

Conclusion for GTS Section 1.1

The staff evaluated the defined terms and definitions in GTS Section 1.1 and determined they are appropriate and consistent with the STS (with justified exceptions) and with the NuScale design and are correctly used in stating the requirements in the remainder of the GTS and in the Bases for the requirements in GTS Chapters 2 and 3. Based on its evaluation and review of DCA Part 2, Section 16, and DCA Part 4, GTS Section 1.1, the staff finds that GTS Section 1.1 is acceptable.

16.4.2.6 Logical Connectors, Completion Times, and Frequency

W-AP1000-STS Sections 1.2, 1.3, and 1.4 provide examples depicting the use and application rules, which are specified in these sections, for logical connectors, required action completion times, and SR frequencies (test intervals), respectively. These examples reflect the AP1000 passive design features. Each example includes a discussion of the particular provision being illustrated. Because the NuScale design also relies on passive design features, the examples in the GTS for these sections are similar to and consistent with the examples in the W-AP1000-STS. The staff therefore concludes that GTS Sections 1.2, 1.3, and 1.4 are acceptable.

Conclusion for GTS Chapter 1

Based on its review and the above evaluation, the staff concludes that GTS Chapter 1 is acceptable.

16.4.3 Safety Limits (GTS Chapter 2)

GTS SL Section 2.1.1.1 states the following:

> 2.1.1 <u>Reactor Core SLs</u>
>
> 2.1.1.1 In MODE 1, the critical heat flux ratio shall be maintained at or above the following correlation safety limits:
>
> | Correlation | Safety Limit |
> |---|---|
> | NSP2 | [1.17] |
> | NSP4 | [1.21] |
> | Extended Hench-Levy | [1.06] |

The staff had expected to see four CHF correlations and their SL values listed, based on Revision 2 of DCA Part 2, Tier 2, Section 4.3.

In a letter dated January 16, 2019 (ADAMS Accession No. ML19016A462), the applicant stated the following, in part *(emphasis added)*:

> Consistent with the standard technical specifications of existing plants, the safety limit[s] in specification 2.1.1, Reactor Core SLs, are applicable in MODE 1 when the reactor is, or may be critical. The three correlation safety limits provided in the technical specifications are the safety limits that must be set to satisfy the requirements of 10 CFR 50.36 for safety limits.
>
> In addition to the evaluation of postulated events during critical operations, the NuScale design safety analyses evaluate the effects of other, post-reactor trip transients on reactor cladding to ensure the integrity of the barrier to radioactivity release is maintained. As described in the response to [the NRC staff request for additional information question number] 15.06.06-2, the Griffith-Zuber correlation is used to evaluate CHFR in low core flow conditions that typically exist during postulated events post-reactor trip. *This limit is not included in the technical specifications because it is not a process variable that is controlled by plant conditions during operations.* CHF is one of many acceptance criteria applied in analyses to demonstrate that the design adequately limits the release of radioactive material after a postulated event.
>
> In summary, the CHFR limits in specification 2.1.1.1 are met through a combination of operating limits and design criteria. The Griffith-Zuber CHFR

limitation is used as an accident analysis design [criterion] that is not directly dependent on operating conditions or controllable by the reactor operators.

Based on this justification, the Griffith-Zuber correlation limit is not included in the technical specifications but is used in the design and accident analyses of the plant.

The staff determined that the Griffith-Zuber correlation limit is not required to be included in TS because the Griffith-Zuber correlation limit is an analysis limit and not a process variable that protects the integrity of certain physical barriers that guard against the uncontrolled release of radioactivity. Therefore, the staff finds omitting a CHFR value for the Griffith-Zuber correlation in SL 2.1.1.1 is acceptable.

The staff reviewed reactor core SL 2.1.1.2 ("In MODE 1 the peak fuel centerline temperature shall be maintained ≤ { 4901 - (1.37E-3 × Burnup, MWD/MTU) } °F") and determined it is appropriate for the NuScale design and is consistent with the W-STS, and therefore finds SL 2.1.1.2 acceptable.

The staff reviewed RCS pressure SL 2.1.2 ("In MODES 1, 2, and 3 pressurizer pressure shall be maintained ≤ 2285 psia [15.755 MPa (absolute)]") and determined it is appropriate for the NuScale design and is consistent with W-STS, and therefore finds SL 2.1.2 acceptable.

The staff reviewed GTS Section 2.2, "Safety Limit Violations," and finds it acceptable because it is consistent with the NuScale operational modes defined in GTS Table 1.1-1 and the W-STS Section 2.2 action requirements for SL violations.

Conclusion for GTS Chapter 2

Based on its review and the above evaluation, the staff finds that GTS Chapter 2 meets the requirements of 10 CFR 50.36(c)(1)(A) for SLs and is therefore acceptable.

16.4.4 Limiting Condition for Operation and Surveillance Requirement Use and Applicability (GTS Chapter 3, Section 3.0)

The staff reviewed the general LCO and SR usage rules of GTS Chapter 3, Section 3.0, for consistency with W-STS Section 3.0 except for departures needed to account for unique NuScale design and operational features.

16.4.4.1 Limiting Condition for Operation Use and Applicability

As discussed below, the staff found that LCO 3.0.1, LCO 3.0.2, LCO 3.0.3, LCO 3.0.4, LCO 3.0.5, LCO 3.0.6, LCO 3.0.7, and LCO 3.0.8 are acceptable because they are consistent with the W-STS (with justified exceptions) and the NuScale design.

<u>LCO 3.0.1</u>

This Specification defines the logical connection between an LCO statement and the associated Applicability statement. It states that "LCOs shall be met during the MODES or other specified conditions in the Applicability, except as provided in LCO 3.0.2, [and] LCO 3.0.7[, and LCO 3.0.8]." The list of LCOs containing exceptions to LCO 3.0.1 is appropriate for the NuScale GTS and includes brackets to reflect the status of bracketed LCO 3.0.8 as a COL action item. Since this Specification matches the W-STS, LCO 3.0.1 is acceptable.

LCO 3.0.2

This Specification defines the logical connection between the LCO and Applicability statements and the associated Action statements; it also specifies that LCO 3.0.5 and LCO 3.0.6 provide exceptions to LCO 3.0.2, consistent with the W-STS.

The industry TSTF submitted Revision 1 of TSTF-565 on March 30, 2018, for the staff's review. The staff accepted the STS Bases changes proposed in the traveler revision in a letter to the TSTF dated December 31, 2018 (ADAMS Accession No. ML18284A377). The staff compared the proposed changes in the revised traveler with Revision 2 of DCA Part 4, Bases for LCO 3.0.2 and LCO 3.0.3, and finds that the GTS Bases for these LCOs match the traveler. Therefore, the Bases for LCO 3.0.2 and LCO 3.0.3 are acceptable.

LCO 3.0.3

This Specification is consistent with W-STS Section 3.0, LCO 3.0.3, with differences stemming from NuScale unit operational mode definitions. The staff noted that this Specification allowed times to place the unit in Mode 2, and in various specified conditions in Mode 3, that appeared to be inconsistent with the allowed times in most other LCO subsections with shutdown action requirements.

In a letter dated September 14, 2017 (ADAMS Accession No. ML17257A450), the applicant modified the Bases for LCO 3.0.3 by adding a paragraph (subsequently modified in DCA Revision 2, as shown in the markup below) describing the reasons why the shutdown sequence Completion Times of LCO 3.0.3 are appropriate, as follows:

> The Completion Times are established considering the limited likelihood of a design basis event during the 37 hours allowed to ~~reach~~ enter MODE 3 and be PASSIVELY COOLED. They also provide adequate time to permit evaluation of conditions and restoration of OPERABILITY without ~~unnecessarily~~ challenging plant systems during a shutdown. Analysis shows that 37 hours from entry into [LCO] 3.0.3 is a reasonable time to ~~reach~~ enter MODE 3 and be PASSIVELY COOLED using normal plant systems and procedures.

This additional Bases explanation clarifies the rationale for the shutdown sequence Completion Times, which seem reasonable because they are consistent with the allowed time intervals to reach safe-shutdown conditions in W-AP1000-STS LCO 3.0.3, which is 37 hours to establish normal shutdown cooling (normal residual heat removal system) in Mode 5, and is equivalent to the GTS LCO 3.0.3 allowance of 37 hours to establish passive cooling in Mode 3 using the DHRS. Based on its assessment of this explanation, the staff concludes that GTS LCO 3.0.3 and Bases are acceptable. This includes the LCO 3.0.3 Bases passages related to TSTF-565 changes.

LCO 3.0.4

This Specification defines the conditions that must be met to allow for entry into a mode or other specified condition in the Applicability of an LCO when the LCO is not met. The GTS LCO 3.0.4 is consistent with Revision 4 of W-STS LCO 3.0.4, which is based on traveler TSTF-359-A, "Increase Flexibility in Mode Restraints," Revision 9. Because LCO 3.0.4 matches the W-STS, LCO 3.0.4 is acceptable.

LCO 3.0.5

This Specification defines an exception to LCO 3.0.2: “Equipment removed from service or declared inoperable to comply with ACTIONS may be returned to service under administrative control solely to perform testing required to demonstrate its OPERABILITY or the OPERABILITY of other equipment.” Because this Specification matches the W-STS, LCO 3.0.5 is acceptable.

As a part of adopting TSTF-529, the third paragraph of the Bases for GTS LCO 3.0.5 was modified in the Bases for W-STS LCO 3.0.5 to reflect the NuScale design, which lacks RCS pressure isolation valves. The proposed Bases discussion referred to RCPB leakage isolation, to illustrate the application of LCO 3.0.5, instead of referring to the opening of an RCS pressure isolation valve, which had been declared inoperable and closed to comply with ACTIONS. In a letter dated March 20, 2018 (ADAMS Accession No. ML18079B134), the applicant stated there are eight CVCSI valves, which are specified to be operable by GTS LCO 3.4.6:

CVC-ISV-0323	Pressurizer Spray Line Outboard Isolation Valve
CVC-ISV-0325	Pressurizer Spray Line Inboard Isolation Valve
CVC-ISV-0329	CVCS Injection Outboard Isolation Valve
CVC-ISV-0331	CVCS Injection Inboard Isolation Valve
CVC-ISV-0334	CVCS Discharge Inboard Isolation Valve
CVC-ISV-0336	CVCS Discharge Outboard Isolation Valve
CVC-ISV-0401	RPV Vent Inboard Isolation Valve
CVC-ISV-0403	RPV Vent Outboard Isolation Valve

In addition to the CVCSI function required by GTS LCO 3.4.6, the containment isolation function of these valves is required to be operable by LCO 3.6.2, “Containment Isolation Valves (CIVs).” The problem with the GTS LCO 3.0.5 Bases referencing RCPB leakage isolation is that no required action of LCO 3.4.5, “RCS Operational LEAKAGE,” explicitly requires isolation of leakage by closing a valve. Although LCO 3.4.6 does not address RCPB leakage, it does address CIV leakage for systems connected to the RCS, such as the four CVCS flow path lines listed above. Therefore, the staff’s suggestion that the LCO 3.0.5 Bases discussion should reference the inoperability of a CVCSI valve (also a CIV) requiring isolation, possibly because of valve leakage, was incorporated in the Bases for LCO 3.0.5.

LCO 3.0.6

This Specification defines the actions required to be taken when a supported system LCO is not met solely because a support system LCO is not being met. Only the support system LCO actions are required to be entered, unless a specific exception is specified. The actions required to be taken include an evaluation that shall be performed in accordance with Specification 5.5.8, “Safety Function Determination Program (SFDP).” Because this Specification matches the W-STS, LCO 3.0.6 is acceptable.

LCO 3.0.7

This Specification defines the rules for applying the allowances of Subsection 3.1.8, “PHYSICS TESTS Exceptions.” Because this Specification matches the W-STS, LCO 3.0.7 is acceptable.

LCO 3.0.8

GTS Section 3.0 and GTS Bases Section B 3.0 include LCO 3.0.8 and the Bases for LCO 3.0.8, respectively, which are based on approved traveler TSTF-427-A, “Allowance for Non-Technical Specification Barrier Degradation on Supported System OPERABILITY,” Revision 2. By a letter dated September 14, 2017 (ADAMS Accession No. ML17257A450), the applicant inserted a reviewer’s note before LCO 3.0.8 and placed the text of LCO 3.0.8 and the reviewer’s note in square brackets to designate LCO 3.0.8 and the reviewer’s note as part of COL Action Item 16.1-1, as follows:

[-------------------------------REVIEWER’S NOTE---------------------------------
A COL applicant who wants to adopt LCO 3.0.8 must perform or reference a risk assessment for the NuScale design that has been submitted to and accepted by the NRC, and that was prepared consistent with the bounding generic risk assessment provided in TSTF-427-A, “Allowance for Non-Technical Specification Barrier Degradation on Supported System OPERABILITY,” Revision 2.
---]

[LCO 3.0.8 When one or more required barriers are unable to perform their related support function(s), any supported system LCO(s) are not required to be declared not met solely for this reason for up to 30 days provided that at least one train or subsystem of the supported system is OPERABLE and supported by barriers capable of providing their related support function(s), and risk is assessed and managed. This Specification may be concurrently applied to more than one train or subsystem of a multiple train or subsystem supported system provided at least one train or subsystem of the supported system is OPERABLE and the barriers supporting each of these trains or subsystems provide their related support function(s) for different categories of initiating events.

If the required OPERABLE train or subsystem becomes inoperable while this Specification is in use, it must be restored to OPERABLE status within 24 hours or the provisions of this Specification cannot be applied to the trains or subsystems supported by the barriers that cannot perform their related support function(s).

At the end of the specified period, the required barriers must be able to perform their related support function(s) or the supported system LCO(s) shall be declared not met.]

The applicant also inserted this reviewer’s note before the Bases for LCO 3.0.8 and placed the text of the Bases for LCO 3.0.8 and the reviewer’s note in square brackets to also designate them as a part of COL Action Item 16.1-1. Designating LCO 3.0.8 and the reviewer’s note and the Bases for LCO 3.0.8 as part of COL Action Item 16.1-1 is acceptable because it minimizes the administrative burden on the NRC staff and a COL applicant if the applicant elects to omit LCO 3.0.8 from the plant-specific TS. Deferring the submission or referencing of an associated risk assessment to a COL application referencing the NuScale design certification is acceptable because it will still ensure that the inclusion of LCO 3.0.8 in the plant-specific TS is technically justified and not adverse to safe operation of the unit.

In addition, by a letter dated September 14, 2017 (ADAMS Accession No. ML17257A450), the applicant adequately justified the omission of two of the traveler's reviewer's notes from Bases Section B 3.0 for LCO 3.0.8. As noted above, the applicant placed square brackets around LCO 3.0.8 and its Bases, as well as around the reviewer's note quoted above, to indicate that they are part of COL Action Item 16.1-1. The staff concludes that LCO 3.0.8 and its Bases, and the reviewer's notes, which are all enclosed in brackets, are acceptable because they are consistent with TSTF-427-A (with justified exceptions).

16.4.4.2 Surveillance Requirement Use and Applicability

As discussed below, the staff found that SR 3.0.1, SR 3.0.2, SR 3.0.3, and SR 3.0.4 are consistent with the W-STS (with justified exceptions) and the NuScale design.

<u>SR 3.0.1</u>

This Specification defines the logical connection that meeting the LCO and Applicability statements requires meeting the acceptance criteria and performance intervals of the associated SRs. Because this Specification matches the W-STS, SR 3.0.1 is acceptable.

<u>SR 3.0.2</u>

This Specification provides a 25-percent extension of the specified Surveillance performance interval (Frequency) "as measured from the previous performance or as measured from the time a specified condition of the Frequency is met." It also defines specific exceptions to this allowance for Frequencies specified as "once," and for the initial performance of a Completion Time that requires periodic performance of a required action on a "once per..." basis. Because this Specification matches the W-STS, SR 3.0.2 is acceptable.

<u>SR 3.0.3</u>

This Specification defines the actions required to be taken if it is discovered that a Surveillance was not performed within its specified Frequency and provides an exception to SR 3.0.1. Because this Specification matches the W-STS, as revised by NRC-approved traveler TSTF-529-A, SR 3.0.3 is acceptable.

<u>SR 3.0.4</u>

The GTS SR 3.0.4 is consistent with Revision 4 of W-STS SR 3.0.4, which is based on traveler TSTF-359-A, Revision 9. Because this Specification matches the W-STS, SR 3.0.4 is acceptable.

Conclusion for GTS Section 3.0

Based on its review the staff concludes that GTS Section 3.0 LCOs and SRs conform to the STS (with justified exceptions) and are appropriate for the NuScale design, and therefore the staff finds that GTS Section 3.0 is acceptable.

16.4.5 Limiting Condition for Operation Statements (GTS Chapter 3, Sections 3.1 through 3.8)

The staff reviewed the LCO statement in each subsection of GTS Sections 3.1 through 3.8 for technical accuracy and consistency with the NuScale design, as described in DCA Part 2, Tier 2, regarding the number of subsystems, trains, channels, divisions, or separation groups of the specified SSC required to be operable; or the value of the limit that the specified process variable must be within. The staff also reviewed each LCO statement for clarity and consistency with the STS writer's guide phrasing, formatting, and punctuation conventions, and for overall nomenclature consistency with the GTS and Bases, and DCA Part 2. In most cases, the staff determined that the LCO statements were clear and accurate and consistent with the NuScale design. The following describes the resolution of issues for selected LCOs.

- LCO 3.1.9, "Boron Dilution Control"

This subsection specifies CVCS DWSI valve operability, boron concentration limits in the boric acid storage tank, and flowrate limits for the CVCS makeup pump flow path.

The makeup flow is limited to the capacity of one makeup pump when thermal power is at or below a specified level in Mode 1; DCA Part 2, Tier 2, Section 15.4.6.2, indicates this is when thermal power is at or below 50-percent RTP. In a public meeting teleconference with NuScale on September 14, 2018, the staff asked NuScale whether the value of this minimum power level for operation of two makeup pumps should be stated either in the LCO or Bases, in addition to DCA Part 2, Tier 2, and the COLR. The applicant asserted its view that the minimum thermal power level for operation of two makeup pumps at full capacity is appropriately maintained in the COLR, which LCO 3.1.9 refers to by stating "flowrate [shall be] within the limits specified in the COLR." The staff concurs with this approach, provided the flowrate limits, as stated in DCA Part 2, Tier 2, Section 15.4.6.2, are maintained consistent with the limits specified in the COLR. The staff therefore concludes that LCO 3.1.9 is acceptable.

Revision 2 of DCA Part 2, Tier 2, Section 15.4.6.3.4, "Input Parameters and Initial Conditions," states: "A minimum makeup temperature of 40 degrees F [4.4 degrees C] is assumed for the analysis of boron dilution of the RCS during Modes 1 through 3." As this temperature assumption is not explicitly surveilled or specified by Subsection 3.1.9, by a letter dated January 29, 2019 (ADAMS Accession No. ML19029B572), the applicant provided a rationale for omitting this makeup water minimum temperature limit from both LCO 3.1.9 and the discussion of applicable safety analyses in Bases Subsection B 3.1.9, and in DCA Part 2, Tier 2, Section 15.4.6.3.4. The applicant stated the following:

> The 40 °F [4.4 °C] used in the boron dilution analysis was chosen because the density of water is approximately at a maximum at that temperature. This maximizes the mass of unborated water injected and the dilution. This simplifies and provides a common baseline for boron effects analyses. Boron concentration limits are described and implemented in accordance with plant procedures so that the assumptions of the core operating limits report (COLR) are appropriately implemented. Consistent with industry practice, effects of temperature differences will be addressed by the implementing procedures required to implement the COLR and technical specification requirements.

The staff concludes that the applicant's rationale for not specifying the 4.4 degrees C (40 degrees F) makeup temperature used in the boron dilution analysis and not discussing it in the Bases for GTS Subsection 3.1.9 is acceptable because it is not a limiting value for the inadvertent boron dilution event safety analysis. Also because there is a reasonable expectation of ambient temperatures always exceeding 4.4 degrees C (40 degrees F) in the vicinity of the demineralized water storage tank in the reactor building, the staff agrees with the applicant that including this temperature assumption in LCO 3.1.9, because of Criterion 2, is not necessary to preclude RCS injection of makeup water with temperature below 4.4 degrees C (40 degrees F) in Modes 1, 2, and 3.

- LCO 3.3.1, "Module Protection System Instrumentation"

There is one CVCS-CIS manual override switch, O-1, per ESFAS Logic and Actuation division. This safety-related switch, the operation of which must be preceded by manual operation of the nonsafety enable switch, is used in a beyond-design-basis event involving a containment bypass leak of radioactivity. In DCA Part 4, on page B 3.3.1-17, the applicant included the following discussion:

> <u>Containment System Isolation Override, O-1</u>
>
> The containment system isolation override, O-1, is established when the manual override switch (one for each division) in the main control room is in the override position for the respective ESFAS division and the RT-1 permissive is established. The O-1 override allows for manual control of the CVCS RCS injection and pressurizer spray containment isolation valves and the containment flood and drain containment isolation valves, from the module control system with an active automatic containment system isolation or automatic CVCS isolation signal present. The override does not affect the CVCS containment isolation valves closure signal when the isolation signal is generated on High Pressurizer Level. The O-1 override switch must be manually taken out of override when the override O-1 is no longer needed. The override is automatically removed if the RT-1 permissive is removed.

The staff finds that the above Bases passage adequately describes the override O-1 switch.

- LCO 3.4.10, "RCS Low Temperature Overpressure Protection (LTOP) Valves"

This subsection specifies that each RVV that is in the closed position shall be operable, but does not state the implied requirement that all three RVVs shall be closed and operable for LTOP. Three RVVs are required, since two RVVs are necessary to perform the overpressure prevention function; the third RVV accounts for the assumed worst case single active failure of an RVV to open on an LTOP actuation signal. This leads to a rather unconventional construction of the associated actions. The staff considered that a clearer presentation would be for the LCO to explicitly require three RVVs to be closed and operable for LTOP or at least two RVVs be open. In a letter dated December 12, 2018 (ADAMS Accession No. ML18347A619), the applicant declined to revise the LCO, Applicability, and Actions, as suggested, and stated the following:

> NuScale technical specifications are developed in close coordination and consultation with the operating staff. Experience with the technical specifications in simulator operations and in support of DCA development has not identified the need for a modified presentation of this LCO.
>
> The staff observation of the LCO as "unconventional" is accurate, however it is appropriate for the NuScale design. The proposed presentation would reduce clarity and introduce unnecessary complexity to the specifications. Therefore, the current construction of the LCO is being retained.

Based on the applicant’s letter, the staff accepts that the LCO as proposed will ensure that the LTOP function of the RVVs is operable when wide range RCS cold temperature is below the T-1 interlock setting. Therefore, Specification 3.4.10 operability and action requirements, and associated Bases, are acceptable.

Based on its review, the staff concludes the LCO statements are acceptable.

16.4.6 Applicability Statements (GTS Chapter 3, Sections 3.1 through 3.8)

The applicability statements of LCOs for SSCs, process parameters, and other operational restrictions must be sufficiently broad to ensure that the safety-related function, initial condition, or other restriction specified by the LCO protects the validity of the transient and accident analyses, thereby ensuring safe operation of the reactor facility and adequate protection of public health and safety.

The operational mode definitions in GTS Section 1.1, Table 1.1-1, reflect the unique characteristics of the design and operation of an NPM. The mode definitions, therefore, differ from the mode definitions used in the STS. The equivalence of STS and GTS mode definitions is described in Section 3.1 of the Regulatory Conformance and Development Report, which states the following:

> The MODE definitions applicable to PWRs were determined consistent with the NuScale design and operation. Individual NPMs use a comparatively small reactor that depends on natural circulation for flow in the reactor, NPMs are passively cooled in postulated accident conditions, and the design includes relocation of NPMs to perform refueling operations. Therefore, NuScale developed a new MODE structure that more appropriately addresses the NuScale operations paradigm.

For most GTS LCOs, the applicability statement includes one or more of Mode 1, Mode 2, and some part or all of Mode 3. The GTS definition of Mode 1 (Operations) encompasses the W-AP1000-STS definitions of Mode 1 (Power Operation) and Mode 2 (Startup). GTS Mode 1 is defined by the core reactivity condition ($k_{eff} \geq 0.99$) and reactor coolant temperature indication (all temperature indications ≥ 216 degrees C (420 degrees F)); W-AP1000-STS definitions of Modes 1 and 2 use the same core reactivity condition ($k_{eff} \geq 0.99$), but use core thermal power as a percent of RTP (> 5 percent RTP for Mode 1 and ≤ 5 percent RTP for Mode 2) instead of reactor coolant temperature indication. Because the minimum RCS temperature for criticality (minimum temperature for criticality) specified by GTS LCO 3.4.2 is also 216 degrees C (420 degrees F), the GTS Mode 1 definition is seen to be equivalent to the W-AP1000-STS Mode 1 and Mode 2 definitions combined. The broader RCS temperature range for the NuScale Mode 1 definition reflects the need to use the module heating system of the CVCS to reach the minimum temperature for criticality and then use core thermal power to reach RCS normal operating temperatures (beginning around 15 percent RTP) because core flow is by natural circulation. An AP1000 unit achieves the minimum temperature for criticality, which is the average RCS temperature near the RCS normal operating temperature, by adding heat with forced core flow from running reactor coolant pumps. Defining GTS Mode 1 in this way results in GTS applicability and action statements that appear different, but which are generally no more or less restrictive than equivalent requirements in the W-AP1000-STS for Modes 1 and 2.

The GTS definition of Mode 2 (hot shutdown) is equivalent to the W-AP1000-STS definition of Mode 3 (hot standby). The GTS Mode 2 is defined by the core reactivity condition ($k_{eff} < 0.99$) and reactor coolant temperature indication (any temperature indication ≥ 216 degrees C

(420 degrees F)); the W-AP1000-STS definition of Mode 3 uses the same core reactivity condition (k_{eff} < 0.99), and a similar reactor coolant temperature indication (reactor coolant average temperature > 216 degrees C (420 degrees F)). Defining GTS Mode 2 in this way results in GTS applicability and action statements that appear different, but which are generally no more or less restrictive than equivalent requirements in the W-AP1000-STS for Mode 3.

The GTS definition of Mode 3 (safe shutdown) encompasses the W-AP1000-STS definitions of Mode 4 (safe shutdown) and Mode 5 (cold shutdown). The GTS Mode 3 is defined by the core reactivity condition (k_{eff} < 0.99) and reactor coolant temperature indication (all temperature indications < 216 degrees C (420 degrees F)); the W-AP1000-STS definition of Mode 4 uses the same core reactivity condition (k_{eff} < 0.99), and a part of the reactor coolant temperature indication range (reactor coolant average temperature ≤ 216 degrees C but > 93 degrees C (≤ 420 degrees F but > 200 degrees F)); the W-AP1000-STS definition of Mode 5 also uses the same core reactivity condition (k_{eff} < 0.99), but the lower part of the reactor coolant temperature indication range (reactor coolant average temperature ≤ 93.3 degrees C (200 degrees F)). Defining GTS Mode 3 in this way results in GTS applicability and action statements that appear different, but which are generally no more or less restrictive than equivalent requirements in the W-AP1000-STS for Modes 4 and 5.

In DCA Part 4, regarding the GTS definition of Mode 3 in Table 1.1-1, in addition to meeting the reactor coolant temperature condition (all indications < 216 degrees C (420 degrees F)) and the core reactivity condition (k_{eff} < 0.99), being in Mode 3 also includes meeting one or more of three conditions, as specified by table footnote (a):

> (a) Any CRA capable of withdrawal, any CVCS or CFDS connection to the module not isolated.

To enter Mode 4 (Transition) from Mode 3, the unit must satisfy all of the following conditions: (1) k_{eff} < 0.95, (2) all CRAs are incapable of withdrawal, (3) all CVCS module connections are isolated, (4) all CFDS module connections are isolated, and (5) all RVVs are electrically isolated. The latter four conditions are specified by table footnote (b):

> (b) All CRAs incapable of withdrawal, [all] CVCS and CFDS connections to the module isolated, and all reactor vent valves electrically isolated.

The GTS definition of Mode 4, although equivalent to the portion of the W-AP1000-STS definition of Mode 5 in which the RCS is filled but vented to the containment, is unique to the NuScale design because during Mode 4, the unit staff can move the NPM to the refueling pool. Also, the core reactivity condition in Mode 4 is more limiting, with k_{eff} < 0.95 instead of k_{eff} < 0.99.

The GTS definition of Mode 5 (refueling) is equivalent to the W-AP1000-STS definition of Mode 6 (refueling) during which the reactor vessel closure head is removed to permit movement of irradiated fuel assemblies in the reactor vessel, the refueling pool, and the spent fuel pool.

In addition to the reactivity condition and reactor coolant temperature indication, GTS applicability statements are further defined in relation to the active or not active status of RTS and ESFAS operating bypass interlocks and permissives. These interlocks and permissive Functions use sensor signals of NPM process variables and the open or closed status of valves and circuit breakers, and the functional status of the CRA drive mechanisms. Typically, there are four sensor channels for each process variable. When at least two out of four channels send an enable signal to the coincidence logic in each of the two actuation logic divisions, each division of the interlock Function outputs a signal in the same division to the actuation logic of the RTS and ESFAS Functions that use the interlock signal. Interlock bypass signals typically require three out of four sensor channels indicating the RTS or ESFAS Function is no longer needed to be operable to bypass the Function. Depending on how an RTS or ESFAS Function is designed to use the interlock or permissive signal, the signal will (1) cause the Function to be automatically bypassed or allow it to be manually bypassed, or (2) cause the Function to be automatically unbypassed or enabled. Because the process variable instrument channels that are used for MPS Functions are also used for interlock and permissive Functions, Section 3.3 does not explicitly state duplicate operability requirements for process variable instrument channels that also generate interlock and permissive signals. Thus, an MPS Function's applicability statement mode requirements, which are modified by whether a relevant process variable is above or below the trip setting of the associated interlock, implicitly requires the interlock to automatically bypass, or automatically permit the manual bypassing of, the associated RTS or ESFAS Function when the Function is not needed to be operable and to automatically unbypass or enable the Function when it is needed to be operable.

Applicability statements are specified using the modes defined in Table 1.1-1 and interlock definitions, which are based on the values of the following listed variables, and the status of the following listed SSCs. This list only describes LCO applicability statements that modify the range of a defined MODE or include other specified conditions. The list also shows that the LCO applicabilities for instrumentation and actuation logic Functions are consistent with or bound the LCO applicabilities for the supported actuated devices.

(1) Core reactivity condition

(a) In MODE 1 with $k_{eff} < 1.0$, the SDM requirements of LCO 3.1.1 are applicable.

(b) In MODE 1 with $k_{eff} \geq 1.0$, the regulating group CRA insertion limits of LCO 3.1.6 are applicable.

(2) Core power level

(a) In MODE 1 with THERMAL POWER ≥ 25% RTP, the following LCOs are applicable:

3.2.1 Enthalpy Rise Hot Channel Factor
3.2.2 AXIAL OFFSET

(b) N-2H—Power Range Linear Power Interlock

N-2H is active or established[4] if
at least 3 of 4 power range channels indicate < 15% RTP.

N-2H is not active if
at least 2 of 4 power range channels indicate ≥ 15% RTP.

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4 In DCA Part 4, when describing the state of an automatic interlock, the Bases for GTS Section 3.3 use "is active" in some cases and "is established" in other cases to indicate that the operational bypass generated by the interlock prevents the supported MPS function from actuating on an automatic actuation signal.

When active, N-2H automatically bypasses the following MPS Functions of LCO 3.3.1 in MODE 1 with THERMAL POWER < 15% RTP:

2.a	RTS	on High Power Range Positive and Negative Rate
2.b	DWSI	on High Power Range Positive and Negative Rate
17.a	RTS	on Low Main Steam Pressure
17.b	DWSI	on Low Main Steam Pressure
17.c	SSI	on Low Main Steam Pressure

When not active, N-2H automatically enables the above MPS Functions of LCO 3.3.1 in MODE 1 with THERMAL POWER ≥ 15% RTP.

With N-2H interlock active, the FWIV Closed Interlock, V-1, bypasses the following MPS Functions of LCO 3.3.1 in MODE 1 with THERMAL POWER < 15% RTP and at least one FWIV indicates closed:

20.a	RTS	on Low Steam Superheat
20.b	DWSI	on Low Steam Superheat

In addition to N-2H and V-1 being active, if L-1 is also active, the following MPS Function is automatically bypassed:

20.c	SSI	on Low Steam Superheat

With N-2H interlock active, the V-1 interlock automatically enables MPS Functions 20.a and 20.b of LCO 3.3.1 in MODE 1 with THERMAL POWER < 15% RTP and both FWIVs indicating open.

With N-2H and V-1 active, the L-1 interlock automatically enables MPS Function 20.c of LCO 3.3.1 in MODE 1 if containment water level is < 13.7 m (45 ft).

Regardless of whether the L-1 interlock, N-2H interlock, or V-1 interlock is active, in MODE 1:

(1) The operability of the two divisions of the RTS Logic and Actuation Function of LCO 3.3.2 is required. Note that this includes each RTB.

(2) The operability of the two divisions of the following ESFAS Logic and Actuation Functions of LCO 3.3.3 is required:

4	DWSI
8	SSI

(3) The operability of the two divisions of the following Manual Actuation Functions of LCO 3.3.4 is required:

1	RTS
5	DWSI
9	SSI

(4) The operability of the two CVCS demineralized water isolation valves is required by LCO 3.1.9 when any dilution source flow path in the CVCS makeup line is not isolated.

(5) The operability of the two MSIVs and two MSIV bypass valves per steam line is required by LCO 3.7.1 (supports SSI actuation).

(6) The operability of the one FWIV and the one FWRV for each steam generator is required by LCO 3.7.2 (supports SSI actuation).

(c) <u>N-2L—Power Range Linear Power Interlock</u>

N-2L interlock is active if
at least 3 of 4 power range channels indicate > 15% RTP.

N-2L interlock is not active if
at least 2 of 4 power range channels indicate ≤ 15% RTP.

When active, N-2L interlock automatically bypasses the following MPS Functions of LCO 3.3.1 in MODE 1 with THERMAL POWER > 15% RTP:

3.a RTS on High Intermediate Range Log Power Rate
3.b DWSI on High Intermediate Range Log Power Rate

When not active, N-2L interlock automatically enables the above MPS Functions of LCO 3.3.1 in MODE 1 with THERMAL POWER ≤ 15% RTP.

Regardless of whether the N-2L interlock is active, in MODE 1:

(1) The operability of the two divisions of the RTS Logic and Actuation Function of LCO 3.3.2 is required. Note that this includes each RTB.

(2) The operability of the two divisions of the following ESFAS Logic and Actuation Function of LCO 3.3.3 is required:

4 DWSI

(3) The operability of the two divisions of the following Manual Actuation Functions of LCO 3.3.4 is required:

1 RTS
5 DWSI

(4) The operability of the two CVCS demineralized water isolation valves is required by LCO 3.1.9 when any dilution source flow path in the CVCS makeup line is not isolated.

(d) <u>N-2L—Power Range Linear Power Permissive</u>

N-2L permissive is active if
at least 3 of 4 power range channels indicate > 15% RTP.

N-2L permissive is not active if
at least 2 of 4 power range channels indicate ≤ 15% RTP.

When active, N-2L permissive allows manual bypass of the following
MPS Functions of LCO 3.3.1 in MODE 1 with THERMAL POWER > 15% RTP:

1.a	RTS	on High-1 Power Range Linear Power
1.b	DWSI	on High-1 Power Range Linear Power

Note: Manually bypassing Function 1.a, RTS on Power Range Linear Power, bypasses the High-1 setpoint without affecting the High-2 setpoint.

When not active, N-2L permissive automatically enables the above MPS Functions of LCO 3.3.1 in MODE 1 with THERMAL POWER ≤ 15% RTP.

(e) N-1—Intermediate Range Log Power Permissive and Interlock

N-1 permissive and interlock are active if
at least 3 of 4 intermediate range log power channels indicate > 1 x 10^5 cps.

N-1 permissive and interlock are not active if
at least 2 of 4 intermediate range log power channels indicate ≤ 1 x 10^5 cps.

When active, N-1 permissive allows manual bypass of the following MPS Functions of LCO 3.3.1 in MODE 1 with intermediate range log power > 1 x 10^5 cps:

4.a	RTS	on High Source Range Count Rate
4.b	DWSI	on High Source Range Count Rate
5.a	RTS	on High Source Range Log Power Rate
5.b	DWSI	on High Source Range Log Power Rate

When active, N-1 interlock automatically bypasses the following MPS Function of LCO 3.3.1 in MODE 1 with intermediate range log power > 1 x 10^5 cps:

6.a	DWSI	on High Source Range Subcritical Multiplication

When not active, N-1 permissive and interlock automatically enable the above MPS Functions of LCO 3.3.1 in MODE 1 with intermediate range log power ≤ 1 x 10^5 cps.

Regardless of whether the N-2L and N-1 interlocks and permissives are active, in MODE 1:

(1) The operability of the two divisions of the RTS Logic and Actuation Function of LCO 3.3.2 is required. Note that this includes each RTB.

(2) The operability of the two divisions of the following ESFAS Logic and Actuation Function of LCO 3.3.3 is required:

4 DWSI

(3) The operability of the two divisions of the following Manual Actuation Functions of LCO 3.3.4 is required:

1 RTS
5 DWSI

(4) The operability of the two CVCS demineralized water isolation valves is required by LCO 3.1.9 when any dilution source flow path in the CVCS makeup line is not isolated.

(3) <u>RTB position</u>

(a) <u>RT-1—Reactor Tripped Interlock</u>

RT-1 is active if
two of the two divisional RTBs indicate open.

RT-1 is not active if
one or two of the two divisional RTBs indicate closed.

The RT-1 Interlock is used in conjunction with the T-2, F-1, and L-1 interlocks, and the override function O-1, in LCO applicability statements described below. RT-1 is also used with T-5; however, *the T-5 interlock is not used to modify the MODE 3 applicability of any MPS Function.*

When both divisional RTBs are open (RT-1 is active, reactor is tripped):

- L-1 is enabled to automatically bypass associated LCO 3.3.1 MPS Functions upon 3 of 4 containment water level channels indicating > 13.7 m (45 ft):

  12.a CIS on Low Low Pressurizer Level
  12.b CVCSI on Low Low Pressurizer Level
  12.c SSI on Low Low Pressurizer Level
  18.c SSI on Low Low Main Steam Pressure
  20.c SSI on Low Steam Superheat
  21.e SSI on High Narrow Range Containment Pressure

- F-1 is enabled to automatically bypass the following associated LCO 3.3.1 MPS Function upon 3 of 4 RCS flow channels indicating ≤ low low RCS flow setpoint (≤ 0.00 cubic meters per second (m^3/sec) (0.0 cubic feet per second (ft^3/sec))) for > specified time period:

  15.b CVCSI on Low Low RCS Flow

- T-2 is enabled to automatically bypass associated LCO 3.3.1 MPS Functions upon 3 of 4 wide range RCS hot temperature channels indicating < 93.3 °C (200 °F):

  12.a CIS on Low Low Pressurizer Level
  12.b CVCSI on Low Low Pressurizer Level
  12.c SSI on Low Low Pressurizer Level

- O-1 switch is enabled to allow manual control of CIVs, even if CIS and CVCSI actuation signals are present, except for LCO 3.3.1 MPS Function 10.b, CVCSI on High Pressurizer Level.

- T-5 is enabled to automatically bypass associated LCO 3.3.1 MPS Functions upon 3 of 4 wide range RCS hot temperature channels indicating < 216 °C (420 °F):

  9.b CVCSI on Low Low Pressurizer Pressure
  9.c DWSI on Low Low Pressurizer Pressure
  9.d SSI on Low Low Pressurizer Pressure

  Note that these Functions are required to be operable in Mode 3 only when the control rod drive system is capable of CRA withdrawal (Table 3.3.1-1, footnote (a)), in which case T-5 is not active because RT-1 is not active.

(4) Containment vessel water level

(a) L-1—Containment Water Level Interlock

L-1 is active if
at least 3 of 4 containment water level channels indicate > 13.7 m (45 ft)
and RT-1 is also active (two divisional RTBs indicate open).

L-1 is not active if
at least 2 of 4 containment water level channels indicate ≤ 13.7 m (45 ft)
or RT-1 is not active (one or two divisional RTBs indicate closed).

The L-1 interlock is used in conjunction with the T-1 (163 °C (325 °F)), T-2 (93.3 °C (200 °F)) and T-3 (177 °C (350 °F)) interlocks, in LCO applicability statements described below.

(5) RCS flow

(a) F-1—RCS Flow Interlock

F-1 is active if
at least 3 of 4 RCS flow channels indicate ≤ low low RCS flow setpoint
(≤ 0.00 m^3/sec (0.0 ft^3/sec))
for > specified time period
and RT-1 is also active (two divisional RTBs indicate open).

F-1 is not active if
at least 2 of 4 RCS flow channels indicate > low low RCS flow setpoint
(> 0.00 m^3/sec (0.0 ft^3/sec))
or RT-1 is not active (one or two divisional RTBs indicate *closed*).

When active, F-1 automatically bypasses the following MPS Function of LCO 3.3.1 in MODE 3, to allow using the CVCS and module heatup system to establish RCS flow and to heat up the RCS during reactor startup.

15.b CVCSI on Low Low RCS Flow

When not active, F-1 automatically enables the above MPS Function of LCO 3.3.1.

Regardless of whether the F-1 Interlock is active in MODE 3, the normally open CVCS CIVs (inboard and outboard, respectively) on the injection line (CVC-331 and CVC-329), the discharge line (CVC-334 and CVC-336), and pressurizer spray line (CVC-325 and CVC-323) are required to be operable by LCO 3.4.6 in MODE 3, and by LCO 3.6.2 in MODE 3 with RCS hot temperature ≥ 93.3 °C (200 °F).

(6) Reactor coolant temperature (93.3 °C, 163 °C, 177 °C, 216 °C, 246 °C, and 316 °C) ((200 °F, 325 °F, 350 °F, 420 °F, 475 °F, and 600 °F)),

(a) MODE 3 with any RCS temperature ≥ 93.3 °C (200°F), the lower moderator temperature coefficient limit of LCO 3.1.3 is applicable.

(b) MODE 3 with RCS hot temperature ≥ 93.3 °C (200 °F) and all ECCS valves closed, the following LCOs are applicable:

3.4.5 RCS Operational LEAKAGE
3.4.7 RCS Leakage Detection Instrumentation (except during containment flooding operations)

(c) MODE 3 with RCS hot temperature ≥ 93.3 °C (200 °F), the following LCOs are applicable:

3.6.1 Containment
3.6.2 Containment Isolation Valves

(d) T-2—Wide Range RCS Hot Temperature Interlock

T-2 is active if
at least 3 of 4 wide range RCS hot temperature channels indicate < 93.3 °C (200 °F)
provided 2 of 4 containment water level channels are ≤ 13.7 m (45 ft) (L-1 not active) or both divisional RTBs are open (RT-1 active).

T-2 is not active if
at least 2 of 4 wide range RCS hot temperature channels indicate ≥ 93.3 °C (200 °F)
provided 3 of 4 containment water level channels are > 13.7 m (45 ft) (L-1 active) or at least one divisional RTB is closed (RT-1 not active), or both.

When active, T-2 Interlock automatically bypasses the following MPS Functions of LCO 3.3.1 in MODE 3 with wide range RCS hot temperature < 93.3 °C (200 °F):

12.a CIS on Low Low Pressurizer Level
12.b CVCSI on Low Low Pressurizer Level
12.c SSI on Low Low Pressurizer Level

and the operability of the two divisions of the following ESFAS Logic and Actuation Function of LCO 3.3.3 is not required in MODE 3 with T-2 active (Table 3.3.3-1 Note (b) implies all RCS temperatures < 93.3 °C (200 °F))

8 SSI

and the operability of the two divisions of the following Manual Actuation Function of LCO 3.3.4 is not required in MODE 3 with T-2 active (Table 3.3.4-1 Note (c) implies all RCS temperatures < 93.3 °C (200 °F)):

9 SSI

<u>When not active</u>, T-2 Interlock automatically enables the above MPS Functions of LCO 3.3.1 in MODE 3 with wide range RCS hot temperature ≥ 93.3 °C (200 °F).

and with any RCS temperature ≥ 93.3 °C (200 °F), Function 8 of LCO 3.3.3 and Function 9 of LCO 3.3.4 are required to be operable.

(e) <u>T-1—Wide Range RCS Cold Temperature Interlock</u>

T-1 is active if
3 of 4 wide range RCS cold temperature channels indicate > LTOP enable temperature specified in the PTLR (approximately 163 °C (325 °F))

T-1 is not active if
2 of 4 wide range RCS cold temperature channels indicate ≤ LTOP enable temperature specified in the PTLR (approximately 163 °C (325 °F))

<u>When active</u>, T-1 interlock automatically bypasses the following MPS Function of LCO 3.3.1 in MODE 3 with wide range RCS cold temperature > approximately 163 °C (325 °F) *or more than one RVV open*:

24.a LTOP on High RCS Pressure

and the operability of the two divisions of the following ESFAS Logic and Actuation Function of LCO 3.3.3 <u>is not required</u> in MODE 3 with T-1 active *or more than one RVV open*:

7 LTOP

and the operability of the two divisions of the following Manual Actuation Function of LCO 3.3.4 <u>is not required</u> in MODE 3 with T-1 active *or more than one RVV open*:

8 LTOP

but the operability of the two RSVs of LCO 3.4.4 <u>is required</u> in MODE 3 with T-1 active,

and the operability of at least two closed RVVs of LCO 3.4.10 <u>is not required</u> in MODE 3 with T-1 active.

When not active, T-1 Interlock automatically enables the above MPS Function 23.a of LCO 3.3.1 in MODE 3 with wide range RCS cold temperature ≤ approximately 163 °C (325 °F), and more than one RVV closed (LTOP RVV lift setting, in terms of wide range pressurizer pressure, is a function of wide range RCS cold temperature),

and in MODE 3 with wide range RCS cold temperature below approximately 163 °C (325 °F) *and more than one RVV closed*, Function 7 of LCO 3.3.3 and Function 8 of LCO 3.3.4 are required to be operable,

but the operability of the two RSVs of LCO 3.4.4 is not required in MODE 3 with T-1 not active,

and the operability of three closed RVVs of LCO 3.4.10 is required in MODE 3 with T-1 not active.

(f) T-3—Wide Range RCS Hot Temperature (T_{hot}) Interlock

T-3 is active if
3 of 4 wide range RCS hot temperature channels indicate < 177 °C (350 °F).

T-3 is not active if
2 of 4 wide range RCS hot temperature channels indicate ≥ 177 °C (350 °F).

When active (Wide Range T_{hot} < 177 °C (350 °F)), T-3 interlock automatically bypasses the following MPS Functions of LCO 3.3.1 in MODE 3 *provided the NPM is not PASSIVELY COOLED*:

21.b	CIS	on High Narrow Range Containment Pressure
21.c	CVCSI	on High Narrow Range Containment Pressure
21.e	SSI	on High Narrow Range Containment Pressure

When active (Wide Range T_{hot} < 177 °C (350 °F)), T-3 interlock automatically bypasses the following MPS Function of LCO 3.3.1 in MODE 3 *provided pressurizer water level is above L-2 interlock (> 20%). The T-3 and L-2 interlocks must both be active to bypass this Function.*

22.a	ECCS	on High Containment Water Level

If wide range RCS hot temperature rises above T-3 interlock (> 177 °C (350 °F)) or if pressurizer level drops below L-2 interlock (< 20%), the bypass is automatically removed from Function 3.3.1.22.a, enabling automatic actuation of ECCS on 2 of 4 high containment water level channels > 7.16 m ± 0.46m (23.5 ft ± 1.5 ft) (as given by DCA Part 2, Tier 2, Table 7.1-4, “ESFAS Functions,” ECCS actuation on high containment vessel (CNV) water level > analytical limit).

When not active (Wide Range T_{hot} ≥ 177 °C (350 °F)), T-3 interlock automatically enables the following MPS Functions of LCO 3.3.1 in MODE 3:

21.b	CIS	on High Narrow Range Containment Pressure
21.c	CVCSI	on High Narrow Range Containment Pressure

and provided the NPM containment water level is below 13.7 m (45 ft) (L-1 interlock not active) in MODE 3 (Table 3.3.1-1 Footnote (m)), the following MPS Function also:

21.e SSI on High Narrow Range Containment Pressure

When not active (Wide Range T_{hot} ≥ 177 °C (350 °F)), T-3 interlock automatically enables the following MPS Function of LCO 3.3.1 in MODE 3:

22.a ECCS on High Containment Water Level

provided pressurizer water level is below the L-2 interlock (as stipulated by GTS Table 3.3.1-1 Footnote (n) "With RCS temperature above the T-3 interlock or pressurizer water level below the L-2 interlock," that modifies the Mode 3 applicability for MPS Function 22.a of LCO 3.3.1).

(g) T-4—Narrow Range RCS Hot Temperature Interlock

T-4 is active if
3 of 4 narrow range RCS hot temperature channels indicate < 316 °C (600 °F).

T-4 is not active if
2 of 4 narrow range RCS hot temperature channels indicate ≥ 316 °C (600 °F).

When active, T-4 Interlock automatically bypasses the following MPS Functions of LCO 3.3.1 in MODE 1:

8.a RTS on Low Pressurizer Pressure
8.b DWSI on Low Pressurizer Pressure

When not active, T-4 Interlock automatically enables the above MPS Functions of LCO 3.3.1 in MODE 1.

(h) T-6—RCS Hot Temperature Interlock

T-6 is active if
3 of 4 narrow range RCS hot temperature channels indicate < 246 °C (475 °F).

T-6 is not active if
2 of 4 narrow range RCS hot temperature channels indicate ≥ 246 °C (475 °F).

When active, T-6 Interlock automatically bypasses the following MPS Function of LCO 3.3.1 in MODES 1 and 2:

23.a ECCS on Low RCS Pressure

When active, T-6 Interlock automatically enables the following MPS Function of LCO 3.3.1 in MODES 1 and 2:

23.a ECCS on Low RCS Pressure

provided the P-1—High Containment Pressure Interlock is not active (containment pressure > 6.9 kPa (absolute) (1 psia)). MPS Function 23.a operability requires that the P-1 Interlock be capable of automatically removing the operational bypass, which is active at or below 6.9 kPa (absolute) (1 psia). A small break LOCA inside containment would increase containment pressure above 6.9 kPa (absolute) (1 psia); hence P-1 will prevent ECCS actuation on low RCS pressure for non-LOCA events that do not cause an increase in containment pressure.

(7) Status of Passive Cooling. The NPM is Passively Cooled if (a) one or more RVVs are open and one or more RRVs are open; (b) DHRS is in operation; or (c) containment vessel water level is > 13.7 m (45 ft) (L-1 active). In MODE 3 with Passive Cooling in operation, the safety function of the ECCS and DHRS is being fulfilled.

(a) LCO 3.0.3 is only applicable in MODES 1 and 2, and in MODE 3 when not Passively Cooled.

(b) If Passive Cooling is in operation, the operability of the four channels of the following MPS Functions of LCO 3.3.1 is not required in MODE 3:

7.b DHRS on High Pressurizer Pressure
13.b DHRS on High Narrow Range RCS Hot Temperature
16.b DHRS on High Main Steam Pressure
25.b DHRS on Low AC Voltage to ELVS Battery Chargers
25.g SSI on Low AC Voltage to ELVS Battery Chargers

and the operability of the two divisions of the following ESFAS Logic and Actuation Functions of LCO 3.3.3 is not required in MODE 3:

1 ECCS
2 DHRS
8 SSI

and the operability of the two divisions of the following Manual Actuation Functions of LCO 3.3.4 is not required in MODE 3:

2 ECCS
3 DHRS
9 SSI

and the Remote Shutdown Station (RSS) instrumentation of LCO 3.3.5, RSS, is not required to be operable in MODE 3,

and the requirements of LCO 3.4.9, SG Tube Integrity, are not required to be met in MODE 3,

and the requirements of LCO 3.5.1, ECCS, for the two RRVs and the three RVVs to be operable, are not required to be met in MODE 3,

and the requirement of LCO 3.5.2, DHRS, for the two DHRS loops to be operable, is not required to be met in MODE 3,

and the requirement of LCO 3.7.1, for two MSIVs and two MSIV bypass valves in each main steamline to be operable, is not required to be met in MODE 3, and the requirement of LCO 3.7.2, for one FWIV and one FWRV for each SG to be operable, <u>is not required to be met</u> in MODE 3.

If Passive Cooling is <u>not</u> in operation, the above LCOs <u>are required to be met</u> in MODE 3.

(8) <u>Position of pressurizer heater breakers (open or closed)</u>. If pressurizer heater breakers are open, the operability of the four channels of the following MPS pressurizer heater trip (PHT) Functions <u>is not required</u> in MODES 2 and 3:

7.c	PHT	on High Pressurizer Pressure
11.b	PHT	on Low Pressurizer Level
13.c	PHT	on High Narrow Range RCS Hot Temperature
16.c	PHT	on High Main Steam Pressure
25.f	PHT	on Low AC Voltage to ELVS Battery Chargers (Mode 2 only)

and the operability of the two divisions of the following ESFAS Logic and Actuation Function of LCO 3.3.3 <u>is not required</u> in MODES 2 and 3:

6 PHT

and the operability of the two divisions of the following Manual Actuation Function of LCO 3.3.4 <u>is not required</u> in MODES 2 and 3:

7 PHT

(9) <u>L-2—Pressurizer Level Interlock</u>

L-2 is active if 3 of 4 pressurizer level channels indicate > 20%.

L-2 is not active if 2 of 4 pressurizer level channels indicate ≤ 20%.

<u>When active</u>, L-2 interlock automatically bypasses the following MPS Function of LCO 3.3.1 in MODE 3 *provided the wide range RCS hot temperature is below the T-3 interlock (< 177* °C (*350 °F)). The L-2 and T-3 interlocks must both be active to bypass this Function.*

22.a ECCS on High Containment Water Level

If pressurizer level drops below L-2 interlock (< 20%) or if wide range RCS hot temperature rises above T-3 interlock (> 177 °C (350 °F)), the bypass is automatically removed from Function 3.3.1.22.a, enabling automatic actuation of ECCS on 2 of 4 high containment water level channels above setpoint.

(10) <u>Status of CRA withdrawal capability (one or more capable; none capable)</u>. If no CRA is capable of withdrawal, the operability of the four channels of the following MPS Functions of LCO 3.3.1 <u>is not required</u> in MODES 2 and 3:

1.a	RTS	on High-1 Power Range Linear Power
1.b	DWSI	on High-1 Power Range Linear Power
3.a	RTS	on High Intermediate Range Log Power Rate
3.b	DWSI	on High Intermediate Range Log Power Rate

4.a	RTS	on High Source Range Count Rate
4.b	DWSI	on High Source Range Count Rate
5.a	RTS	on High Source Range Log Power Rate
5.b	DWSI	on High Source Range Log Power Rate
6.a	DWSI	on High Source Range Subcritical multiplication
7.a	RTS	on High Pressurizer Pressure
7.d	DWSI	on High Pressurizer Pressure
9.a	RTS	on Low Low Pressurizer Pressure
9.b	CVCSI	on Low Low Pressurizer Pressure (Mode 3 only)
9.c	DWSI	on Low Low Pressurizer Pressure
9.d	SSI	on Low Low Pressurizer Pressure (Mode 3 only)
10.a	RTS	on High Pressurizer Level
10.c	DWSI	on High Pressurizer Level
11.a	RTS	on Low Pressurizer Level
11.c	DWSI	on Low Pressurizer Level
15.a	RTS	on Low Low RCS Flow
15.c	DWSI	on Low Low RCS Flow
16.a	RTS	on High Main Steam Pressure (Mode 2 only)
16.d	DWSI	on High Main Steam Pressure (Mode 2 only)
18.a	RTS	on Low Low Main Steam Pressure
18.b	DWSI	on Low Low Main Steam Pressure
21.a	RTS	on High Narrow Range Containment Pressure
21.d	DWSI	on High Narrow Range Containment Pressure
25.a	RTS	on Low AC Voltage to ELVS Battery Chargers
25.e	DWSI	on Low AC Voltage to ELVS Battery Chargers
26.a	RTS	on High Under-the-Bioshield Temperature
26.d	DWSI	on High Under-the-Bioshield Temperature

and the operability of the two divisions of the RTS Logic and Actuation Function of LCO 3.3.2 <u>is not required</u> in MODES 2 and 3;

and the operability of the two divisions of the following Manual Actuation Function of LCO 3.3.4 <u>is not required</u> in MODES 2 and 3:

1 RTS

but the operability of the two CVCS demineralized water isolation valves <u>is required</u> by LCO 3.1.9 in MODES 2 and 3, regardless of CRA capability, because MPS Function 14.a, DWSI on Low RCS Flow, is also required in MODES 2 and 3 regardless of CRA capability.

If one or more CRAs are capable of being withdrawn, the above LCOs <u>are required to be met in the specified MODES</u>.

(11) <u>Position of reactor vessel upper assembly.</u> The two refueling neutron flux channels and the neutron flux audible count rate channel are required to be operable in MODE 5 by LCO 3.8.1, except when the reactor vessel upper assembly is seated on the reactor vessel flange.

The staff compared the Applicable Safety Analyses and Applicability sections of the Bases of each LCO subsection to check that each SSC credited by an analysis of a postulated accident, infrequent event, or AOO is required to be operable for the range of operational modes and other specified conditions in which the analysis assumes the analyzed event could occur and require mitigation by RTS and ESF systems.

The staff verified that the limiting applicability of each MPS instrumentation Function spans the applicability of all associated RTS and ESFAS Logic and Actuation Functions. Although the applicability of an MPS Function may span a smaller range of unit operational conditions for one associated RPS or ESFAS Function, the Actuation Function with the broadest applicability determines the limiting applicability for the MPS instrumentation Function.

The staff verified that the applicability of each LCO-required support system bounds the LCO applicability of all of its LCO-required supported systems.

Conclusion for GTS Chapter 3 LCO Applicability Statements

Based on its review, the staff finds that the LCO applicability statements are acceptable.

16.4.7 Action Requirements (GTS Chapter 3, Sections 3.1 through 3.8)

The staff reviewed the Actions table for each LCO subsection to determine whether the action requirements (Actions) are appropriate for the safety significance of each Condition where the associated LCO is not met.

For each LCO requiring operability of redundant trains of a safety system, the staff verified that the Actions table includes (1) a Condition for one train inoperable (loss of redundancy) with a Required Action (or, in some cases, an implied Required Action) to restore the affected train to operable status within an appropriate associated Completion Time and (2) a Condition for failure to meet the Required Action and associated Completion Time with Required Actions to place the unit in a Mode in which meeting the LCO is not required. An Actions table of an LCO for a safety system may also include alternative Required Actions, which if completed, would allow unit operation to continue indefinitely in a loss of redundancy Condition. The staff assessed such Required Actions for whether they provide an equivalent level of safety to that provided by meeting the LCO. An Actions table of an LCO for a safety system may also include a Condition for both redundant trains being inoperable (loss of function); in such cases, the staff verified that the Completion Times of the Required Actions for unit shutdown are consistent with the times allowed for unit shutdown by LCO 3.0.3.

For each LCO that requires staying within limits specified for a unit process variable, such as SDM, core reactivity, moderator temperature coefficient, CRA position alignment deviation, core power distribution, RCS pressure and temperatures, pressurizer water level, UHS water level and bulk average temperature, and UHS boron concentration, the staff verified that the Actions table includes (1) an appropriate Condition for each variable outside its specified limits, with a Required Action to restore the variable to within limits within an appropriate associated Completion Time, and (2) a Condition for failure to meet the Required Action and associated Completion Time with Required Actions to place the unit in a Mode in which meeting the LCO is not required.

It is possible that some LCO Subsections have an Actions table with Conditions and Required Actions for a unit status not captured by the kinds of LCOs described above. The following is an example of such a Condition (and the Completion Time to restore redundancy or to complete another remedial action):

- LCO 3.1.7 Condition C. One or more control rod drive mechanisms (CRDMs) with inoperable position indicators have been moved in excess of 6 steps in one direction since the last determination of the CRA's position. (Verify position of affected CRAs by using the module control system within 4 hours.)

It is also possible that some LCO subsections include Surveillances for which it is unclear how meeting the Surveillance supports meeting the LCO. In such cases, the Actions table may need to include a Condition for when the Surveillance is not met. Some LCOs specify that a particular subsystem or component be in operation, or in a standby configuration, in addition to being operable; such an LCO subsection may have an Actions table with a Condition addressing when the subsystem or component is not in operation with appropriate Required Actions to restore operation, or other measures to compensate for the out-of-operation system or component, including a unit shutdown. The following is an example of such a Condition (and the Completion Time to restore redundancy or to complete another remedial action):

- LCO 3.1.7 Condition D. CRA counter position indicator inoperable for one or more CRAs. (Verify by administrative means the operability of all rod position indicators for affected shutdown bank and regulating bank CRA groups once per 8 hours and verify the most withdrawn CRA and least withdrawn CRA of the affected groups are less than or equal to 6 steps apart once per 8 hours.)

The staff also reviewed the Actions table of each LCO to ascertain consistency with the use and application rules of GTS Sections 1.2, 1.3, and 3.0.

16.4.7.1 Conditions for a Loss of Redundancy

The staff reviewed the Chapter 3 Actions Conditions, in Revision 2 of DCA Part 4, that involve a loss of protection from a single active failure (i.e., a loss of system functional redundancy). In most instances, 72 hours are allowed to restore redundancy, which is consistent with STS. These Conditions (and the Completion Time to restore redundancy or to complete another remedial action) are as follows:

- LCO 3.1.7 Condition A. One [rod position indication (RPI)] per CRDM inoperable for one or more CRDMs. (Verify affected CRA position with [Module Control System (MCS)] once per 8 hours.)

- LCO 3.1.9 Condition A. One CVCS demineralized water isolation valve inoperable. (72 hours)

- LCO 3.3.1 Condition A. One or more Functions with one channel inoperable. (6 hours to place channel in trip or bypass)

  Condition B. One or more Functions with two channels inoperable. (6 hours to place one inoperable channel in trip and the other inoperable channel in bypass)

•	LCO 3.3.2	Condition A.	One reactor trip breaker (RTB) inoperable. (48 hours to open or restore RTB)
		Condition B.	One division of RTS Logic and Actuation inoperable. (6 hours to restore division to operable status)
•	LCO 3.3.3	Condition A.	LTOP Actuation Function with *one* or both Logic and Actuation divisions inoperable. (Open two RVVs within 1 hour.)
		Condition B.	One or more Actuation Functions, other than the LTOP Actuation Function, with one ESFAS Logic and Actuation division inoperable. (Enter the Condition Referenced in Table 3.3.3-1 for affected actuation Function within 6 hours.)
	ECCS, DHRS, SSI	Condition C(1)	As required by Required Action B.1 and referenced in Table 3.3.3-1. (Be in Mode 2 in 6 hours; and Mode 3 and Passively Cooled within 36 hours.)
	CIS	Condition D(1)	As required by Required Action B.1 and referenced in Table 3.3.3-1. (Be in Mode 3 with containment isolated within 48 hours.)
	DWSI	Condition E(1)	As required by Required Action B.1 and referenced in Table 3.3.3-1. (Isolate the dilution source flow paths in the CVCS makeup line within 1 hour.)
	CVCSI	Condition F(1)	As required by Required Action B.1 and referenced in Table 3.3.3-1. (Isolate the flow paths between the CVCS and the RCS within 1 hour.)
	PHT	Condition G(1)	As required by Required Action B.1 and referenced in Table 3.3.3-1. (Open pressurizer heater breakers within 6 hours.)

The staff notes that the Actions for one inoperable division of ESFAS Logic and Actuation are the same as the Actions for two inoperable divisions, except that entry into the referenced Condition for the affected ESFAS Logic and Actuation Function is required within 6 hours instead of immediately.

•	LCO 3.3.4	Condition A.	One or more Functions with one manual actuation division inoperable. (Enter the Condition referenced in Table 3.3.4-1 for the affected Function within 48 hours.)
	RTS	Condition C	As required by Required Action A.1 or B.1 and referenced in Table 3.3.4-1. (Immediately open RTBs.)
	ECCS,	Condition D	As required by Required Action A.1 or B.1 and

DHRS, SSI		referenced in Table 3.3.4-1. (Be in Mode 2 within 24 hours; be in Mode 3 and Passively Cooled within 72 hours.)
DWSI	Condition E	As required by Required Action A.1 or B.1 and referenced in Table 3.3.4-1. (Isolate dilution source flow paths in the CVCS makeup line within 1 hour.)
CVCSI	Condition F	As required by Required Action A.1 or B.1 and referenced in Table 3.3.4-1. (Isolate the flow paths between the CVCS and the RCS within 1 hour.)
PHT	Condition G	As required by Required Action A.1 or B.1 and referenced in Table 3.3.4-1. (Open pressurizer heater breakers within 24 hours.)
LTOP	Condition H	As required by Required Action A.1 or B.1 and referenced in Table 3.3.4-1. (Immediately open two RVVs.)
CIS	Condition I	As required by Required Action A.1 or B.1 and referenced in Table 3.3.4-1. (Be in Mode 3 with containment isolated within 48 hours.)

The staff notes that the Actions for one inoperable division are the same as the Actions for two inoperable divisions, except that entry into the referenced Condition for the affected Manual Actuation Function is required within 48 hours instead of 6 hours. In addition, compared to the Required Action Completion Times of LCO 3.3.3, the corresponding Completion Times for the Manual Actuation Functions are significantly longer. By a letter dated September 14, 2017 (ADAMS Accession No. ML17257A450), the applicant provided the rationale for the time differences to achieve similar shutdown conditions in Mode 3 for Containment Isolation and Manual Actuation Functions compared to the other automatic RTS and ESFAS Functions. SER Section 16.4.4.1, “LCO Use and Applicability,” under the discussion of LCO 3.0.3, gives the staff’s evaluation of this rationale. Further, SER Section 16.4.7.6, “Shutdown Required Actions and Completion Times,” provides additional discussion about relaxing shutdown action Completion Times for specified systems of lesser safety significance. These SER sections provide the staff’s rationale for finding the applicant’s proposed action requirements acceptable and concluding that the shutdown action Completion Times are acceptable.

• LCO 3.4.4	Condition A.	One RSV inoperable. (72 hours)
• LCO 3.4.6	Condition A.	One or more CVCS flow paths with one CVCS valve inoperable. (Isolate the affected CVCS flow path within 72 hours AND Verify the affected CVCS flow path is isolated once per 31 days.)
• LCO 3.4.7	Condition A.	One or more required leakage detection instrumentation methods with one required channel inoperable. (Perform SR 3.4.5.1 (RCS water inventory

balance) once per 24 hours AND Restore required channel(s) to operable status within 14 days.)

		Condition B.	One required leakage detection instrumentation method with all required channels inoperable. (Restore one channel of affected required leakage detection instrumentation method to operable status within 72 hours.)
•	LCO 3.4.10	Condition A.	One closed RVV inoperable. (Within 72 hours, either restore RVV to operable status or open the inoperable RVV.)
•	LCO 3.5.1	Condition A.	One RVV inoperable. (Within 72 hours, restore RVV to operable status.)
		Condition B.	One RRV inoperable. (Within 72 hours, restore RRV to operable status.)
•	LCO 3.5.2	Condition A.	One DHRS loop inoperable. (Within 72 hours, restore DHRS loop to operable status.)
•	LCO 3.6.2	Condition A.	*One* or more penetration flow paths with one containment isolation valve inoperable. (Isolate the affected penetration flow path within 72 hours AND Verify the affected penetration flow path is isolated once per 31 days.)
•	LCO 3.7.1	Condition A.	*One* or more [main steam isolation] valves inoperable. (Isolate affected [main steam line] flow path within 72 hours AND Verify affected flow path is isolated once per 7 days.)

By letter dated December 12, 2018 (ADAMS Accession No. ML18347A619), the applicant revised the Actions of Subsection 3.7.1 to more clearly reflect the NuScale design and assure that the LCO requirements are consistent with the main steam system description in DCA Part 2, Tier 2, the credited function, and the writer's guide. The applicant clarified that each of the two mainsteam lines contain a safety-related isolation valve and isolation bypass valve in parallel upstream of the module steamline disconnect, and a non-safety-related isolation valve and isolation bypass valve in parallel downstream of the module steamline disconnect. Each valve is considered to be in its own flow path. Isolation of a main steamline requires closure of at least one of the two pairs of isolation valves in the steamline. Conditions A and B were combined into new Condition A:[5]

[5] The following statement of Condition A comes from DCA Revision 3 and includes a change made after the December 12, 2018 letter.

Condition A. -------------------------NOTE---------------------
Separate Condition entry is allowed for each valve.

One or more valves inoperable.

The Actions table Note 1, in DCA, Revision 2, was moved to Condition A, as shown above; Actions table Note 2 ("Main steam line flow paths may be unisolated intermittently under administrative controls.") remains as a table note with its enumeration removed. Removing the designators "main steam isolation" and "MSIV bypass" is acceptable because the meaning of the revised Condition A remains clear; therefore, Condition A is acceptable.

Condition C was relabeled Condition B, and was changed to state the following:

Condition B. Steam line that cannot be isolated.

The staff finds that only allowing a separate Condition entry for new Condition A is appropriate, since new Condition B (Condition C as revised and relabeled) would require a unit shutdown if one valve in each pair of valves in a steamline cannot be isolated automatically, and the associated, affected flow path cannot be isolated "by use of at least one closed and de-activated automatic valve, manual valve, or blind flange." The staff concludes that revised Conditions A and B are acceptable because they adequately account for (1) having up to all eight steamline isolation valves inoperable, and (2) an inability to isolate a valve in each pair of valves on one or both steam lines.

The staff reviewed the applicant's proposed changes to the Background, LCO, Applicability, and Actions sections of Bases Subsection B 3.7.1 and found they are consistent with the revised Actions table.

- LCO 3.7.2 Condition A. *One* or two FWIVs inoperable. (Isolate the affected FWIV flow path within 72 hours <u>AND</u> Verify FWIV [flow] path [is] isolated once per 7 days.)

  (Actions table Note 1, "Separate Condition entry is allowed for each valve.")

  Condition B. *One* or two FWRVs inoperable. (Isolate the affected FWRV flow path within 72 hours <u>AND</u> Verify FWRV [flow] path [is] isolated once per 7 days.)

  (Actions table Note 1, "Separate Condition entry is allowed for each valve.")

- LCO 3.8.1 Condition A. *One required refueling neutron flux channel inoperable. <u>OR</u> Required refueling neutron flux audible count rate channel inoperable*. (Immediately suspend positive reactivity changes and suspend operations that would cause introduction of water into UHS with boron concentration less than specified in the COLR.)

Conclusion for Loss of Redundancy Conditions

The staff finds that the restoration actions and remedial actions, and the associated Completion Times for the loss of redundancy Conditions, are appropriate for the NuScale design, provide an adequate level of safety during operation within each Condition, and are consistent with STS. Therefore, the staff concludes that these Actions are acceptable.

16.4.7.2 Conditions for When a Required Action and Associated Completion Time Are Not Met

The staff reviewed the Chapter 3 Actions Conditions, in Revision 3 of DCA Part 4, that require a unit shutdown from MODE 1 above 25-percent RTP (25% RTP) whenever a Required Action for another entered Condition of the LCO subsection is not met within the associated Completion Time. In a few instances, the initially entered Condition specifies an Action to exit the applicability (e.g., LCO 3.1.4 Required Action A.2). Table 16.4.7-1 of this SER summarizes the default Required Actions and Completion Times, in Revision 3 of DCA Part 4, to facilitate comparison of times to reach different RCS temperatures in Mode 3 based on the affected systems, parameter limits, and instrumentation functions, and their relative importance to safety.

<u>Actions To Isolate Flow Paths between the CVCS and the RCS and Reactor Coolant Boron Concentration Dilution Source Flow Paths in the CVCS Makeup Line</u>

In DCA Revision 2, the various Required Actions to isolate the demineralized water source to the CVCS makeup pumps were phrased in a variety of ways; using DCA Revision 3 enumeration, these Actions were LCO 3.1.9 Action B; LCO 3.3.1 Actions F, H, and L; LCO 3.3.3 Actions E and F; and LCO 3.3.4 Actions E and F. DCA Revision 3 states these requirements as follows:

LCO 3.1.9 Required Action DWSI B.1

------------------------------NOTE------------------------------
Flow paths may be unisolated intermittently under administrative controls.

Isolate dilution source flow paths in the CVCS makeup line by use of at least one closed manual or one closed and de-activated automatic valve. | 1 hour

LCO 3.3.1 Required Action CVCSI F.1

------------------------------NOTE------------------------------
Flow paths may be unisolated intermittently under administrative controls.

Isolate the flow paths between the CVCS and the Reactor Coolant System by use of at least one closed manual or one closed and deactivated automatic valve. | 6 hours

DWSI H.1 Isolate dilution source flow paths in the CVCS makeup line by use of at least one closed manual or one closed and deactivated automatic valve. | 1 hour

DWSI L.4 Isolate dilution source flow paths in the CVCS makeup line by use of at least one closed manual or one closed and deactivated automatic valve. | 96 hours

LCO 3.3.3 Required Action DWSI E.1
------------------------------NOTE-------------------------------
Flow paths may be unisolated intermittently under administrative controls.

Isolate dilution source flow paths in the CVCS makeup line by use of at least one closed manual or one closed and deactivated automatic valve. | 1 hour

Required Action CVCSI F.1
------------------------------NOTE-------------------------------
Flow paths may be unisolated intermittently under administrative controls.

Isolate the flow paths between the CVCS and the Reactor Coolant System by use of at least one closed manual or one closed and deactivated automatic valve. | 1 hour

LCO 3.3.4 Required Action DWSI E.1
------------------------------NOTE-------------------------------
Flow paths may be unisolated intermittently under administrative controls.

Isolate dilution source flow paths in the CVCS makeup line by use of at least one closed manual or one closed and deactivated automatic valve. | 1 hour

Required Action CVCSI F.1
------------------------------NOTE-------------------------------
Flow paths may be unisolated intermittently under administrative controls.

Isolate the flow paths between the CVCS and the Reactor Coolant System by use of at least one closed manual or one closed and deactivated automatic valve. | 1 hour

The staff finds that the revised phrasing of the above action statements achieved consistency among the listed action statements and associated Notes, as requested by the staff. These remedial actions to isolate CVCS flow paths and the associated Completion Times for the Conditions where automatic and manual Functions for isolating the CVCS flow paths are inoperable are appropriate for the NuScale design, provide an adequate level of safety during operation within each Condition, and are consistent with STS.

The staff notes that LCO 3.1.9, “Boron Dilution Control,” Action B, requires isolating the dilution source, which completes the safety function of the DWSI makeup isolation valves. The applicant revised the Applicability of LCO 3.1.9 to state, “MODES 1, 2, and 3 with any dilution source flow path in the CVCS makeup line not isolated." The staff finds this is acceptable because with the underlined phrase, the Applicability more accurately captures the conditions requiring the operability of the DWSI makeup isolation valves.

In DCA Revision 2, Required Action E.1 of LCO 3.3.1 stated, "Reduce THERMAL POWER to below the N-2L interlock. | 6 hours"; this Action applies to the following MPS Functions that are applicable in Mode 1 with power above the N-2H interlock (operating bypass not active) according to Footnote (b) of Table 3.3.1-1:

2.a RTS on High Power Range Positive and Negative Rate
17.a RTS on Low Main Steam Pressure
17.c SSI on Low Main Steam Pressure

The staff notes that, to be consistent, Required Action E.1 should say N-2H instead of N-2L. In DCA Revision 3, the applicant changed Required Action E.1 to say, "Reduce Thermal Power to below the N-2H interlock." This is appropriate because N-2H automatically bypasses the above-listed MPS instrument Functions below 15-percent RTP.

Based on its review and evaluation of Required Actions and associated Completion Times for Conditions in which a Required Action and associated Completion Time are not met, which are summarized below in SER Table 16.4.7-1, and because these Actions are appropriate for the NuScale design and consistent with Actions for equivalent Conditions in the W-STS, the staff concludes that the GTS Actions are acceptable.

Table 16.4.7-1 Default Shutdown Action Completion Times

LCO ACTION	Be in Mode 1 below 25% RTP	Be in Mode 1 below 15% RTP (< N-2H)	Be in Mode 1 with k_{eff} < 1.0	Open **all reactor trip breakers *Open pressurizer heater breakers	Be in Mode 2 *Open 2 reactor vent valves **with T_{hot} < 246°C (475 °F) (< T-6)	Be in Mode 3 and Passively Cooled	Be in Mode 3 with T_{hot} < 93.3 °C (200 °F) *with T_{cold} < 163 °C (325 °F) (< T-1)	Be in Mode 3 with all RCS temperatures < 93.3 °C (200 °F)	Be in Mode 3 with T_{hot} < 93.3 °C (200 °F) (< T-2) *with T_{hot} < 177 °C (350 °F) (< T-3)	Isolate flow path (1) CVCS makeup line dilution source; (2) Between CVCS and RCS.
LCO 3.0.3					7 hours	37 hours				
3.1.2 Action B					6 hours					
3.1.3 Action B					6 hours			48 hours		
3.1.4 Action A					6 hours					
3.1.5 Action B					6 hours					
3.1.6 Action B			6 hours							
3.1.7 Action E					6 hours					
3.1.9 Action B										(1) 1 hour
3.2.1 Action A	6 hours									
3.2.2 Action A	6 hours									
3.3.1 Actions C&**D** for RTS Functions 1a, 3a, 4a, 5a, 7a, 8a, 9a, 10a, 11a, 13a, 15a, 16a, 18a, 19a, 20a, 21a				6 hours						
3.3.1 Actions C&**E** for RTS Functions 2a, 17a		6 hours								
3.3.1 Actions C&**E** for SSI Function 17c		6 hours								

LCO ACTION	Be in Mode 1 below 25% RTP	Be in Mode 1 below 15% RTP (< N-2H)	Be in Mode 1 with k_{eff} < 1.0	Open **all reactor trip breakers *Open pressurizer heater breakers	Be in Mode 2 *Open 2 reactor vent valves **with T_{hot} < 246°C (475 °F) (< T-6)	Be in Mode 3 and Passively Cooled	Be in Mode 3 with T_{hot} < 93.3 °C (200 °F) *with T_{cold} < 163 °C (325 °F) (< T-1)	Be in Mode 3 with all RCS temperatures < 93.3 °C (200 °F)	Be in Mode 3 with T_{hot} < 93.3 °C (200 °F) (< T-2) *with T_{hot} < 177 °C (350 °F) (< T-3)	Isolate flow path (1) CVCS makeup line dilution source; (2) Between CVCS and RCS.
3.3.1 Actions C&**F** for CVCSI Functions 9b, 10b, 12b, 15b, 21c, 25d, 26c										(2) 6 hours
3.3.1 Actions C&**G** for PHT Functions 7c, 11b, 13c, 16c				* 6 hours						
3.3.1 Actions C&**H** for DWSI Functions 1b, 2b, 3b, 4b, 5b, 6a, 7d, 8b, 9c, 10c, 11c, 13d, 14a, 15c, 16d, 17b, 18b, 19b, 20b, 21d										(1) 1 hour
3.3.1 Actions C&**I** for ECCS Function 22a, DHRS Functions 7b, 13b, 16b, SSI Functions 7e, 9d, 12c, 13e, 16e, 18c, 19c, 20c, 21e					6 hours	36 hours				
3.3.1 Actions C&**J** for LTOP Function 24a					* 1 hour					
3.3.1 Actions C&**K** for CIS Function 12a					6 hours				48 hours	
3.3.1 Actions C&**L** for RTS Functions 25a, 26a					L.1 72 hours	L.2 96 hours				
3.3.1 Actions C&**L** for DHRS Function 25b					L.1 72 hours	L.2 96 hours				
3.3.1 Actions C&**L** for CIS Functions 25c, 26b					L.1 72 hours	L.2 96 hours			L.3 96 hours	
3.3.1 Actions C&**L** for DWSI Functions 25e, 26d					L.1 72 hours					L.4 (1) 96 hours
3.3.1 Actions C&**L** for PHT Function 25f				L.5 *96 hours	L.1 72 hours					
3.3.1 Actions C&**L** for SSI Function 25g					L.1 72 hours	L.2 96 hours			L.3 96 hours	
3.3.1 Actions C&**M** for CIS Function 21b					6 hours				*48 hours	
3.3.1 Actions C&**N** for ECCS Function 23a					**6 hours					
3.3.2 Action C				**Imme-diately						
3.3.3 Actions B&**C** for Functions 1. ECCS 2. DHRS 8. SSI					6 hours	36 hours				
3.3.3 Actions B&**D** for Function 3. CIS								48 hours Note 1		

LCO ACTION	Be in Mode 1 below 25% RTP	Be in Mode 1 below 15% RTP (< N-2H)	Be in Mode 1 with k_{eff} < 1.0	Open **all reactor trip breakers *Open pressurizer heater breakers	Be in Mode 2 *Open 2 reactor vent valves **with T_{hot} < 246°C (475 °F) (< T-6)	Be in Mode 3 and Passively Cooled	Be in Mode 3 with T_{hot} < 93.3 °C (200 °F) *with T_{cold} < 163 °C (325 °F) (< T-1)	Be in Mode 3 with all RCS temperatures < 93.3 °C (200 °F)	Be in Mode 3 with T_{hot} < 93.3 °C (200 °F) (< T-2) *with T_{hot} < 177 °C (350 °F) (< T-3)	Isolate flow path (1) CVCS makeup line dilution source; (2) Between CVCS and RCS.
3.3.3 Actions B&**E** for Function 4. DWSI										(1) 1 hour
3.3.3 Actions B&**F** for Function 5. CVCSI										(2) 1 hour
3.3.3 Actions B&**G** for Function 6. PHT				*6 hours						
3.3.4 Action **C** for Manual Function 1. RTS				Imme-diately						
3.3.4 Action **D** for Manual Functions 2. ECCS 3. DHRS 9. SSI					24 hours	72 hours				
3.3.4 Action **E** for Manual Function 5. DWSI										(1) 1 hour
3.3.4 Action **F** for Manual Function 6. CVCSI										(2) 1 hour
3.3.4 Action **G** for Manual Function 7. PHT				*24 hours						
3.3.4 Action **H** for Manual Function 8. LTOP					* Imme-diately					
3.3.4 Action **I** for Manual Function 4. CIS								48 hours Note 1		
3.3.5 Action B					6 hours	36 hours				
3.4.1 Action C					6 hours					
3.4.2 Action A					30 min					
3.4.3 Action B					6 hours	36 hours Note 2				
3.4.3 Action D					Imme-diately	36 hours Note 3				
3.4.4 Action B					6 hours		*36 hours Note 4			
3.4.5 Action B					6 hours		48 hours			
3.4.6 Action C					6 hours		48 hours			
3.4.7 Action C					6 hours		48 hours			
3.4.8 Action C					6 hours	36 hours				
3.4.9 Action B					6 hours	36 hours				
3.5.1 Action C					6 hours	36 hours				
3.5.2 Action B					6 hours	36 hours				
3.5.3 Action D					6 hours	36 hours				
3.6.1 Action B					6 hours		48 hours			
3.6.2 Action C					6 hours		48 hours			
3.7.1 Action C					6 hours	36 hours				

LCO ACTION	Be in Mode 1 below 25% RTP	Be in Mode 1 below 15% RTP (< N-2H)	Be in Mode 1 with k_{eff} < 1.0	Open **all reactor trip breakers *Open pressurizer heater breakers	Be in Mode 2 *Open 2 reactor vent valves **with T_{hot} < 246°C (475 °F) (< T-6)	Be in Mode 3 and Passively Cooled	Be in Mode 3 with T_{hot} < 93.3 °C (200 °F) *with T_{cold} < 163 °C (325 °F) (< T-1)	Be in Mode 3 with all RCS temperatures < 93.3 °C (200 °F)	Be in Mode 3 with T_{hot} < 93.3 °C (200 °F) (< T-2) *with T_{hot} < 177 °C (350 °F) (< T-3)	Isolate flow path (1) CVCS makeup line dilution source; (2) Between CVCS and RCS.
3.7.2 Action D					6 hours	36 hours				
3.7.3 Action A					6 hours	36 hours				

Note 1: The applicability of CIS and SSI in 3.3.3 and 3.3.4 is MODES 1, 2, and 3. For CIS, 3.3.3 Required Action D.1 and 3.3.4 Required Action I.1 say, "Be in Mode 3 with containment isolated."

Note 2: Required Action B.2 of LCO 3.4.3 says, "Be in MODE 3 with RCS pressure < 500 psia [3,450 kPa (absolute)]."

Note 3: Required Action D.2 of LCO 3.4.3 says, "Be in MODE 3 with RCS temperature less than or equal to the containment flooding RCS temperature limit allowed by the PTLR."

Note 4: Required Action B.2 of LCO 3.4.4 says, "Be in MODE 3 with RCS cold temperature below LTOP enable interlock T-1 temperature."

16.4.7.3 Conditions for a Loss of Function

The staff reviewed the Chapter 3 Actions Conditions, in Revision 2 of DCA Part 4, that involve a loss of function caused by all redundant trains of a system being inoperable, or because fewer than the minimum number of trains needed to perform the system function are operable. In most cases, the associated Required Actions and Completion Times are identical to those listed in SER Table 16.4.7-1 in SER Section 16.4.7.2. In the following quotations of Condition statements, for statements that address both loss of redundancy and loss of function, italics are used to emphasize the portion of the statement corresponding to a loss of function condition. In a few cases, the associated required actions and completion times are summarized in parentheses, as well as in SER Table 16.4.7-1.

A. One or more of a set of nonredundant but identical components inoperable

- LCO 3.1.4 Condition A(1). One *or more* CRAs inoperable. (Verify SDM to be within COLR limits or initiate boration within 1 hour and be in Mode 2 in 6 hours.)

- LCO 3.4.9 Condition A. One *or more* SG tubes satisfying the tube plugging criteria and not plugged in accordance with the Steam Generator Program. (Verify tube integrity of the affected tube(s) is maintained until the next refueling outage or SG tube inspection within 7 days and plug the affected tube(s) in accordance with the Steam Generator Program prior to entering MODE 3 following the next refueling outage or SG tube inspection.)

  Condition B(2). SG tube integrity not maintained. (SER Table 16.4.7-1 gives the associated Required Actions and Completion Times.)

B. Redundant trains of a two-train system inoperable, or more than two of four channels inoperable, two of two divisions inoperable, or the single train of a one-train system is inoperable

- LCO 3.1.7 Condition B. *More than one* RPI per CRDM inoperable. (Place affected CRA under manual control immediately; verify position of affected CRA using in-core neutron detectors once per 8 hours; and restore at least one rod position indicator on each CRA within 24 hours.)

- LCO 3.1.9 Condition B(2). *Two* CVCS demineralized water isolation valves inoperable.

- LCO 3.3.1 Condition C(2). One or more Functions with *three or more channels inoperable*. (Immediately enter Condition referenced in Table 3.3.1-1 for the channel(s). SER Table 16.4.7-1 gives the associated Required Actions and Completion Times.)

- LCO 3.3.2 Condition C(2). Both divisions of RTS Logic and Actuation inoperable. (Immediately open all RTBs.)

  Condition C(3). More than one RTB inoperable. (Immediately open all RTBs.)

- LCO 3.3.3 Condition A. LTOP actuation Function with one *or both* Logic and Actuation divisions inoperable. (Open two RVVs within 1 hour.)

The staff verified that Revision 2 of DCA Part 2, Tier 2, Section 3.9.1.1.2, Service Level B Conditions, describes the cold overpressure protection transient under the heading "Service Level B Transient 11—Cold Overpressure Protection Transient." DCA Part 2, Tier 2, Table 3.9-1, also lists this transient. In addition, Revision 2 of DCA Part 2, Tier 2, Section 5.2.2.2.2, states the following:

> The spurious actuation of the pressurizer heaters is the limiting RCS cold overpressurization event. ... The analysis results indicate the peak pressure remains below the brittle fracture stress limit.

Revision 2 of DCA Part 2, Tier 2, Section 5.2.2.4.2, states the following:

> The inadvertent actuation block arming setpoint is above the limiting RPV pressure at LTOP conditions and, as such, will not prevent LTOP actuation of the RVVs when LTOP enabling setpoint is reached. ... Three RVVs, associated actuators, and controls ensure LTOP protection is maintained assuming a single active component failure. The RVVs are designed with sufficient pressure relief capacity to accommodate the most limiting single active failure assuming the most limiting allowable operating condition and system configuration.

The staff concludes from the above passages that the automatic opening of two RVVs at the LTOP actuation pressurizer pressure setting (which is a function of RCS cold temperature) will limit RCS peak pressure to below the low temperature pressure limit for the limiting RCS cold overpressurization event. Since the containment vessel is designed to accommodate the pressure transient of this limiting event, the action requirement for manually opening two RVVs when the LTOP automatic actuation capability is inoperable is acceptable.

- LCO 3.3.3 Condition C(2). Both divisions of ECCS Actuation Function inoperable. (Be in Mode 2 in 6 hours and Mode 3 and Passively Cooled within 36 hours)

  Condition C(3). Both divisions of DHRS Actuation Function inoperable. (Be in Mode 2 in 6 hours and Mode 3 and Passively Cooled within 36 hours)

  Condition C(4). Both divisions of SSI Actuation Function inoperable. (Be in Mode 2 in 6 hours and Mode 3 and Passively Cooled within 36 hours)

  Condition D(2). Both divisions of Containment Isolation Actuation Function inoperable. (Be in Mode 3 with containment isolated within 48 hours)

  Condition E(2). Both divisions of Demineralized Water Supply Isolation Actuation Function inoperable. (Isolate the dilution source flow path in CVCS makeup line within 1 hour.)

  Condition F(2). Both divisions of CVCS Isolation Actuation Function inoperable. (Isolate the flow paths between the CVCS and the RCS within 1 hour.)

  Condition G(2). Both divisions of Pressurizer Heater Trip Actuation Function inoperable. (Open pressurizer heater breakers within 6 hours.)

- LCO 3.3.4 Condition B. One or more Functions with two manual actuation divisions inoperable. (Enter the Condition referenced in Table 3.3.4-1 for the affected Function within 6 hours.)

  The staff notes that the Actions for two inoperable manual actuation divisions are the same as the Actions for one inoperable manual actuation division, except that entry into the referenced Condition for the affected manual actuation function is required within 6 hours instead of 48 hours.

- LCO 3.3.5 Condition A. Instrumentation in the [Remote Shutdown Station (RSS)] inoperable.

- LCO 3.4.4 Condition B(2). Two RSVs inoperable.

- LCO 3.4.6 Condition B. One or more CVCS flow paths with two CVCS valves inoperable.

- LCO 3.4.7 Condition C(2). Two required leakage detection instrumentation methods with all required channels inoperable.

- LCO 3.4.10 Condition B. Two closed RVVs inoperable. (Restore two closed RVVs to operable status or open two RVVs within 4 hours.)

  Condition C. Three closed RVVs inoperable. (Within 2 hours initiate action to depressurize RCS and open two RVVs.)

  SER Section 16.4.5 provides additional discussion of GTS Subsection 3.4.10.

- LCO 3.5.1 Condition C(2). Two or more RVVs inoperable. (Be in Mode 2 within 6 hours and in Mode 3 and Passively Cooled within 36 hours.)

  Condition C(3). Two RRVs inoperable. (Be in Mode 2 within 6 hours and in Mode 3 and Passively Cooled within 36 hours.)

- LCO 3.5.2 Condition B(2). Both DHRS loops inoperable. (Be in Mode 2 within 6 hours and in Mode 3 and Passively Cooled within 36 hours.)

- LCO 3.6.1 Condition A. Containment inoperable. (Restore containment to OPERABLE status within 1 hour.)

- LCO 3.6.2 Condition B. One or more penetration flow paths with two containment isolation valves inoperable. (Isolate the affected penetration flow path within 1 hour.)

- LCO 3.7.1 Condition A.

  -------------------------NOTE---------------------
  Separate Condition entry is allowed for each valve.

  One *or more* valves inoperable.
  (72 hours to isolate affected [main steam line] flow path or restore MSIV, and verify flow path isolated once per 7 days)

  Condition B. Steamline that cannot be isolated. (Isolate affected main steamline within 8 hours.)

- LCO 3.7.2 Condition A. One or two FWIVs inoperable. (72 hours to isolate FWIV flow path and verify FWIV [flow] path isolated once per 7 days.) (Note, separate Condition entry allowed for each valve.)

  Condition B. One or two FWRVs inoperable. (72 hours to isolate FWRV flow path and verify FWRV [flow] path isolated once per 7 days.) (Note, separate Condition entry allowed for each valve.)

Note that, as long as one isolation valve in each feedwater flow path remains operable for closing, the situation is a loss of redundancy, not a loss of function. SER Section 10.4 provides the staff's evaluation of the suitability of the FWRVs to function as backup FWIVs.

	Condition C.	Two valves in the same flow path inoperable. (8 hours to isolate affected [feedwater (FW)] flow path or restore one of the affected valves.)

- LCO 3.8.1 Condition B. Two required refueling neutron flux channels inoperable. (Immediately initiate action to restore one channel to operable status and verify UHS bulk average boron concentration is within limits once per 12 hours.)

Based on its review and evaluation of Required Actions and associated Completion Times for Conditions in which a loss of function exists, and because these Actions are appropriate for the NuScale design and consistent with Actions for equivalent Conditions in the W-STS, the staff concludes that the GTS Actions are acceptable.

16.4.7.4 Actions Notes Allowing Separate Condition Entry

Whenever a system contains two or more identical subsystems, which function independently of each other, and the system's LCO Actions table includes a Note allowing separate Condition entry for each subsystem, the control room operator may track a separate Completion Time for each subsystem, if they are concurrently inoperable. The Actions table Note defines the basis for separate Condition entry. Guidance for applying such an Actions table Note is provided in Section 1.3 by Example 1.3-5. The GTS includes the following Actions table Notes.

- LCO 3.1.7 Separate Condition entry is allowed for each CRDS rod position indicator and each CRA counter position indicator.
- LCO 3.3.1 (Note 1) Separate Condition entry is allowed for each [MPS instrumentation] Function.

  (Note 2) Separate Condition entry is allowed for each steam generator for Functions 16, 17, 18, 19, and 20.

  (Note 3) Separate Condition entry is allowed for each ELVS battery charger of Function 24.
- LCO 3.3.3 Separate Condition entry is allowed for each [ESFAS Logic and Actuation] Function.
- LCO 3.3.4 Separate Condition entry is allowed for each [RTS and ESF Manual Actuation] Function.
- LCO 3.4.6 (Note 2) Separate Condition entry is allowed for each [CVCS] flow path.
- LCO 3.4.7 Separate Condition entry is allowed for each [containment evacuation system (CES)] condensate channel and each [CES inlet] pressure channel.

- LCO 3.4.9 Separate Condition entry is allowed for each SG tube.
- LCO 3.6.2 (Note 2) Separate Condition entry is allowed for each [containment vessel] penetration flow path.
- LCO 3.7.1 (Condition A) Separate Condition entry is allowed for each [main steam isolation valve (MSIV) and each MSIV bypass] valve.
- LCO 3.7.2 (Note 1) Separate Condition entry is allowed for each [feedwater isolation valve (FWIV) and each feedwater regulation] valve [(FWRV)].

The staff finds that the above Actions Notes are appropriate because the basis for each separate Condition entry involves a set of independent components, Functions, valves, flow paths, or channels consistent with the W-STS. Therefore, the staff concludes that these Actions Notes that allow separate Condition entry are acceptable.

16.4.7.5 Conditions for Process Variable Outside Limits

When an LCO limit on a process variable is not met, the Actions specify a Completion Time to restore the variable to within limits. Such Actions are provided for the following Conditions, and the Completion Time to restore the variable within limits, or other remedial action, is also provided:

- LCO 3.1.1 Condition A. SDM not within limits. (15 minutes)
- LCO 3.1.2 Condition A. Core reactivity balance not within limit. (7 days)
- LCO 3.1.3 Condition A. [Moderator Temperature Coefficient (MTC)] not within limits. (Be in Mode 2 within 6 hours)

  Condition B. MTC not within lower limit. (Be in MODE 3 with all RCS temperatures < 93.3 °C (200 °F) within 48 hours)
- LCO 3.1.4 Condition A(2). One or more CRAs not within alignment limits. (Verify SDM within limits or initiate boration within 1 hour, and be in Mode 2 within 6 hours)
- LCO 3.1.5 Condition A. One or more shutdown [bank] groups not within insertion limits. (Verify SDM within limits or initiate boration within 1 hour, and restore shutdown [bank] groups to within limits within 2 hours)
- LCO 3.1.6 Condition A. One or more regulating [bank] groups not within insertion limits. (Verify SDM within limits or initiate boration within 1 hour, and restore regulating [bank] groups to within limits within 2 hours)
- LCO 3.1.9 Condition B(3). Boric Acid supply boron concentration not within limits. (Isolate dilution source flow paths in the CVCS makeup line... within 1 hour)

Condition B(4). CVCS makeup pump demineralized water flow path not configured to ensure maximum flowrate is within limits. (Isolate dilution source flow paths in the CVCS makeup line within 1 hour)

- LCO 3.2.1 Condition A. Enthalpy rise hot channel factor ($F_{\Delta H}$) not within limit. (Reduce Thermal Power to < 25% RTP within 6 hours)

- LCO 3.2.2 Condition A. [AXIAL OFFSET (AO)] not within limits. (Reduce Thermal Power to < 25% RTP within 6 hours)

- LCO 3.4.1 Condition A. RCS pressurizer pressure or RCS cold temperature [Critical Heat Flux (CHF)] parameters not within limits. (Restore RCS CHF parameter(s) to within limit within 2 hours.)

  Condition B. RCS flow resistance not within limits. (Evaluate flow resistance effect on safety analysis and verify that the reactor coolant system flow rate is acceptable for continued operation within 7 days.)

- LCO 3.4.2 Condition A. One or more RCS temperatures not within [minimum temperature for criticality] limit [of ≥ 216 °C (420 °F)]. (Be in Mode 2 within 30 minutes.)

- LCO 3.4.3 Condition A. Requirements of LCO [for PTLR limits on RCS pressure, temperature, and heatup and cooldown rates] not met in MODE 1, 2, or 3. (Restore parameters to within limits in 30 minutes, and determine RCS is acceptable for continued operation within 72 hours.)

  Condition C. Requirements of LCO not met any time in other than MODE 1, 2, or 3. (Immediately initiate action to restore parameter(s) to within limits, and determine RCS is acceptable for continued operation prior to entering MODE 3 [from MODE 4].)

  Condition D. Containment flooding initiated while RCS temperature greater than allowed by PTLR. (Be in MODE 2 immediately; be in MODE 3 below the PTLR RCS temperature limit within 36 hours; and determine RCS is acceptable for continued operation prior to entering MODE 2 from MODE 3.)

By letter dated May 16, 2019 (ADAMS Accession No. ML19140A270), the applicant satisfactorily addressed whether Action D is the appropriate means of addressing prevention and mitigation of the postulated inadvertent actuation of the CFDS that floods the containment vessel when RCS temperature is above the RCS temperature limit in the PTLR. The applicant made the following points:

1) "LCO 3.4.3, Action D, was provided to specify actions to be taken if inappropriate containment flooding occurred for whatever reason. It is not a means for prevention or mitigation of such an occurrence - rather it describes the actions that must be taken if the inappropriate flooding occurs.

   "Action D was provided based on the unique nature of the NuScale design compared to other PWR designs. The Action is somewhat analogous to Actions A, B, and C; however, it was recognized that those Conditions did not explicitly address conditions outside the RCS that could affect the OPERABILITY of the reactor vessel. The other Conditions and Actions in 3.4.3, and those in other PWRs are directed at controlling RCS pressure, temperature, and heatup and cooldown rates of change. However, the NuScale design routinely floods the exterior of the reactor vessel during cooldown evolutions and it was determined appropriate to provide a Condition and appropriate Actions for that condition."

2) Approved operating procedures required by Specification 5.4.1, and as described in Section 9.3.6.2.2 (as revised by the response) and Section 13.5 of DCA Part 2, Tier 2, will be developed in accordance with COL item 5.3-1. These procedures will govern manual operation of the CFDS during Mode 3 operation to fill and drain the containment vessel with water from and to the reactor pool. "Current plans are for only one CFDS pump to be used for flooding or draining operation with the other pump in standby. The detailed design of the non-safety related, uncredited CFDS pumps will be completed at a future time. The design, use, and flow rates of the pumps [are] irrelevant to the safety of the NuScale plant…"

3) The RCS hot temperature and reactor pool water bulk temperature limits "will be specified in the PRESSURE AND TEMPERATURE LIMITS REPORT (PTLR) as required by technical specifications 5.6.4. FSAR section 5.3 describes the reactor vessel including limits and materials that will be considered in developing the specific temperature limits implemented during operations that control the use of the CFDS to flood the containment. The Ultimate Heat Sink (UHS) minimum and maximum reactor pool temperature limits are also specified by LCO 3.5.3."

4) The FSAR Section 9.3.6.2.2 description of the nonsafety interlock states, "The CFDS pump operation is automatically prevented if the CFDS isolation valve to more than one [NuScale Power Module (NPM)] is open, and valve operation to other NPMs is prevented once the CFDS pump [is] aligned to an NPM and the pump is in service. In addition, for the selected NPM, the CFDS module isolation valve cannot be opened and CFDS pump start is prevented if RCS wide range hot leg temperature is greater than 350 °F [177 °C]."

5) The CFDS pump flow rate is significantly less than the flow rate assumed in the FSAR Section 15.1.6 safety analysis of a loss of containment vacuum event caused by a component cooling water system

in-containment pipe break, which is the bounding non-reactor-coolant containment flooding event.

6) FSAR Section 9.3.6.2.3 is revised to correct an error, by replacing “NPM CES isolation valve” with “CFDS module isolation valve,” which “automatically closes when the preset water level in the CNV is reached” while flooding the CNV.

7) “Inadvertent initiation of the CFDS is not [considered an AOO because it is not] a credible initiating event during reactor operations because there is no single malfunction or operator error that could cause the event to occur. Pipe breaks are deterministically addressed in [FSAR] Chapter 15 consistent with the NuScale Design Specific Review Standard and NUREG 0800…. there is no regulatory basis to justify, nor precedence to include additional requirements designed to prevent a condition that is not credible.”

8) The response justified not specifying an SR in Subsection 3.4.3 to verify the two CFDS containment isolation valves are closed with DC power disconnected or isolated from the solenoid, to prevent engaging the hydraulic system that opens the valves, until RCS hot temperature is less than or equal to 177 degrees C (350 degrees F), the PTLR limit, by stating that plant “procedures and indications in the control room provide adequate assurance that the CFDS containment isolation valves remain closed unless the system is in operation. The position of the CFDS containment isolation valves with regard to this specification does not meet any of the [LCO selection] criteria of 10 CFR 50.36 that would result in a need for an additional surveillance requirement.”

9) “The limits on UHS pool temperature in LCO 3.5.3 do not affect the PTLR or the procedural limits that will be implemented to control containment vessel flooding and that ensure compliance with the PTLR limits. Whether 140 °F or 110 °F [60 °C or 43.3 °C], the LCO 3.5.3 limits on pool temperature do not represent normal operating conditions…. The normal pool operating temperature remains as listed in Table 9.2.5-1 as 100 °F [37.8 degrees C].”

Based on the above explanation, the staff concludes that the proposed controls, including the CFDS pump start interlocks, for the operation of the CFDS are adequate to minimize the likelihood of the occurrence of a CFDS containment fill operation with RCS hot temperature above the PTLR limit. Should such an operation occur, proposed Condition D provides appropriate remedial actions to ensure RCPB operability is verified before the next entry into Mode 2 from Mode 3.

- LCO 3.4.5 Condition A. RCS operational LEAKAGE not within limits for reasons other than pressure boundary LEAKAGE or primary to secondary LEAKAGE. (Reduce LEAKAGE to within limits within 4 hours)

  Condition B(2). Pressure boundary LEAKAGE exists. (See SER Table 16.4.7-1)

Condition B(3). Primary to secondary LEAKAGE not within limit. (See SER Table 16.4.7-1)

These Conditions and the Required Actions and Completion Times of these Conditions are consistent with the W-STS and the W-AP1000-STS. Therefore, the Actions of LCO 3.4.5 are acceptable.

- LCO 3.4.8 Condition A. DOSE EQUIVALENT I-131 > 0.037 μCi/g [microcuries per gram (1.37 kilobecquerels per gram (kBq/g))].

  Condition B. DOSE EQUIVALENT Xe-133 > 10 μCi/g [370 kBq/g].

  Condition C. DOSE EQUIVALENT I-131 > 2.2 μCi/g [81.4 kBq/g]. (See SER Table 16.4.7-1)

These Conditions and the Required Actions and Completion Times for these Conditions are consistent with the W-STS and the W-AP1000-STS. Therefore, the Actions of LCO 3.4.8 are acceptable. SER Section 16.4.2.5 and SER Section 12.2.4 provide additional discussion of the basis for the LCO 3.4.8 specific activity limits.

- LCO 3.5.3 Condition A. Ultimate Heat Sink Level < 20.7 m (68 ft). (Restore level to within limits within 30 days.)

  Condition B. Ultimate Heat Sink Level ≤ 19.8 m (65 ft). (Restore level to > 19.8 m (65 ft) within 24 hours.)

  Condition C. Ultimate Heat Sink bulk average temperature not within limits. (14 days)

  Condition E. Ultimate Heat Sink bulk average boron concentration not within limits. (Immediately initiate action to restore concentration to within limits and other remedial actions.)

- LCO 3.7.3 Condition A. In-containment secondary system leakage > 5.7 liters per hour (L/h) (1.5 gallons per hour (gph)). (See SER Table 16.4.7-1.)

- LCO 3.8.2 Condition A. Reactor subcritical for < 48 hours. (Immediately suspend movement of irradiated fuel in the RPV.)

Based on its review and evaluation of Required Actions and associated Completion Times for Conditions where a process variable is outside limits, and because these Actions are appropriate for the NuScale design and consistent with Actions for equivalent Conditions in the W-STS, the staff concludes that the GTS Actions are acceptable.

16.4.7.6 Shutdown Required Actions and Completion Times

As previously discussed in the Section 16.4.4 evaluation of GTS LCO 3.0.3 shutdown Completion Times, and the Section 16.4.6 evaluation of GTS Section 1.1 definitions of operational modes, the times allowed by shutdown action requirements to place the unit in Mode 2 and Mode 3 appeared to be inconsistent.

By letter dated September 14, 2017 (ADAMS Accession No. ML17257A450), the applicant indicated that GTS Required Action Completion Times are based on consideration of the following:

- the NPM design
- operational processes required to perform the associated evolutions
- operating experience of legacy nuclear power plants
- the relative significance of the affected safety function and the availability of alternative means to compensate for a reduced or lost capability to perform the safety function
- industry standard Completion Times times reflected in STS
- the reliability and capability of remaining (i.e., redundant) operable specified SSCs to perform required safety functions
- the low probability of a DBA occurring with the LCO not met during the specified Required Action Completion Time
- the time needed to perform the Required Action, including reaching the prescribed plant conditions, collecting data, completing evaluations, and performing surveillances
- the urgency of exiting the emergent plant conditions

In general, the NuScale GTS Conditions and associated Required Actions and Completion Times are comparable to the action requirements in the STS. In particular, LCO 3.0.3 specifies a 1-hour period to begin initiating action for placing the unit in Mode 2 within 7 hours, and in Mode 3 and passively cooled within 37 hours of entry into LCO 3.0.3. Individual LCO Actions tables specify similar shutdown requirements but without the 1-hour period. The standard Completion Times are 6 hours to Mode 2, and 36 hours to Mode 3 and passively cooled. Longer times are provided for systems such as Manual Actuation Functions of LCO 3.3.4. Also, a longer time of 48 hours is specified to reach the final state in Mode 3 for inoperable CIS instrumentation Functions, and CIS logic and actuation Functions because RCS temperature must be taken below the wide range RCS hot temperature interlock, T-2, which is active below 93.3 degrees C (200 degrees F). In contrast, the standard end state in Mode 3 with passive cooling in operation may be reached at a much higher RCS temperature, with the DHRS in operation.

The applicant modified the Bases for LCO 3.0.3 by adding a paragraph describing the reasons the shutdown sequence Completion Times are appropriate. The staff finds the explanation acceptable, as described in SER Section 16.4.4.1.

Based on its review and the explanation and additional justification provided by the applicant, the staff concludes that the Completion Times for the shutdown actions in the GTS are appropriate, consistent with the STS, and therefore acceptable.

Conclusion for Action Requirements

Based on its review and the above evaluation, the staff concludes that the GTS action requirements are acceptable.

16.4.8 Surveillance Requirements (GTS Chapter 3, Sections 3.1 through 3.8)

The staff reviewed the SRs specified for each LCO subsection to verify they satisfy 10 CFR 50.36(c)(3), which states that SRs "are requirements relating to test, calibration, or inspection to assure that the necessary quality of systems and components is maintained, that facility operation will be within the safety limits, and that the limiting conditions for operation will be met." For each LCO on an SSC or parameter, the associated SRs verify the capability of the SSC to perform its specified safety function, or that the parameter is within specified limits. The staff also reviewed each surveillance frequency to verify test or performance intervals are consistent with both the reliability and availability assumed in the NuScale design's PRA. The choice of an SR frequency for an SSC should also take into consideration past precedents, the operating and test history for similar TS-required SSCs, and recommendations of the SSC's manufacturer. The staff reviewed the basis for each SR frequency provided in the Bases of each GTS Chapter 3 LCO subsection. Table 16.1-1 of DCA Part 2, Tier 2, Section 16.1, provides the Bases for the initial or base Frequency of each SR for which the Frequency is specified to be governed by Subsection 5.5.11. Table 16.4.8-1 below lists Surveillances with Frequencies governed not by the SFCP, but according to the inservice testing program, the containment leakage rate testing program, or the steam generator program, or by an event-driven surveillance performance requirement.

16.4.8.1 Surveillance Statements

The staff verified that the SRs of each LCO are adequate to ensure the LCO is being met. The proposed surveillances are phrased in a manner consistent with the phrasing of equivalent kinds of STS SRs involving SSC performance tests, inspections, and status checks and verification that the unit is operating within the specified limits of selected process variables. Surveillances that are unique to the NuScale design are quoted below (surveillance frequency is indicated in parenthesis):

- SR 3.1.9.1 Verify that CVCS makeup pump demineralized water flow path is configured to ensure that the maximum demineralized water flowrate remains within the limits specified in the COLR. (SFCP/31 days)

  SR 3.1.9.4 Verify each CVCS makeup pump maximum flowrate is ≤ 1.58 liters per second (L/s) (25 gpm). (SFCP/24 months)

  These surveillances verify that, when thermal power is below the limit specified in the COLR, the two makeup pumps are aligned so that just one pump can supply the RCS through the CVCS injection line to satisfy initial conditions of the inadvertent RCS boron dilution event analysis.

- SR 3.3.1.3 Verify CHANNEL RESPONSE TIME is within limits. The CHANNEL RESPONSE TIME is combined with the allocated MPS digital time response and the ACTUATION RESPONSE TIME to determine and verify the TOTAL RESPONSE TIME. (SFCP/24 months)

  SER Sections 16.4.2.3 and 16.4.2.4 discuss response time testing and the associated defined terms and definitions.

- SR 3.3.1.5 Perform CHANNEL CALIBRATION on each Class 1E isolation device. (SFCP/24 months)

  Instrumentation Subsections 3.3.1, 3.3.2, and 3.3.3 include this Surveillance to ensure that the MPS is protected from an electrical fault in the non-safety-related electrical power system by isolating the MPS on overcurrent or undervoltage.

- SR 3.3.2.1 Perform ACTUATION LOGIC TEST. (SFCP/24 months)

  The definition of this Surveillance in Section 1.1 differs from the W-AP1000-STS definition of Actuation Logic Test. SER Sections 16.4.2.2 and 16.4.8.4 provide additional discussion of this definition.

- SR 3.3.2.2 Verify ACTUATION RESPONSE TIME is within limits. The ACTUATION RESPONSE TIME is combined with the allocated MPS digital time response and the CHANNEL RESPONSE TIME to determine and verify the TOTAL RESPONSE TIME. (SFCP/24 months)

  SER Section 16.4.2.4 discusses response time testing and the associated defined terms and definitions.

- SR 3.3.2.3 Perform CHANNEL CALIBRATION on each Class 1E isolation device. (SFCP/24 months)

- SR 3.3.3.1 Perform ACTUATION LOGIC TEST. (SFCP/24 months)

- SR 3.3.3.2 Verify pressurizer heater breaker ACTUATION RESPONSE TIME is within limits. The ACTUATION RESPONSE TIME is combined with the allocated MPS digital time response and the CHANNEL RESPONSE TIME to determine and verify the TOTAL RESPONSE TIME. (SFCP/24 months)

- SR 3.3.3.3 Perform CHANNEL CALIBRATION on each Class 1E isolation device in accordance with the Setpoint Program. (SFCP/24 months)

- SR 3.3.3.4 Verify each pressurizer heater breaker actuates to the open position on an actual or simulated actuation signal. (SFCP/24 months)

  This Surveillance verifies that the pressurizer heater breakers will open if the MPS detects reactor conditions that could lead to uncovery of the heaters. The ESFAS PHT Function is designed to protect the pressurizer heaters from uncovering, overheating, and potentially compromising the RCS pressure boundary. SER Section 16.4.1, Table 16.4.1-3, “ESFAS Logic and Actuation Functions,” lists the MPS Functions that initiate a PHT.

- SR 3.3.4.1 Perform actuation device operational test. (SFCP/24 months)

  This Surveillance exercises manual switches that actuate the two divisions of RTBs and ESF-actuated valves and pressurizer heater breakers. It is equivalent to the manual actuation testing part of the TRIP ACTUATING DEVICE OPERATIONAL TEST (TADOT) included in W-AP000-STS; but NuScale GTS do not include this defined term. SER Section 16.4.2.4 provides the staff's reasoning for finding that omitting the W-STS TADOT definition from the GTS is acceptable.

- SR 3.3.5.2 Verify that the [Remote Shutdown Station (RSS)] communicates indication with each required function of the Module Control System and Plant Control System. (SFCP/24 months)

This Surveillance reflects the NuScale design in which only flat panel displays of selected process variables and system status are required to be operable to monitor the safe-shutdown condition of each NPM, defined as Mode 3 with passive cooling established. In the event of control room evacuation, operators would first shut down all NPMs and actuate passive core cooling systems, which will establish and maintain the modules in safe-shutdown conditions.

- SR 3.4.1.3 Verify RCS flow resistance is within the limits specified in the COLR. (Once prior to exceeding 75% RTP after each refueling)

This surveillance verifies that the flow resistance of the reactor coolant flow paths inside the reactor vessel is still within limits following operation in Mode 5 with module disassembly for refueling and subsequent reassembly. The 12-hour surveillance to verify RCS flow is above a lower limit, which is specified in the TS of PWRs using forced circulation, is not appropriate for the NuScale design because reactor coolant flow is by natural circulation. Reactor coolant flow in the NuScale design is caused by coolant density differences across the core and the SG tubes and is a function of core thermal power (reactor coolant mass flow rate is proportional to the cube root of core thermal power).

- SR 3.4.6.1 Verify [required] valves accumulator pressures are within limits. (SFCP/12 hours)

This Surveillance ensures that valves necessary to initiate the ESF Function of CVCSI have sufficient accumulator pressure to actuate to the required position. The applicant proposed placing "required" in brackets as shown above, to account for a COL applicant using a different type of actuator on a CVCS automatic isolation valve. The term "required" in valve actuator accumulator pressure surveillance requirements and the associated bases were modified by placing the terms in square brackets. This indicates that the content is required to be finalized by a COL applicant when final plant-specific information is finalized. The requirement to provide final plant-specific information identified by square brackets is described in FSAR Chapter 16, as COL item 16.1-1.

- SR 3.4.10.3 For each RVV, verify the inadvertent actuation block function is OPERABLE, and the block function setpoints are within limits. (INSERVICE TESTING PROGRAM)

This Surveillance ensures that the mechanical block of the RVVs to open will not prevent opening of these three valves on a high RCS pressure LTOP signal in Mode 3 below the T-1 interlock.

- SR 3.5.1.3 For each RVV and RRV, verify the inadvertent actuation block function is OPERABLE, and the block function setpoints are within limits. (INSERVICE TESTING PROGRAM)

  This Surveillance ensures that the mechanical block of the three RVVs and two RRVs will prevent opening of these five valves upon an ECCS ESFAS signal until the pressure difference between the RCS and the containment vessel is below the specified setting. This block also prevents inadvertent ECCS actuation in Modes 1, 2, and 3.

- SR 3.5.2.1 Verify [required] valves accumulator pressures within limits. (SFCP/12 hours)

  This Surveillance ensures that valves necessary to initiate the ESF Function of the DHRS have sufficient accumulator pressure to actuate to the required position. The applicant proposed placing "required" in brackets as shown above, to account for a COL applicant using a different type of actuator on a DHRS automatic actuation valve.

- SR 3.5.2.2 Verify DHRS heat exchangers are filled. (SFCP/24 hours)

  This SR is appropriate because, with the DHRS in standby, the DHRS level sensors monitor level in the heat exchanger inlet piping downstream of the closed DHRS actuation valves.

- SR 3.5.2.3 --------------------------------------NOTE---------------------------------------
  Not required to be performed for DHRS loop with associated FWIV open.

  Verify SG level is > [5]% and ≤ [65]%. (SFCP/12 hours)

  The applicant added this Surveillance in its letter dated May 16, 2019 (ADAMS Accession No. ML19136A404), to assure the SG contains inventory adequate to support actuation and operability of the associated DHRS loop when the SG's associated FWIV is closed. When the associated FWIV is open, normal feedwater system controls will ensure that the SG will support DHRS loop actuation and operability.

- SR 3.5.3.3 Verify Ultimate Heat Sink bulk average boron concentration is within limits. (SFCP/31 days)

  This Surveillance reflects the multiple Functions of the NuScale reactor pool; besides serving as the UHS for the decay heat of the NPMs following shutdown, the reactor pool also provides reactivity control during refueling.

- SR 3.6.2.1 Verify [required] valves accumulator pressures are within limits. (SFCP/12 hours)

  The applicant proposed placing "required" in brackets as shown above, to account for a COL applicant using a different type of actuator on a CIV.

- SR 3.7.1.1 Verify [required] valves accumulator pressures are within limits. (SFCP/12 hours)

The applicant proposed placing "required" in brackets as shown above, to account for a COL applicant using a different type of actuator on an MSIV and main steamline bypass isolation valve.

- SR 3.7.2.1 Verify [required] FWIV accumulator pressures are within limits. (SFCP/12 hours)

  SR 3.7.1.1 and SR 3.7.2.1 ensure that MSIVs and FWIVs, which are necessary to initiate the ESF Functions of CIS and DHRS, have sufficient accumulator pressure to actuate to the required position. The applicant proposed placing "required" in brackets as shown above, to account for a COL applicant using a different type of actuator on an FWIV.

- SR 3.7.3.1 Verify in-containment secondary system leakage ≤ 5.7 L/h (1.5 gph). (SFCP/72 hours)

- SR 3.8.1.2 Perform CHANNEL CALIBRATION. (SFCP/24 months)

Based on its review, the staff determined that the above NuScale-specific Surveillance statements clearly describe the Surveillances, are appropriate for assuring the associated LCOs are met, and are consistent with the NuScale design and the W-STS. Therefore, the staff finds that these Surveillance statements are acceptable.

16.4.8.2 Surveillance Frequencies Not Governed by the Surveillance Frequency Control Program

The staff reviewed the Surveillances with a performance Frequency that is contingent on (1) having exceeded a specified thermal power level, (2) not having exceeded a specified thermal power level, (3) having exceeded a specified fuel expenditure expressed as a number of EFPDs, (4) not having exceeded a specified number of EFPDs, (5) having entered a specified mode or other specified condition, (6) not having entered a specified mode or other specified condition, (7) having completed a specified task, (8) not having completed a specified task, (9) a specified event having occurred, (10) a specified event not having occurred, or (11) a specified time interval having elapsed or not elapsed. In addition, there are Surveillances governed by other requirements, such as the steam generator program and the inservice testing program. These Frequencies are stated below in Table 16.4.8-1 and may not be changed in accordance with the SFCP.

Table 16.4.8-1[6] Surveillance Frequencies Not Governed by the Surveillance Frequency Control Program

SURVEILLANCE		FREQUENCY
SR 3.1.2.1	Verify overall core reactivity balance is within ±1% Δk/k of predicted values.	Once prior to exceeding 5% RTP after each refueling <u>AND</u>

[6] In this table, material is added to define acronyms in the quoted passage.

SURVEILLANCE		FREQUENCY
		--------------------------NOTE------------------------ Only required after 60 EFPDs. --- In accordance with the SFCP
SR 3.1.3.1	Verify moderator temperature coefficient (MTC) is within the upper limit.	Once prior to exceeding 5% RTP after each refueling
SR 3.1.3.2	Verify MTC is within the lower limit.	Once within 7 EFPDs after reaching 40 EFPDs fuel burnup from beginning of cycle (BOC) <u>AND</u> Once within 7 EFPDs after reaching 2/3 fuel burnup from BOC <u>AND</u> --------------------------NOTE------------------------ Only required when projected end of cycle MTC is not within limit. --- 7 EFPDs thereafter
SR 3.1.4.3	Verify each control rod assembly (CRA) drop time is ≤ 2.2 seconds.	Prior to reactor criticality after each removal of the upper reactor pressure vessel section
SR 3.1.7.1	Verify each RPI channel agrees within 6 steps of the group counter position indication for the full indicated range of CRA travel.	Prior to criticality after coupling a CRA to the associated CRDM for one or more CRAs
SR 3.2.1.1	Verify Enthalpy Rise Hot Channel Factor ($F_{\Delta H}$) is within the limits specified in the COLR.	Once after each refueling prior to THERMAL POWER exceeding 25% RTP <u>AND</u> In accordance with the SFCP
SR 3.4.1.3	-------------------NOTE-------------------- Not required to be performed until 96 hours after exceeding 50% RTP. -- Verify RCS flow resistance is within the limits specified in the COLR.	Once prior to exceeding 75% RTP after each refueling
SR 3.4.4.1	Verify each reactor safety valve (RSV) is OPERABLE in accordance with the INSERVICE TESTING PROGRAM. Following testing, lift settings shall be within 1% of the nominal setpoints of 2075 psia [14.307 MPa (absolute)] and 2100	In accordance with the INSERVICE TESTING PROGRAM

	SURVEILLANCE	FREQUENCY
	psia [14.479 MPa (absolute)] as shown below: Valve 1 Setpoint: ≥ 2055 psia and ≤ 2095 psia [≥ 14.169 MPa (absolute) and ≤ 14.445 MPa (absolute)]. Valve 2 Setpoint: ≥ 2079 psia and ≤ 2121 psia [≥ 14.344 MPa (absolute) and ≤ 14.624 MPa (absolute)].	
SR 3.4.6.2	Verify the isolation ACTUATION RESPONSE TIME of each automatic power operated CVCS valve is within limits. The ACTUATION RESPONSE TIME is combined with the allocated MPS digital time response and the CHANNEL RESPONSE TIME to determine and verify the TOTAL RESPONSE TIME.	In accordance with the INSERVICE TESTING PROGRAM
SR 3.4.9.1	Verify steam generator (SG) tube integrity in accordance with the Steam Generator Program.	In accordance with the Steam Generator Program
SR 3.4.9.2	Verify that each inspected SG tube that satisfies the tube plugging criteria is plugged in accordance with the Steam Generator Program.	Prior to entering MODE 3 following a SG tube inspection
SR 3.4.10.2	Verify the open ACTUATION RESPONSE TIME of each RVV is within limits. The ACTUATION RESPONSE TIME is combined with the allocated MPS digital time response and the CHANNEL RESPONSE TIME to determine and verify the TOTAL RESPONSE TIME.	In accordance with the INSERVICE TESTING PROGRAM
SR 3.4.10.3	For each RVV, verify the inadvertent actuation block function is OPERABLE, and the block function setpoints are within limits.	In accordance with the INSERVICE TESTING PROGRAM
SR 3.5.1.2	Verify the open ACTUATION RESPONSE TIME of each RVV and RRV is within limits. The ACTUATION RESPONSE TIME is combined with the allocated MPS digital time response and the CHANNEL RESPONSE TIME to	In accordance with the INSERVICE TESTING PROGRAM

	SURVEILLANCE	FREQUENCY
	determine and verify the TOTAL RESPONSE TIME.	
SR 3.5.1.3	For each RVV and RRV, verify the inadvertent actuation block function is OPERABLE, and the block function setpoints are within limits.	In accordance with the INSERVICE TESTING PROGRAM
SR 3.5.2.5	Verify the open ACTUATION RESPONSE TIME of each DHRS actuation valve is within limits. The ACTUATION RESPONSE TIME is combined with the allocated MPS digital time response and the CHANNEL RESPONSE TIME to determine and verify the TOTAL RESPONSE TIME.	In accordance with the INSERVICE TESTING PROGRAM
SR 3.6.2.3	Verify the isolation ACTUATION RESPONSE TIME of each automatic containment isolation valve is within limits. The ACTUATION RESPONSE TIME is combined with the allocated MPS digital time response and the CHANNEL RESPONSE TIME to determine and verify the TOTAL RESPONSE TIME.	In accordance with the INSERVICE TESTING PROGRAM
SR 3.7.1.2	Verify isolation ACTUATION RESPONSE TIME of each MSIV and MSIV bypass valve is within limits on an actual or simulated actuation signal. The ACTUATION RESPONSE TIME is combined with the allocated MPS digital time response and the CHANNEL RESPONSE TIME to determine and verify the TOTAL RESPONSE TIME.	In accordance with the INSERVICE TESTING PROGRAM
SR 3.7.1.3	Verify each MSIV and MSIV bypass valve leakage is within limits.	In accordance with the INSERVICE TESTING PROGRAM
SR 3.7.2.2	Verify the closure ACTUATION RESPONSE TIME of each FWIV and FWRV is within limits on an actual or simulated actuation signal. The ACTUATION RESPONSE TIME is combined with the allocated MPS digital time response and the CHANNEL RESPONSE	In accordance with the INSERVICE TESTING PROGRAM

	SURVEILLANCE	FREQUENCY
	TIME to determine and verify the TOTAL RESPONSE TIME.	
SR 3.7.2.3	Verify each FWIV and FWRV leakage is within limits.	In accordance with the INSERVICE TESTING PROGRAM
SR 3.8.2.1	Verify reactor has been subcritical for ≥ 48 hours.	Once prior to movement of irradiated fuel assemblies in the reactor pressure vessel

In a letter dated December 12, 2018 (ADAMS Accession No. ML18347A619), regarding SR 3.7.1.3 and SR 3.7.2.3, the applicant explained how the SSI valve leakage acceptance criteria will be determined, as follows:

> Specific valve leakage limits for the individual valves will be developed as required by the applicable ASME Code requirements. Development of acceptance criteria will be based on the functions of the valves as described in FSAR Tables 3.9-16 and 3.9-17 including forming a portion of the decay heat removal system boundary. Specific values will be developed and implemented in the inservice testing program developed by a COL applicant as required by COL Item 3.9-5.

The staff concludes that COL Item 3.9-5 will ensure that, in accordance with the inservice testing program, a COL applicant will develop appropriate leakage acceptance criteria for the secondary system MSIVs and associated bypass valves, and FWIVs, FWRVs, and feedwater check valves to include the safety-related valves and the backup non-safety-related valves. Limiting valve leakage to within the SR leakage acceptance criteria, established under the inservice testing program, will ensure that each passive decay heat removal subsystem will maintain sufficient water inventory to perform its specified safety function in case an event requiring DHRS heat exchanger operation occurs.

The staff determined that the Frequencies of the above Surveillances, which are not included in the SFCP, are appropriate for the NuScale design and consistent with W-STS and W-AP1000-STS and are therefore acceptable.

16.4.8.3 Surveillance Frequencies Governed by the Surveillance Frequency Control Program

The initial base Frequencies of SRs with Frequencies governed by GTS Subsection 5.5.11, and the basis for each Frequency, are provided in DCA Part 2, Tier 2 (FSAR), Table 16.1-1. FSAR Section 16.1.1 states the following:

> Table 16.1-1 provides the initial surveillance test frequencies to be incorporated into the Surveillance Frequency Control Program (SFCP) required by NuScale GTS 5.5.11. The table identifies each GTS surveillance test requirement that references the SFCP, the base testing frequency for evaluation of future changes to the surveillance test frequency, and the basis for that test frequency. Base test frequencies in Table 16.1-1 include consideration of the rules of applicability for surveillance testing including, when applicable, up to 1.25 times the specified interval as permitted by technical specification SR 3.0.2. For example, a base

> frequency of 24 months implies consideration of up to 30 months between performance[s] of the surveillance test.

Therefore, DCA Part 2, Tier 2, Table 16.1-1, is part of the program documentation required by GTS Subsection 5.5.11. This programmatic specification is acceptable because it conforms to the W-STS and TSTF-425-A. Based on its evaluation of the Surveillance Frequencies governed by the SFCP, the staff determined that the base Frequencies, and the rationales of the base Frequencies for the SRs within the SFCP scope are consistent with the guidance in Nuclear Energy Institute (NEI) 04-10, "Risk-Informed Method for Control of Surveillance Frequencies." In order to apply test experience to justify a longer test interval, the guidance assumes the validity of the basis for the existing Frequency. The proposed bases for the initial Frequencies for the GTS SRs to be controlled by the SFCP are valid because they are consistent with STS Frequencies for equivalent SRs and are appropriate for the NuScale design. Therefore, the staff concludes that the initial Frequencies and associated Bases in FSAR Table 16.1-1, and GTS Subsection 5.5.11 are acceptable.

16.4.8.4 Instrumentation Surveillances

<u>Channel Check</u>

A channel check with a base performance frequency of 12 hours is specified for each MPS function listed in Table 3.3.1-1, which is consistent with the testing described in DCA Part 2, Tier 2, Section 7.2.15, for RTS and ESFAS instrumentation. DCA Part 2, Tier 2, Section 7.2.15.1, "System Calibration," states the following:

> The MPS and NMS are designed with the capability for calibration and surveillance testing, including channel checks, calibration verification, and time response measurements, as required by the technical specifications to verify that I&C safety systems perform required safety functions.

DCA Part 2, Tier 2 Section 7.2.15.2, "I&C System Testing," states the following, in part:

> The MPS and NMS allow [structures, systems, and components (SSC)] to be tested while retaining the capability to accomplish required safety functions. The MPS uses modules from the [Highly Integrated Protection System (HIPS)] platform which are designed to eliminate non-detectable failures through a combination of built-in self-testing and periodic surveillance testing.
>
> Testing from the sensor inputs of the MPS through to the actuated equipment is accomplished through a series of overlapping sequential tests, and the majority of the tests may be performed with the NPM at power. Where testing final equipment at power has the potential to upset plant operation or damage equipment, provisions are made to test the equipment when the NPM is shut down.
>
> The MPS provides a means for checking the operational availability of the sense and command feature input sensors relied upon for a safety function during reactor operation.
>
> This capability is provided by one of the following methods:

- Perturbing the monitored variable
- Cross-checking between channels that have a known relationship (i.e., channel check)
- Introducing and varying a substitute input to the sensor.

The staff finds that the specified channel checks are consistent with the MPS testing described in DCA Part 2, Tier 2, Section 7.2.15, and are therefore acceptable.

Channel Operational Test

The applicant proposed specifying a Channel Operational Test only for LCO-required instrumentation functions implemented by the module control system. These are the RCS leakage detection instrumentation of the CES condensate monitor (two channels) and CES gaseous radioactivity monitor (one channel), which are evaluated below.

The staff requested that the applicant clarify its justification for not proposing to specify a Channel Operational Test for MPS instrumentation functions, the RTS logic and actuation function, ESFAS logic and actuation functions, and the CES inlet pressure monitor channels, which are used for RCS leak detection, in RAI 156-9031, Question 16-2, Subquestion c (ADAMS Accession No. ML17220A038); RAI 196-9050, Question 16-16, Subquestion e (ADAMS Accession No. ML17237C007); and RAI 197-9051, Question 16-25, Subquestion a4.2 (ADAMS Accession No. ML17237C008).

In its responses to Subquestion 16-2c (ADAMS Accession No. ML17269A210); Subquestion 16-16e (ADAMS Accession No. ML17291A482), and Subquestion 16-25.a4.2 (ADAMS Accession No. ML17291A299), NuScale stated that a Channel Operational Test would not add to the assurance of operability provided by the MPS continuous self-testing features, which verify sensor input to the output switching logic for MPS instrumentation functions, the RTS logic and actuation function, ESFAS logic and actuation functions, and the CES inlet pressure monitor channels. SER Chapter 7 contains the staff's evaluation of the MPS self-testing features' capability to provide adequate assurance of MPS operability without performing manual Channel Operational Tests.

The staff recognizes that, upon receipt of an alarm generated by an MPS self-testing feature, the control room staff would promptly determine the operability of the affected MPS instrumentation function channel or MPS logic and actuation function division. This operability determination would include following the alarm response procedure, which is required by Specification 5.4.1. This procedure can be expected to account for the built-in redundancy of the MPS power supplies and the logic within each SFM, SVM, and communication module provided for each MPS function channel and actuation logic division. An alarm associated with a single redundant component within a module would likely not make the associated channel or division inoperable but would be addressed by the licensee's corrective action program. The combination of the MPS continuous self-testing capability and the 12-hour Frequency channel check, which includes verifying alarm status, provide adequate assurance that any component malfunction in an MPS channel or division will not go undetected for more than a brief period. This will ensure that an MPS degraded condition is identified and its effect on channel or division operability determined in a timely manner.

For the reasons described above, the staff concludes that omission of a Channel Operational Test SR for MPS instrumentation functions and MPS logic and actuation functions, and MPS-supported RCS leakage detection instrumentation is acceptable.

A Channel Operational Test with a base Frequency of 92 days is specified for the CES gaseous radioactivity monitor channel by SR 3.4.7.4, and the two CES condensate monitor channels by SR 3.4.7.5. These SRs are needed because these monitors are implemented using the module control system, which lacks the MPS capability to perform automatic self-testing of the instrument loop. In addition, the applicant revised the Section 1.1 definition of Channel Operational Test to that for analog instrumentation based on the W-STS definition of Channel Operational Test, but with a modification based on recently approved STS change traveler TSTF-563, Revision 0. As such, the staff concludes that this definition is acceptable. The proposed base test Frequency of 92 days is consistent with the Channel Operational Test Frequency of similar instrumentation in current use at operating power reactor facilities and also with the W-STS and the W-AP1000-STS. The rationale for this base Frequency, provided in DCA Part 2, Tier 2, Section 16.1, Table 16.1-1, states the following:

> The Frequency of 92 days considers instrument reliability, and industry operating experience has shown that it is proper for detecting degradation.

This is consistent with the basis for the 92-day Frequency of the Channel Operational Test for the F18 radioactive particulate monitor leakage detection instrumentation in W-AP1000-STS Subsection B 3.4.9, and therefore, acceptable. The proposed modification of the Channel Operational Test definition, and other instrumentation surveillance definitions, based on recently approved STS change traveler TSTF-563, on adoption of an SFCP, is described in SER Section 16.4.2. Therefore, the staff concludes that the proposed GTS Channel Operational Test SRs are acceptable.

<u>Channel Calibration</u>

A Channel Calibration with a base Frequency of 24 months is specified for each MPS instrumentation function listed in Table 3.3.1-1, which is consistent with the testing described in FSAR Section 7.2.15 for RTS and ESFAS instrumentation. The proposed base test Frequency is consistent with the Channel Calibration Frequency of similar instrumentation in current use at operating power reactor facilities and also with the W-STS and the W-AP1000-STS. The rationale for this base Frequency, provided in DCA Part 2, Tier 2, Section 16.1, Table 16.1-1, for SR 3.3.1.4, states as follows:

> The Frequency is based on consideration of the design reliability and performance characteristics of the equipment.

A Channel Calibration with a base Frequency of 24 months is specified for each RCS leakage detection instrument function channel. The proposed base test Frequency is consistent with the Channel Calibration Frequency of similar instrumentation in current use at operating power reactor facilities and also with the W-STS and the W-AP1000-STS.

The rationale for this base Frequency, provided in DCA Part 2, Tier 2, Section 16.1, Table 16.1-1, for SR 3.4.7.6 for the CES condensate channel, and SR 3.4.7.8 for the CES gaseous radioactivity monitor channel, states the following:

> The Frequency of 24 months considers instrument reliability, and industry operating experience that has proven that this Frequency is acceptable.

The rationale for this base Frequency, provided in DCA Part 2, Tier 2, Section 16.1, Table 16.1-1, for SR 3.4.7.7 for the CES inlet pressure channel, states the following:

> The Frequency is based on consideration of the design reliability and performance characteristics of the equipment.

A Channel Calibration with a base Frequency of 24 months is specified for SR 3.8.1.2 for the two refueling neutron flux channels and one refueling neutron flux audible count rate channel. The rationale for this base Frequency, provided in DCA Part 2, Tier 2, Section 16.1, Table 16.1-1, states the following:

> Industry operating experience has shown that similar components usually pass this Surveillance when performed at the 24-month Frequency.

The staff concludes that the above rationales are acceptable because they are consistent with STS Bases and are appropriate for the NuScale reactor coolant leakage detection instrumentation.

SER Chapter 7 describes the individual components comprising a measurement channel of an MPS instrument loop and subject to calibration. However, for the present evaluation of the Channel Calibration surveillance, the description provided in the NRC-approved TR-1015-18653-P-A, Revision 2, was considered.

The staff notes that Bases Subsection B 3.3.1 includes discussions that clarify the scope and intent of the Channel Calibration. One discussion explains that, when determining the as-found trip setting at the beginning of the instrument Channel Calibration, as-found tolerances for the output signal of each sensor and device in the instrument loop must be satisfied for the sensor or device to be considered functioning normally. Provided the actual trip setting of the channel as a whole is within the as-found tolerance specified by the setpoint program (SP), the channel is considered operable. However, any sensor or device found to be outside its as-found tolerance should be entered into the corrective action program. Specifically, the Background section of Bases Subsection B 3.3.1 discusses the nominal trip setpoints (NTSPs) as follows (emphasis added):

> The trip and actuation setpoints used in the [safety function module (SFM)] core logic function are based on the analytical limits derived from accident analysis (Ref. 5). The calculation of the limiting trip setpoint (LTSP) specified in the Setpoint Program (SP) is such that adequate protection is provided when all sensor and processing time delays are taken into account. To allow for calibration tolerances, instrumentation uncertainties, instrument drift, and severe environment errors for those MPS channels that must function in harsh environments as defined by 10 CFR 50.49 (Ref. 6), the LTSP specified in the SP is conservative with respect to the analytical limits. The nominal trip setpoint (NTSP) is the LTSP with margin added and is always equal to or more conservative than the LTSP. A detailed description of the methodology used to calculate the NTSPs is provided in the “NuScale Instrument Setpoint Methodology” (Ref. 7). The as-left tolerance and as-found tolerance band methodology is provided in the SP. The as-found OPERABILITY limit for the purpose of the CHANNEL CALIBRATION is defined as the as-left limit plus the acceptable drift about the NTSP.

> The NTSPs listed in the SP are based on the methodology described in Reference 7, which incorporates all of the known uncertainties applicable for each channel. The magnitudes of these uncertainties are factored into the determination of each NTSP. *All field sensors and signal processing equipment for these channels are assumed to operate within the allowances of these uncertainty magnitudes. Transmitter and signal processing equipment calibration tolerances and drift allowances must be specified in plant calibration procedures and must be consistent with the values used in the setpoint methodology.*
>
> The OPERABILITY of each transmitter or sensor can be evaluated when its "as-found" calibration data are compared against the "as-left" data and are shown to be within the setpoint methodology assumptions. The as-left and as-found tolerances listed in the SP define the OPERABILITY limits for a channel during a periodic CHANNEL CALIBRATION that requires trip setpoint verification.

Another discussion in the Background section of Bases Subsection B 3.3.1 explains that an RTS trip Function division requires its associated interlock to be in the correct state to be operable, likewise, for an ESFAS function that has an enabling interlock. The combined Applicable Safety Analyses, LCO, and Applicability sections of Bases Subsection B 3.3.1 (and by reference in Subsections B 3.3.2 and B 3.3.3) state the following, in part:

> …Proper operation of these permissive[s] and interlocks supports OPERABILITY of the associated reactor trip and ESF functions and/or the requirement for actuation logic OPERABILITY. The permissives and interlocks must be in the required state, as appropriate, to support OPERABILITY of the associated functions. The permissives and interlocks associated with each MPS Instrumentation Function channel, each Reactor Trip System (RTS) Logic and Actuation Function division, and each Engineered Safety Features Actuation System (ESFAS) Logic and Actuation Function division, respectively, must be OPERABLE for the associated Function channel or Function division to be OPERABLE.

In addition, since the sensors and transmitters for process variables used by the RTS and ESFAS are also used to generate the interlock and permissive signals, a Channel Calibration of an MPS sensor and transmitter satisfies the calibration requirement for the shared interlock sensor and transmitter. The combined Applicable Safety Analyses, LCO, and Applicability sections of Bases Subsection B 3.3.1 also state the following, in part:

> …The combination of the continuous self-checking features of the MPS and the CHANNEL CALIBRATION specified by SR 3.3.1.4 verify the OPERABILITY of the interlocks and permissives.

In a letter dated May 16, 2019 (ADAMS Accession No. ML19140A270), the applicant clarified the relationship of the MPS instrumentation Functions, and their bypassing or enabling interlocks and permissives, to the SP controls and Channel Calibration surveillances, by adding the following sentence to the end of the above-quoted paragraph of the combined Applicable Safety Analyses, LCO, and Applicability sections of Bases Subsection B 3.3.1:

> …Specification 5.5.10, Setpoint Program is used to control interlock and permissive setpoints.

The applicant made 18 additional similar clarifications throughout the combined Applicable Safety Analyses, LCO, and Applicability sections of Bases Subsection B 3.3.1, under the heading, “Reactor Trip System and ESFAS Functions,” for each MPS instrumentation function that has an associated supporting interlock or permissive Function. In most cases, a sentence such as the following was appended to the appropriate paragraph: “Interlock and permissive setpoints are governed by the Setpoint Program.” The applicant also appended the phrase “in accordance with the Setpoint Program” to the statement of the Channel Calibration in SR 3.3.1.4 to ensure the SR is performed according to the requirements of the SP. The applicant also revised GTS Subsection 5.5.10, paragraph b, to reference TR-0616-49121-P, “NuScale Instrument Setpoint Methodology.” The applicant placed the report number, NRC-approved version number, and title of the setpoint methodology in square brackets to ensure that the SP reflects the most current approved version of the methodology when a COL applicant submits the plant-specific TS for approval. The staff finds the scope of the Channel Calibration SRs, as described in the Bases, and the associated SP consistent with the NuScale design and the W-AP1000-STS. Therefore, the Channel Calibration SRs for MPS instrumentation functions are acceptable.

MPS Class 1E Isolation Devices

The staff determined that specifying a Channel Calibration for the Class 1E isolation devices is appropriate for assuring the device will actuate to protect the MPS upon an electrical fault in the electrical power supply, and that the 24-month initial Frequency is adequately justified in DCA Part 2, Tier 2, Chapter 16, Table 16.1-1, by the associated Bases. Therefore, the staff concluded that the Channel Calibration SRs for the Class 1E isolation devices are acceptable.

Actuation Logic Test

SER Section 16.4.2.2 discusses the NuScale definition of the defined term Actuation Logic Test.

An Actuation Logic Test with a base Frequency of 24 months is specified for the two divisions of the RTS Logic and Actuation for the reactor trip Function, which is addressed by GTS Subsection 3.3.2, and the two divisions of the ESFAS Logic and Actuation for each ESFAS Actuation Function listed in Table 3.3.3-1.

The discussion of SR 3.3.2.1 in DCA Part 4, Bases Subsection B 3.3.2, states the following, in part:

> …The RTS Logic and Actuation circuitry functional testing is accomplished with continuous system self-testing features on the SVMs and [equipment interface modules (EIMs)] and the communication between them. The self-testing features are designed to perform complete functional testing of all circuits on the SVM and EIM, with the exception of the actuation and priority logic (APL) circuitry. The self-testing includes testing of the voting and interlock/permissive logic functions. The built-in self-testing will report a failure to the operator and place the SVM or EIM in a fail-safe state.
>
> The ACTUATION LOGIC TEST includes testing of the APL on all RTS EIMs, the enable nonsafety control switches, and the operating bypass switches. The ACTUATION LOGIC TEST includes a review of any alarms or failures reported by the self-testing features.

In DCA Part 4, the SRs section of Bases Subsection B 3.3.3, for SR 3.3.3.1, similarly states, in part, the following:

> The ESFAS Logic and Actuation circuitry functional testing is accomplished with continuous system self-testing features on the SVMs and EIMs and the communication between them. The self-testing features are designed to perform complete functional testing of all circuits on the SVM and EIM, with the exception of the actuation and priority logic (APL) circuitry. The self-testing includes testing of the voting and interlock/permissive logic functions. The built-in self-testing will report a failure to the operator and place the SVM or EIM in a fail-safe state.
>
> The ACTUATION LOGIC TEST includes testing of the APL on all ESFAS EIMs, the enable nonsafety control switches, the main control room isolation switches, the override switches, and the operating bypass switches. The ACTUATION LOGIC TEST includes a review of any alarms or failures reported by the self-testing features.

Based on its review as described in SER Section 16.4.2.2 and the above discussion, the staff concludes that the Actuation Logic Test SRs are appropriate for the NuScale MPS and APL design. The staff concludes that, because of the continuous self-testing of the MPS components, the Actuation Logic Test will provide adequate assurance that the MPS RTS and ESF Logic and Actuation Functions are operable and that LCO 3.3.2 and LCO 3.3.3 are met. For the logic components, such as the APL, which are not covered by self-tests, manual testing under the Actuation Logic Test Frequency of 24 months is adequate to assure operability because of the component reliability and the need to perform this test when the unit is shut down to avoid an inadvertent operational transient.

DCA Part 2, Tier 2, Section 7.2.15.2, "I&C system testing," addresses testing that cannot be performed during normal power operation, as follows:

> Where testing final equipment at power has the potential to upset plant operation or damage equipment, provisions are made to test the equipment when the NPM is shut down.

The basis in DCA Part 2, Tier 2, Table 16.1-1, for the 24-month initial Frequency of SR 3.3.2.1 and SR 3.3.3.1 is consistent with the above and states the following:

> The 24-month Frequency is based on the potential for unplanned plant transients if the Surveillances were performed with the unit at power. This Frequency is justified based on the system design, which includes the use of continuous diagnostic test features that will report a failure within the logic and actuation system to the operator promptly. The only part of the actuation logic circuitry that is not continuously self-tested is the actuation and priority logic circuit which consists of simple discrete components that are very reliable.

Based on the above information, the staff concludes that the Actuation Logic Test SRs and their 24-month Frequency are acceptable.

Based on its review as described in SER Section 16.4.2 and the above evaluation, the staff concludes that the instrumentation Surveillances are acceptable.

Conclusion for Surveillance Requirements

Based on its review and evaluation of the NuScale SRs, the staff concludes that the Surveillance statements and Frequencies of Section 3.1 though Section 3.8 satisfy 10 CFR 50.36(c)(3) and, therefore, are acceptable.

16.4.9 Design Features (GTS Chapter 4, Sections 4.1 through 4.3)

In 10 CFR 50.36(c)(4), the NRC requires that TS include design features, which it states are "those features of the facility such as materials of construction and geometric arrangements, which, if altered or modified, would have a significant effect on safety that are not covered in [the] categories" of SLs, LCOs, or SRs.

GTS Chapter 4 addresses the requirement to include design features not covered in the LCOs of GTS Chapter 3. GTS Chapter 4 contains information about site location, core design, and fuel storage design.

16.4.9.1 GTS Section 4.1, Site Location

GTS Section 4.1 contains bracketed information regarding site-specific information about the facility's location, site and exclusion boundaries, and the facility's low-population zone, which must be provided by applicants for a COL referencing the NuScale certified design. Section 16.5 of this SER summarizes the COL information items included in NuScale DCA Part 4.

16.4.9.2 GTS Section 4.2, Reactor Core

GTS Section 4.2 contains reactor core design requirements. GTS Subsection 4.2.1, "Fuel Assemblies," specifies the design number of fuel assemblies and allowed composition of fuel rod cladding and fuel material, and it requires that fuel assemblies be limited to fuel designs that have been analyzed with applicable NRC staff-approved codes and methods and shown by tests or analyses to comply with fuel safety design bases. It also permits a limited number of lead test assemblies that have not completed representative testing to be placed in nonlimiting core regions.

GTS Subsection 4.2.2, "Control Rod Assemblies," specifies the number of CRAs and the permitted control materials used in the CRAs.

16.4.9.3 GTS Section 4.3, Fuel Storage

GTS Subsection 4.3.1, "Criticality," contains design requirements for the spent fuel storage racks to prevent criticality of the stored fuel assemblies. The spent fuel storage racks are designed and maintained with stored fuel assemblies with a maximum uranium-235 enrichment of 5.0 weight percent; a $k_{eff} \leq 0.95$ with the fuel storage pool fully flooded with borated water at a minimum soluble boron concentration of 800 parts per million; a $k_{eff} < 1.00$ with the fuel storage pool fully flooded with unborated water; and a nominal center-to-center distance between fuel assemblies placed in the spent fuel storage racks. To meet GDC 61, "Fuel Storage and Handling and Radioactivity Control," NuScale is incorporating neutron-absorbing material into the design of the spent fuel racks to maintain the specified subcriticality and ensure safe operation. GTS Subsection 5.5.12, "Spent Fuel Rack Neutron Absorber Monitoring Program," is included in GTS Section 5.5 to ensure safe operation by requiring periodic physical examination and neutron attenuation testing, and performance-based examinations. SER Section 16.4.10.3

further discusses GTS Subsection 5.5.12. GTS Subsection 4.3.2, "Drainage," requires the spent fuel pool to be designed and maintained to prevent inadvertent draining of the pool below 6.1 m (20 ft) above the spent fuel pool floor. GTS Subsection 4.3.3, "Capacity," contains information regarding how the spent fuel pool shall be designed and maintained to hold a specified maximum number of fuel assemblies.

Conclusion for GTS Chapter 4

The staff found GTS Chapter 4 to be consistent with the W-STS and the NuScale design as described in DCA Part 2, Tier 2. The staff concludes that GTS Chapter 4 satisfies 10 CFR 50.36(c)(4) and is therefore acceptable.

16.4.10 Administrative Controls (GTS Chapter 5, Sections 5.1 through 5.7)

16.4.10.1 GTS Sections 5.1, Responsibility; 5.2, Organization; and 5.3, Facility Staff Qualifications

The staff reviewed these sections and found that they are consistent with W-STS and are therefore acceptable. For GTS Subsection 5.2.2, "Facility Staff," SER Chapter 18 evaluates NuScale's minimum licensed staffing requirements while 1 to 12 NPMs are operating in Mode 1, 2, or 3.

16.4.10.2 GTS Section 5.4, Procedures

<u>GTS Subsection 5.4.1, Procedures</u>

Because the GTS Subsection 5.4.1 opening paragraph and paragraphs a, b, c, d, and e are consistent with the W-STS, the staff concludes these paragraphs are acceptable. In particular, paragraph 5.4.1.a states the following:

> 5.4.1 Written procedures shall be established, implemented, and maintained covering the following activities:
>
> a. The applicable procedures recommended in Regulatory Guide 1.33, Revision 3, June 2013;

The staff noted that the Regulatory Conformance and Development Report does not describe how the availability and testing of NuScale non-safety-related SSCs, which NuScale has determined do not meet any of the four LCO selection criteria of 10 CFR 50.36(c)(2)(ii), are intended to be controlled by a NuScale Nuclear Power Plant COL holder, including references to any regulatory basis for the controls. In a letter dated August 26, 2019 (ADAMS Accession No. ML19238A372), the applicant stated that including procedural controls for such non-safety-related SSCs in Specification 5.4.1 is not required by regulation and would be inconsistent with STS 5.4.1.

The applicant proposed establishing an owner-controlled requirements manual that would provide reasonable assurance that appropriate written procedures will be established, implemented, and maintained to satisfy the availability and reliability requirements for selected non-safety-related SSCs that are within the scope of the owner-controlled requirements manual. Establishment of an owner-controlled requirements manual by a COL holder is addressed by COL Action Item 16.1-2, which DCA Part 2, Tier 2, Section 16.1.1, describes as follows:

A COL applicant that references the NuScale Power Plant design certification will prepare and maintain an owner-controlled requirements manual that includes owner-controlled limits and requirements described in the Bases of the Technical Specifications or as otherwise specified in the FSAR.

In DCA Part 2, Tier 2 (FSAR), Section 6.4.5, states that controls over the availability and reliability of the control room habitability system, including the control room envelope, will be included in the owner-controlled requirements manual; DCA Part 2, Tier 2 Section 9.4.1.4 states that controls over the availability and reliability of the control room ventilation system will be included in the owner-controlled requirements manual. The owner-controlled requirements manual addresses controls for the following:

- control room filtered ventilation systems (FSAR Section 9.4.1)
- control room ventilation system filters (FSAR Section 9.4.1)
- control room ventilation system and emergency air bottle breathing air and passive temperature control system (control room habitability system) (FSAR Sections 6.4 and 9.4.1)
- control room envelope boundary integrity control and unfiltered inleakage testing (FSAR Section 9.4.1)

Other SSCs, which are not safety related, are expected to have procedural controls appropriate to their classification. To the extent non-safety-related SSCs are described in the FSAR, changes to those descriptions will be governed by 10 CFR 50.59. SSCs described in the FSAR as being included in the owner-controlled requirements manual will be subject to whatever additional controls are included by a COL applicant to resolve COL Item 16.1-2.

Based on the above discussion and its evaluation, the staff concludes GTS Section 5.4 is acceptable.

16.4.10.3 GTS Section 5.5, Programs and Manuals

<u>GTS Subsection 5.5.1, Offsite Dose Calculation Manual (ODCM)</u>
<u>GTS Subsection 5.5.2, Radioactive Effluent Control Program</u>
<u>GTS Subsection 5.5.3, Component Cyclic or Transient Limit</u>

These three Specifications are consistent with W-STS and are therefore acceptable.

<u>GTS Subsection 5.5.4, Steam Generator (SG) Program</u>

Together with GTS Subsection 3.4.9, “SG Tube Integrity,” and GTS Subsection 5.6.5, “SG Tube Inspection Report,” the SG Program ensures that SG tube integrity is maintained. The staff compared these subsections against the corresponding provisions in W-STS as modified by STS change traveler TSTF-510-A, Revision 2. The staff also took into consideration the unique design of the NPM SGs to evaluate the proposed (1) criteria for assessing the as-found condition of a SG tube following a tube inspection, (2) SG tube integrity performance criteria (tube structural integrity, accident-induced primary-to-secondary Leakage limits, and operational primary-to-secondary Leakage limits), (3) SG tube plugging criteria, (4) criteria for selection of SG tube inspection intervals and the tubes to be inspected, and (5) provisions for monitoring operational primary-to-secondary Leakage. SER Section 5.4.2, “SG Program,” further discusses the staff’s technical evaluation of SG-related GTS requirements.

The NRC staff determined that the GTS incorporate TSTF-510 as intended, consistent with the NuScale design, and concludes that GTS Subsections 3.4.5, 3.4.9, 5.5.4, and 5.6.5 together satisfy 10 CFR 50.36(c), Subsections (2), (3), and (5), and that Bases Subsections B 3.4.5 and B 3.4.9 satisfy 10 CFR 50.36(a), and they are therefore acceptable.

GTS Subsection 5.5.5, Secondary Water Chemistry Program
GTS Subsection 5.5.6, Explosive Gas and Storage Tank Radioactivity Monitoring Program
GTS Subsection 5.5.7, TS Bases Control Program
GTS Subsection 5.5.8, Safety Function Determination Program (SFDP)

These four program Specifications are consistent with the W-STS and are therefore acceptable.

GTS Subsection 5.5.9, Containment Leakage Rate Testing Program

The staff verified that this subsection is consistent with the W-STS and satisfies the requirements of 10 CFR 50.54(o) and 10 CFR Part 50, Appendix J, “Primary Reactor Containment Leakage Testing for Water-Cooled Power Reactors,” Option A, “Prescriptive Requirements.” This program is referenced by DCA Part 4, SR 3.6.1.1 (“Perform required visual examinations and leakage rate testing in accordance with the Containment Leakage Rate Testing Program”). In Bases Subsection B 3.6.1, the Applicable Safety Analyses section defines P_a as “the calculated peak containment internal pressure 994 psia [6853 kPa (absolute)] (P_a) resulting from the limiting DBA”; the LCO section states, “Leakage integrity is assured by performing local leak rate testing (LLRT) and containment inservice inspection. Total LLRT leakage is maintained < 0.60 L_a in accordance with 10 CFR Part 50, Appendix J (Ref. 1).”

GTS Subsection 5.5.10, Setpoint Program

SER Chapter 7 gives the staff’s evaluation of TR-0616-49121-P. GTS Specification 5.5.10, paragraph b, of DCA Part 4, includes the document revision number of the NRC-approved version of TR-0616-49121-P.

Based on being consistent with the W-AP1000-STS SP, including the number of the setpoint methodology version approved by the NRC, and requiring calculation and documentation of the LTSP values in accordance with the approved setpoint methodology, the staff finds the SP satisfies the LSSS requirement of 10 CFR 50.36(c)(1)(ii)(A) and is acceptable.

GTS Subsection 5.5.11, Surveillance Frequency Control Program

SER Section 16.4.8.3 gives the staff’s evaluation of this program.

GTS Subsection 5.5.12, Spent Fuel Storage Rack Neutron Absorber Monitoring Program

Because the GTS adopt the content of the improved version of this program, as stated in STS change traveler TSTF-557-A, Revision 1, this Subsection is acceptable.

Conclusion for GTS Section 5.5

Based on the above evaluation, the staff concludes that GTS Section 5.5 is acceptable.

16.4.10.4 GTS Section 5.6, Reporting Requirements

GTS Subsection 5.6.1, Annual Radiological Environmental Operating Report
GTS Subsection 5.6.2, Radioactive Effluent Release Report

These report Specifications are consistent with the W-AP1000-STS report Specifications and are therefore acceptable.

GTS Subsection 5.6.3, Core Operating Limits Report (COLR)

By letter dated June 12, 2018 (ADAMS Accession No. ML18163A417), the applicant inserted a listing of the documents describing analytical methods previously reviewed and approved by the NRC and used to determine the core operating limits in GTS Subsection 5.6.3, paragraph b, with brackets to indicate the list is a COL action item. Along with this bracketed list, the applicant also inserted the following bracketed reviewer's note:

b. The analytical methods used to determine the core operating limits shall be those previously reviewed and approved by the NRC, specifically those described in the following documents:

> [----------------------------------REVIEWER'S NOTE---------------------------------
> The COL applicant shall confirm the validity of each listed document and the listed Specifications for the associated core operating limits, or state the valid NRC approved analytical method document and list of associated Specifications.
>
> The COL applicant shall state the valid core reload analysis methodology document and list of associated Specifications.
> --]

Each document is listed by title, revision number, and date, along with the LCOs supported by the analytical methods described in the document. Paragraph b is consistent with the W-AP1000-STS presentation regarding level of detail and format. SER Section 4.3 gives the staff's evaluation of the listed methodologies. The staff verified that the listed methodologies and associated LCOs accurately cite the FSAR sections and topical reports provided in DCA Part 2. Specification 5.6.3 encloses these methodology references and associated LCOs within brackets to indicate their designation as COL action items.

GTS Subsection 5.6.4, RCS Pressure and Temperature Limits Report (PTLR)

This report is consistent with the W-STS PTLR Specification and is therefore acceptable. SER Section 5.3 gives the staff's evaluation of TR-1015-18177, "Pressure and Temperature Limits Methodology," Revision 1.

GTS Subsection 5.6.5, Steam Generator Tube Inspection Report

This report is consistent with the W-STS SG tube inspection report and NRC staff-approved improvements described in TSTF-510-A and is therefore acceptable.

Omitted Reports Included in STS Section 5.6

As described in SER Section 16.4.1.6, the GTS do not include an LCO for PAM instrumentation; accordingly, Section 5.6 omits the PAM Report.

16.4.10.5 GTS Section 5.7, High-Radiation Area

Because GTS Section 5.7 is identical to the W-STS Section 5.7, it is acceptable.

Conclusion for GTS Chapter 5

Based on its review and the above evaluation, the staff concludes that GTS Chapter 5 satisfies 10 CFR 50.36(c)(5); therefore, the GTS administrative controls are acceptable.

16.4.11 Technical Specification Task Force Traveler Disposition

The applicant presented its evaluation of TSTF travelers in Table C-1 of Appendix C of Revision 3 of the Regulatory Conformance and Development Report. Appendix C states the following:

> The NuScale power plant design is different from previously licensed nuclear power plants. Plant operations are also different from previously operating nuclear power plants. Experience and lessons learned from the improved technical specifications were extensively considered during development of the proposed GTS.
>
> Consideration of the contents of travelers does not imply direct correspondence or functional [equivalence] unless described as such. The NuScale design is not addressed in the traveler process, so none of the travelers are explicitly applicable to the NuScale GTS. Rather the intent of the traveler was considered based on available information related to the changes made or proposed to the STS. The term 'implemented' as used below indicates the traveler changes were made to the extent practicable and appropriate for the NuScale design.
>
> The table provides details of the extent of consideration of features from the listed STS travelers that correspond with specifications included in the proposed NuScale GTS.
>
> The travelers that [were] considered are those that were issued as new or revised since the earliest manuscript date of [Revision 4 of] the [STS NUREGs], October 2011, and by comparison of the traveler content with the contents of the STS with the changes identified in the TSTF.

The staff reviewed the applicant's rationale for choosing or declining to incorporate applicable changes of each TSTF traveler that the applicant had evaluated. Travelers that were not yet approved by the staff when Revision 3 of the NuScale DCA was submitted may be recognized by having no "-A" appended to the traveler number.

In Table 16.4.11-1 to Table 16.4.11-6 below, italics denotes material quoted from Regulatory Conformance and Development Report Table C-1. Table 16.4.11-7 lists commitments that a licensee must make as a condition of NRC approval of plant-specific TS changes based on TSTF traveler changes already incorporated into Revision 4 of the STS. The status of each traveler listed in the tables below is based on its approval status when Revision 3 of DCA Part 4 was submitted to the NRC on August 22, 2019 (ADAMS Accession Nos. ML19241A434 and ML19241A435). In this SER section, the phrase "TSTF travelers proposed for incorporation" means TSTF traveler changes that the applicant has considered and found to be appropriate for the NuScale design and has proposed for the GTS to the extent practicable.

- Table 16.4.11-1 *Approved TSTF travelers proposed for incorporation:* 490-A, 493-A, 510-A, 513-A, 523-A, 529-A, 545-A, 546-A, 557-A, 563-A, 565-A

- Table 16.4.11-2 *Approved TSTF travelers not proposed for incorporation:* 426-A, 432-A, 501-A, 505-A, 514-A, 522-A, 535-A, 542-A, 547-A, 551-A, 567-A

- Table 16.4.11-3 *Unapproved TSTF travelers under NRC staff review*
  Proposed for incorporation: None
  Not proposed for incorporation:
  521, 530, 531, 536, 537, 538, 540, 541, 566, 568, 569

- Table 16.4.11-4 *Withdrawn, previously approved, or pending TSTF travelers:*
  Proposed for incorporation: None
  Not proposed for incorporation:
  454, 515, 525, 534, 553, 564

- Table 16.4.11-5 *Disposition of T-travelers:*
  Proposed for incorporation:
  502-T, 548-T, 555-T
  Not proposed for incorporation:
  494-T, 504-T, 520-T, 524-T, 526-T, 527-T, 528-T, 532-T, 533-T, 539-T, 543-T, 549-T, 550-T, 556-T, 558-T, 559-T, 560-T, 561-T, 562-T, 570-T

- Table 16.4.11-6 *Conditions for adoption of TSTF changes, which are included in STS Revision 4, and*
  Included in GTS: 359-A, 366-A, 425-A, 427-A
  Not included in GTS: 409-A, 422-A

(For the tables in this SER section, shading in the first column denotes that the listed traveler is incorporated, as described.)

16.4.11.1 Approved Technical Specification Task Force Travelers Proposed for Incorporation

The Regulatory Conformance and Development Report Table C-1 indicated the following approved travelers were proposed for incorporation, consistent with the NuScale design. Italics denotes material quoted from Regulatory Conformance and Development Report Table C-1.

Table 16.4.11-1 Approved Technical Specification Task Force Travelers Proposed for Incorporation

TSTF Traveler No.		Purpose of Traveler	Applicant's Rationale for Incorporation
490-A, Revision 1		*Deletion of E-Bar Definition and Revision to RCS Specific Activity Tech Spec*	*The proposed NuScale TS implement the TSTF changes modified to reflect the NuScale specific limits.* Changes are reflected in GTS Section 1.1, "Definitions," and Subsection 3.4.8, "RCS Specific Activity"

TSTF Traveler No.		Purpose of Traveler	Applicant's Rationale for Incorporation
493-A, Revision 4		*Clarify Application of Setpoint Methodology for LSSS Functions* in STS Section 3.3 and offer the option to implement an STS Section 5.5 setpoint program (SP)	*The proposed NuScale TS Sections 3.3 and 5.5 implement Option B of the traveler through inclusion of a Setpoint Program in Section 5.5* (GTS 5.5.10).
510-A, Revision 2 (not addressed in Regulatory Conformance and Development Report Table C-1)		"Revision to Steam Generator Program Inspection Frequencies and Tube Sample Selection."	GTS 1.1, 3.4.5, 3.4.9, 5.5.4, and 5.6.5 incorporate TSTF-510
513-A, Revision 3		*Revise PWR Operability Requirements and Actions for RCS Leakage* Detection *Instrumentation*, which affects W-STS 3.4.15.	*The contents of* this *traveler were considered during construction of proposed* GTS Subsection *3.4.7, "RCS Leakage Detection Instrumentation." The NuScale leakage detection methods are significantly different from those used in PWRs* accounted for in W-STS, CE-STS, and W-AP1000-STS.
523-A, Revision 2		*Generic Letter 2008-01, Managing Gas Accumulation*	*Affects GTS 3.5.2, "Decay Heat Removal System"* *The NuScale DHRS was conservatively determined to have the potential for accumulation of non-condensible gases. Instrumentation is provided to permit monitoring of the volume where gases could accumulate, and safety analyses are performed assuming the presence of gases in the volume above the instrumentation.* *NuScale design incorporates design features to detect postulated accumulation of non-condensible gases and safety analyses are conservatively performed assuming gases are present in the quantity that could exist before indication of their presence.*
529-A, Revision 4		*Clarify Use and Application Rules. Affects [STS] Section 1.3, "Completion Times," and [STS Bases Section B 3.0, "SR Applicability,"* of the B&W-STS, W-STS, and CE-STS.	*The changes to W-STS by this traveler are included as appropriate in the GTS, in* • *Section 1.3, See response (ML17269A210) to RAI 156-9031, Question 16-3* • *LCO 3.0.2 and Bases* • *LCO 3.0.3 Bases* • *LCO 3.0.4 Bases* • *LCO 3.0.5 Bases, See response (ML19072A287) to RAI 157-9033, Question 16-12 and SER Section 16.4.4.1.* • *SR 3.0.2 Bases* • *SR 3.0.3 Bases, See responses (ML17257A450, ML19072A287) to RAI 157-9033, Question 16-15, and SER Section 16.4.4.2.*

TSTF Traveler No.		Purpose of Traveler	Applicant's Rationale for Incorporation
545-A, Revision 3		*TS Inservice Testing (IST) Program Removal & Clarify SR Usage Rule Application to Section 5.5 Testing*	*The changes described in the TSTF were implemented in appropriate locations throughout the proposed NuScale GTS (Section 1.1, "Definitions," Subsections 3.1.9, "Boron Dilution Control," 3.4.4, "Reactor Safety Valves (RSVs)," 3.4.6, "CVCS Isolation Valves," 3.5.1, "ECCS," 3.5.2, "Decay Heat Removal System," 3.6.2, "CIVs," 3.7.1, "MSIVs," 3.7.2, "Feedwater Isolation.") The [Inservice Testing] program was incorporated into the GTS Definitions section. SRs applicable to similar components associated with functions or SSCs in the GTS were revised to be consistent with the traveler. Consistent with the TSTF traveler, the [Inservice Testing] program description is not provided in [GTS Section] 5.5 Programs. The following statement is included after the first paragraph of [Bases] Subsection B 3.0 SR Applicability: "SR 3.0.2 and SR 3.0.3 apply in Chapter 5 only when invoked by a Chapter 5 Specification."* See response (ML17257A450) to RAI 157-9033, Question 16-14. Also see response (ML19010A409) to RAI 512-9634, Question 16-60, Subquestion 49.
546, Revision 0		*Revise* average power range [neutron flux] monitor *(APRM) Channel Adjustment SR;* affects *BWR* STS reactor protection system *(RPS) instrumentation.*	*The NuScale design does not incorporate APRMs, however the excore neutron monitoring system that provides a similar function incudes requirement for calibration by comparison with a heat balance. The limits on acceptable deviation between the neutron flux monitor indication and the value measured by heat balance distinguishes between conservative and non-conservative differences, and establishes a limit and required actions to make adjustments if the difference is not in the conservative direction.* *The allowances provided by the TSTF traveler are incorporated in the proposed NuScale GTS Subsection 3.3.1, "Module Protection System Instrumentation,"* SR 3.3.1.2, surveillance column Note 3b, which applies to Functions: 1a, "Reactor Trip Signal (RTS)" on "High Power Range Linear Power"; and 1b, "Demineralized Water System Isolation (DWSI)" on "High Power Range Linear Power."

TSTF Traveler No.		Purpose of Traveler	Applicant's Rationale for Incorporation
557-A, Revision 1		*Spent fuel storage rack neutron absorber monitoring program*	*See response (ML18114A827) to RAI 316-9222, Question 9.1.1-19 regarding Specification 5.5.12 conformance to this traveler's proposed program language.*
563-A, Revision 0		*Revise definition of Channel Calibration and Channel Operational Test to permit each segment of an instrument loop to have its own Frequency controlled by the SFCP.*	*The proposed modification of the [Channel Operational Test] definition, and other instrumentation surveillance definitions, implements STS change traveler TSTF-563-A;* see SER Section 16.4.2.2.
565-A, Revision 1		*Clarify the Term Operational Convenience in the LCO 3.0.2 Bases to correct an inconsistency between the LCO 3.0.2 and LCO 3.0.3 Bases, and to restore the original intent of the phrase described in Generic Letter (GL) 87-09.*	*Addressed as described in [supplemental] response (ML18122A292) to RAI [157-9033, Question] 16-9S1.* This response stated, *"Changes have been made to the proposed NuScale technical specifications to incorporate TSTF 565, Revision 1 into the Bases of LCO 3.0.2 and LCO 3.0.3.* In Revision 2 of DCA Part 4, the Bases for LCO 3.0.2 and LCO 3.0.3 incorporated the changes of this traveler.

16.4.11.2 Approved Technical Specification Task Force Travelers Not Proposed for Incorporation

The Regulatory Conformance and Development Report Table C-1 indicated the following approved travelers were not proposed for incorporation. Italics denotes material quoted from Regulatory Conformance and Development Report Table C-1.

Table 16.4.11-2 Approved Technical Specification Task Force Travelers Not Proposed for Incorporation

TSTF Traveler No.	Purpose of Traveler	Applicant's Rationale for Non-incorporation
426-A, Revision 5	*Revise or Add Actions to Preclude Entry into LCO 3.0.3—[Risk-Informed] TSTF Initiatives 6b & 6c*	*The topical report does not apply to NuScale. The TS have been written to minimize the potential for conditions leading to explicit or default entry into LCO 3.0.3.*
432-A, Revision 1	*Change in TS End States (WCAP-16294)*, which affects W-STS action requirements	*The topical report does not apply to NuScale. The proposed NuScale TS including operational paradigm is significantly different from that addressed in the TSTF.*
501-A, Revision 1	*Relocate Stored Fuel Oil and Lube Oil Volume Values to Licensee Control*, which affects W-STS 3.8.3, "Diesel Fuel Oil, Lube Oil, and Starting Air"	*The NuScale design does not require or include safety-related onsite diesel generators. Therefore, no corresponding specification is proposed, and the TSTF traveler is not applicable.*

TSTF Traveler No.	Purpose of Traveler	Applicant's Rationale for Non-incorporation
505-A, Revision 1	*Provide Risk-Informed Extended Completion Times - [Risk-Informed TSTF] Initiative 4b, which affects W-STS and CE-STS*	*NuScale has chosen not to incorporate this traveler into the proposed GTS.*
514-A, Revision 3	*Revise BWR* STS *Operability Requirements and Actions for RCS Leakage Detection Instrumentation*	*NuScale leakage detection instrumentation and methods are not similar to those used in [General Electric (GE)] BWRs.* Therefore, changes related to this traveler are not applicable to the NuScale design.
522-A, Revision 0	*Revise Ventilation System SRs to Operate for 10 hours per Month*	*The NuScale design does not include credited ventilation systems and no TS are proposed.*
535-A, Revision 1	*Revise Shutdown Margin Definition to Address Advanced Fuel Designs – Only affects BWR STS definition of SDM.*	*Not applicable* to NuScale SDM definition.
542-A, Revision 1	*Reactor Pressure Vessel Water Inventory Control*	*Not applicable. The NuScale design and operating paradigm does not include operations at reduced inventories or water levels.* *The NuScale design and operations, including refueling activities, will not result in a potential for water inventory in the reactor vessel to be reduced to the level of the fuel. All refueling operations are conducted with the reactor vessel and fuel remaining submerged in the reactor pool.*
547-A, Revision 1	*Clarification of Rod Position Requirements;* affects W-STS Section *3.1 reactivity control specifications related to rod position requirements.*	*The NuScale core design is significantly different from that of large PWRs. The traveler was not incorporated* in Subsections 3.1.4, "Rod Group Alignment Limits," 3.1.5, "Shutdown Bank Insertion Limits," and 3.1.6, "Regulating Bank Insertion limits," *because the proposed changes are not necessary.*
551-A, Revision 3	*Revise Secondary Containment SRs; affects Bases for BWR STS Subsection 3.6.4, "Secondary Containment."*	This traveler is no*t applicable because the NuScale design does not include or credit a secondary containment or similar functional boundary and does not include a corresponding specification.*
567-A, Revision 1	*Add Containment Sump TS to Address GSI-191 Issues*	*The NuScale containment and recirculation occurs directly from the reactor pressure vessel to the containment volume via the ECCS valves. There are no equivalent components to those addressed in the traveler.*

16.4.11.3 Unapproved Technical Specification Task Force Travelers under NRC Staff Review and Not Proposed for Incorporation

Regulatory Conformance and Development Report Table C-1 indicated that no unapproved travelers, which were under NRC staff review, were proposed for incorporation. The following unapproved travelers, which were under NRC staff review, were not proposed for incorporation. Italics denotes material quoted from Regulatory Conformance and Development Report Table C-1.

Table 16.4.11-3 Unapproved Technical Specification Task Force Travelers under NRC Staff Review and Not Proposed for Incorporation

TSTF Traveler No.	Purpose of Traveler	Applicant's Rationale for Disposition
521, Revision 0	*Exclusion of Time Constants from Channel Operational Tests in* W-STS *Specifications 3.3.1,* "Reactor Protection System (RPS) Instrumentation," *and 3.3.2*, "Engineered Safety Features Actuation System (ESFAS) Instrumentation."	*The NuScale protective instrumentation does not include functions similar to the Westinghouse PWR design that this traveler is applicable to.*
530, Revision 0	*Clarify SR 3.0.3* and Section B 3.0, Bases for SR 3.0.3, *to be Consistent with Generic Letter 87-09*	The initial version of NuScale SR 3.0.3 had incorporated the content of this traveler, but that content was removed in the response (ML17257A450) to RAI 157-9033, Question 16-15, because, in 2012, the staff had declined to review this traveler. See Section 16.4.4.2 of this SER.
531, Revision 0	*Revision of Specification 3.8.1*, "AC Sources—Operating," *Required Actions B.3.1 and B.3.2.*	*The NuScale design does not depend on emergency AC power sources and there are no corresponding requirements in the proposed NuScale TS.*
536, Revision 0	*Resolve CE Digital TS Inconsistencies Regarding [Core Protection Calculators] and [Control Element Assembly Calculators]*—affects CE-STS *instrumentation and control specifications*	*The NuScale digital control system does not include CE core protection calculators (CPCs) or control element assembly calculators (CEACs), however the underlying purpose of the traveler was considered in the development of the Actions and SRs applicable to the corresponding NuScale specifications* (3.3.1, "Module Protection System";.3.3.2, "Reactor Trip System Logic and Actuation"; 3.3.3, "ESFAS Logic and Actuation"; and 3.3.4, "Manual Actuation Functions.") *The NuScale TS considered the reason for* the proposed changes *to the STS by the TSTF traveler. The specification Actions and SRs do not include Conditions unrelated to system Operability.* The staff concludes that this traveler is not adopted because it is not applicable.

TSTF Traveler No.	Purpose of Traveler	Applicant's Rationale for Disposition
537, Revision 0	*Increase containment isolation valve (CIV) Completion Times; update of TSTF-373;* affects CE-STS Subsection 3.6.3	*TSTF traveler is based on a risk-informed technical basis applicable to CE designed plants.* *The NuScale design is not consistent with the CE design and the technical basis for the traveler is not applicable to the NuScale design.*
538, Revision 0	*Add Actions to preclude entry into LCO 3.0.3—Risk-Informed TSTF (RITSTF) Initiatives 6b & 6c.* Affects B&W-STS Specifications for *containment spray and cooling systems, and emergency ventilation systems.*	*The NuScale design does not include a containment spray system or emergency ventilation systems. Containment cooling is a passive function utilizing heat transfer through the [containment vessel] walls to the reactor pool. There are no credited ventilation systems in the design that need TS.*
540, Revision 0	*Add Exceptions to SRs When the Safety Function is Being Performed;* affects *BWR specifications for secondary containment and control room ventilation and filtration systems.*	*The NuScale design does not incorporate a containment gas treatment system similar to that used by the secondary containment design of BWRs. Nor does the NuScale design credit the control room ventilation systems with performing a function that is required to be performed in response to a DBA.* The staff concludes that this traveler is not adopted because it is not applicable.
541, Revision 1	*Add Exceptions to SRs When the Safety Function is Being Performed*	The applicant withdrew all SR notes motivated by the inferred intent of this traveler, because it identified no practical configurations where such a note would provide the desired relief.
566, Revision 0	*Revise Actions for Inoperable BWR [Residual Heat Removal] Shutdown Cooling Subsystems*	The NuScale passive shutdown cooling design does not include component or configuration issues similar to those addressed in this traveler
568, Revision 0	*BWR Drywell to Suppression Chamber pressure and Primary Oxygen Concentration LCO*	*The NuScale design does not include a BWR-like drywell and suppression containment design. The NuScale containment operates at a very low pressure to support RCS leakage detection OPERABILITY as required by LCO 3.4.5.*
569, Revision 0	*Revise Response Time Testing Definition*	*The NuScale protection system is different from existing plant designs. This results in the need for different testing boundaries and approaches*

16.4.11.4 Withdrawn Previously Approved or Pending Technical Specification Task Force Travelers

Regulatory Conformance and Development Report Table C-1 indicated the following previously approved or pending travelers had been withdrawn by the TSTF. Italics denotes material quoted from Regulatory Conformance and Development Report Table C-1.

Table 16.4.11-4 Withdrawn Previously Approved or Pending Technical Specification Task Force Travelers

TSTF Traveler No.	Purpose of Traveler	Applicant's Rationale for Disposition
454, Revision 3	Staggered Integrated ESFAS Testing (WCAP-15830); affects CE-STS ESFAS and ESF surveillance tests	*The topical report does not apply to NuScale design, which uses ESFAS and ESF systems that are not similar to those accounted for in the CE-STS.*
515, Revision 0	*Revise Post-Accident Monitoring Instrumentation based on Regulatory Guide 1.97, Rev. 4 and NEDO-33349*, which affects GE-BWR4-STS (NUREG-1433) and GE-BWR6-STS (NUREG-1434) Section 3.3.3.	*Withdrawn by TSTF. Also, the NuScale design does not include any PAM instrumentation that meets the threshold for inclusion in the TS,* as described in SER Section 16.4.1.6.
525, Revision 0	*Post-Accident Monitoring Instrumentation Requirements (WCAP-15981-NP-A).* The NRC declined to review this traveler in a letter dated March 7, 2011 (ML103420584).	Since this *TSTF Traveler is specific to PAM instrumentation selection for Westinghouse designs*, it would not apply to NuScale PAM instrumentation for Type B and C variables. The applicant found no *PAM instrumentation* for Type B and C variables meeting *the threshold for inclusion in GTS,* as described in Subsection 16.4.1.6 of this SER.
534, Revision 0	*Clarify Application of Pressure Boundary Leakage Definition.* Affects W-STS Subsections 3.4.5 and B 3.4.5, "RCS Operational LEAKAGE."	The initial version of GTS Section 1.1 (added a sentence to LEAKAGE definition), GTS Subsection 3.4.5, "RCS Operational LEAKAGE," and Bases Subsection B 3.4.5 had incorporated this traveler, even though the TSTF had previously withdrawn it following receipt of NRC staff comments. In a letter dated April 22, 2019, (ML19112A378), NuScale removed the changes associated with this traveler, as requested by the staff.
553, Revision 1	*Add Action for Two Inoperable Control Room Emergency Air Temperature Control System (CREATCS) Trains; affects B&W-STS, W-STS, and CE-STS.*	*The TSTF withdrew this traveler.* In addition, since the *NuScale design does not credit a CREATCS or a similar* function*, the GTS [do] not include a corresponding specification.*
564, Revision 1	*BWR 2.1.1, Safety Limits Safety Limit [Minimum Critical Power Ratio]*	*The traveler is not applicable because it [is] related to calculating the [Minimum Critical Power Ratio] limit at BWRs. The NuScale*

TSTF Traveler No.	Purpose of Traveler	Applicant's Rationale for Disposition
		design uses a design-specific methodology for calculating core parameters and limits.

16.4.11.5 Disposition of T-Travelers

Some industry-proposed minor improvements to STS have been documented in TSTF travelers that the TSTF chose not to submit for NRC staff review. These travelers are identified with a "T" appended to the sequential TSTF number (e.g., TSTF-494-T). Such a T-traveler may become an approved traveler following staff approval of a license amendment request to incorporate the associated changes into an individual licensee's plant-specific TS. Following are the T-travelers evaluated by the applicant as described in Regulatory Conformance and Development Report Table C-1. Italics denotes material quoted from Regulatory Conformance and Development Report Table C-1.

Table 16.4.11-5 Disposition of T-Travelers

TSTF Traveler No.	Purpose of Traveler	Applicant's Rationale for Disposition
494-T, Revision 2	*Correct Bases Discussion of Figure B 3.0-1*, which is related to Bases for W-STS LCO 3.0.6	*NuScale has not incorporated the expanded explanation provided by the TSTF, consistent with NUREG-2194, Rev. 0 and the ESBWR GTS that did not incorporate the TSTF.*
502-T, Revision 1	*Correct Containment Isolation Valve Bases Regarding Closed Systems*, which affects W-STS B 3.6.3, "Containment Isolation Valves"	*The proposed NuScale Bases* for GTS Subsection 3.6.2, "Containment Isolation Valves," *incorporate the corrected wording.*
504-T, Revision 0	*Revised the Main Steam Isolation Valve (MSIV) and Main Feedwater Isolation Valve (MFIV) Specifications to Provide Actions for Actuator Trains*, which affects W-STS 3.7.1, "MSIVs" and 3.7.2, "MFIVs"	The NuScale MSIV and feedwater isolation valve (FWIV) designs do not incorporate dual actuators such that the TSTF traveler changes should be incorporated. Therefore, changes related to this traveler were not incorporated in GTS 3.7.1 "MSIVs" and GTS 3.7.2, "Feedwater Isolation."
520-T, Revision 0	*Correct* conflicting statements in CE-STS Subsection B *3.1.4,* "Control Element Assembly (CEA) Alignment," Actions section of Bases for *Required Action A.1.*	The proposed NuScale TS Bases do not include the conflicting statements. Therefore, this traveler is not applicable for incorporation in GTS Subsection B 3.1.4, "Rod Group Alignment Limits."
524-T, Revision 0	*Clarify the Application of SR 3.0.2 to SR 3.1.3.2, MTC;* affects Bases for W-STS *SR 3.1.3.2*	*The NuScale moderator temperature coefficient (MTC) specification SR does not include Notes that correspond directly with those in* W-STS Subsection 3.1.3 and Subsection B 3.1.3, Surveillance Requirements section, *and the NuScale Bases are consistent with the proposed specifications.* Therefore, this traveler is not applicable for incorporation in

TSTF Traveler No.	Purpose of Traveler	Applicant’s Rationale for Disposition
		GTS Subsection B 3.1.3, “Moderator Temperature Coefficient.”
526-T, Revision 0	*Clarify* SR section of Bases for STS Subsection concerning surveillance column *Notes regarding momentary transients outside the load band.* Affects W-STS Subsection B 3.8.1, SRs section, discussion of emergency diesel generator load tests required by SR 3.8.1.3 Note 2, SR 3.8.1.14 Note 1, and SR 3.8.1.15 Note 1.	*The NuScale design does not depend on emergency AC power sources and there are no corresponding requirements in the proposed NuScale TS.* Therefore, this traveler is not applicable for incorporation in GTS.
527-T, Revision 0	*Incorporate* Commitments *in Model Applications* for TSTF travelers *as Reviewer's Notes* in Bases of affected STS.	*This traveler describes the use of Reviewer’s Notes in the Bases of the published STS. The TSTF traveler describes the management and identification of commitments into travelers and Bases. The proposed NuScale TS are based on the licensing basis provided in the DCA.* See SER Section 16.4.11.6.
528-T, Revision 0	*Bracket Accident Analysis Discussion in LCO 3.4.4.* Affects B&W-STS (NUREG-1430) Bases Subsection B 3.4.4, “RCS Loops—MODES 1 and 2.”	*The NuScale plant does not include ‘loops’ or associated TS. The proposed NuScale Bases reflect the safety analyses applicable to the design and the use of brackets for non-COLA items is contrary to DC/COL-ISG-8.* Therefore, this traveler is not applicable for incorporation in GTS Bases.
532-T, Revision 0	*Eliminate Incorrect Reference to Appendix R in the Remote Shutdown System* (RSS) *Bases*; affects CE-STS Bases Subsection B 3.3.5	*The incorrect reference in the CE*-STS *Bases* Subsection B 3.3.5 References section *is not included in the NuScale Bases for the RSS,* G*TS* Subsection B *3.3.5. Therefore, this traveler is not applicable for incorporation in the GTS Bases.*
533-T, Revision 0	*Remove COLR and PTLR Revision and Date Relocation Provisions Added by TSTF-363, -408, and -419; affects B&W-STS, W-STS, and CE-STS*	Not included. *The NuScale administrative specifications in* GTS Section 5.6 *that describe the COLR and PTLR will include the current number, title, date, and NRC staff approval document for the methodology by NRC letter and date.* This information in GTS Subsections 5.6.3 and 5.6.4 is bracketed to denote it as part of COL Information Item 16.1-1.
539-T, Revision 0	*Correction of Post-Accident Monitoring (PAM) Instrumentation Bases;* affects B&W-STS, W-STS and CE-STS PAM instrumentation Bases.	*The NuScale PAM design does not include any variables that result in inclusion of a PAM technical specification.* See discussion in Section 16.4.1.6 of this SER.

TSTF Traveler No.	Purpose of Traveler	Applicant's Rationale for Disposition
543-T, Revision 0	*Clarify Verification of Time Constants; affects W-STS Section 3.3, [Instrumentation]*	The NuScale protective instrumentation does not include functions similar to the Westinghouse PWR design to which this traveler is applicable.
548-T, Revision 0	*Safety Function Determination Program (SFDP) Changes for Consistency;* affects W-STS *Subsection 5.5.8 program description.*	*The NuScale SFDP description provided in* GTS Subsection *5.5.8 is consistent with the intended content as previously described in* B&W-STS, CE-STS, and W-AP1000-STS.
549-T, Revision 0	*Correct* Actions section of Bases for W-STS Subsection 3.2.4, *"Quadrant Power Tilt Ratio (QPTR)."*	*The NuScale design does not include monitoring of a QPTR or QPTR-like variable. The TSTF is specific to an inappropriate wording that existed in the W-STS Bases.* This traveler is not incorporated because it does not apply to NuScale GTS Section 3.2 requirements for core operating limits.
550-T, Revision 1	*Correct Misleading Bases Statements in Systems not Required to be Operable in Shutdown Modes; affects* B&W-STS, W-STS, and CE-STS *Bases for* TS *systems that perform a support function for other* TS *systems required to be operable when the facility is shutdown. Specifically, cooling water systems.*	*The NuScale design uses a large reactor pool as the* Ultimate Heat Sink *(UHS) during operational modes and during transition and refueling operations.* The applicability of *Specification 3.5.3,* "UHS," *is "At all times" and the Bases reflect this. There are no other corresponding systems in the NuScale design that are required to be operable during* operational modes, which also *provide support functions during shutdown conditions.* Therefore, this traveler is not applicable to the NuScale design, and the GTS and Bases.
555-T, Revision 0	*Clarify the Nuclear Instrumentation Bases Regarding the Detection of an Improperly Loaded Fuel Assembly;* affects B&W-STS, W-STS, and CE-STS *Section 3.9 nuclear instrumentation specifications*. This traveler removes the incorrect claim in the STS Bases Section B 3.9.	*The NuScale design includes neutron flux instrumentation at the refueling tool that corresponds to and performs a function similar to that of the source range neutron flux monitors used at PWRs. Therefore, the GTS includes Specification 3.8.1, "Nuclear Instrumentation."* In that GTS Subsection B 3.8.1 does not include a description of an ability to detect an improperly loaded fuel assembly, this traveler is incorporated.
556-T, Revision 1	*Modify TS 3.8.1 and TS 3.8.2 Bases to Address an Open Phase Condition*	This traveler is not applicable to the GTS because the GTS have no LCOs for AC electrical power sources, since *the NuScale design does not credit offsite electrical power.*
558-T, Revision 0	*Clarify SR Bases added by TSTF-523; affects PWR and BWR specifications related to ECCS, decay heat removal, residual heat removal, shutdown cooling, and containment Spray systems.*	*Affects GTS 3.5.2, "Decay Heat Removal System (DHRS)"* *The NuScale DHRS was conservatively determined to have the potential for accumulation of non-condensible gases. Instrumentation is provided to permit monitoring of the volume where gases could*

TSTF Traveler No.	Purpose of Traveler	Applicant's Rationale for Disposition
		accumulate, and safety analyses are performed assuming the presence of gases in the volume above the instrumentation. *NuScale design incorporates design features to detect postulated accumulation of non-condensible gases and safety analyses are conservatively performed assuming gases are present in the quantity that could exist before indication of their presence.* The staff concludes that clarification of the Bases for the SRs to check for gas accumulation is not applicable to the GTS Bases for SR 3.5.2.2.
559-T, Revision 0	*Revise Bases to Reflect Revised SL Pressure Limit; affects BWR STS Bases for Subsections 2.1.1, 3.3.1, and 3.3.6.*	*This traveler resolves an issue specific to the GE design that does not correspond to a NuScale SSC or function. Therefore, this traveler is not applicable to NuScale GTS.*
560-T, Revision 0	*Addition of SRs Note for Turbine Bypass System, LCO 3.7.7 (BWR4 STS) and LCO 3.7.6 (BWR6 STS.)*	*This traveler is not applicable because no corresponding SSC or function in the NuScale design is credited or otherwise would result in inclusion in the GTS. There is no LCO for a Turbine Bypass System.*
561-T, Revision 0	*Bracket LCO 3.5.1 LCO Note in the [improved STS];* affects BWR-STS Subsection 3.5.1, "ECCS," LCO Note	*Addition of optional content or reviewer's notes to STS are not applicable or appropriate for DCA GTS submittal. Only COL-specific content is presented as bracketed content to be modified by applicants referencing the certified design.*
562-T, Revision 0	*PWR and BWR 3.8.1, AC Sources Operating Bases Clarification for TS 3.8.1, Required Actions B.3.1 and B.3.2*	*NuScale design does not credit electrical power and therefore does not include corresponding TS.* The NRC staff concludes this traveler is not applicable.

16.4.11.6 Conditions for Adoption of Technical Specification Task Force Changes Included in STS Revision 4

The staff reviewed the previously approved TSTF travelers, which are included in the W-STS, CE-STS, or both, and which the applicant determined contain changes appropriate for the NuScale design and the GTS, to verify that the applicant had satisfied the associated conditions stated in the traveler for including the changes. These travelers, some of which are marked with an asterisk (*) because they are addressed by TSTF-527-T, are given below. Italics denotes material quoted from Regulatory Conformance and Development Report Table C-1.

Table 16.4.11-6 Conditions for Adoption of Technical Specification Task Force Changes Included in STS Revision 4

TSTF Traveler No.	Purpose of Traveler	Conditions for Adoption/Reviewer's Note(s)
359-A, Revision 9	The STS Revision 2 version of LCO 3.0.4 is revised to allow entry into a MODE or other specified condition in the Applicability while relying on the associated ACTIONS, provided (a) the ACTIONS to be entered permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time, (b) a risk assessment has been performed which justifies the use of LCO 3.0.4, or (c) an NRC-approved allowance (i.e., a Required Actions Note) is provided in the Specification to be entered ("LCO 3.0.4.c is applicable"). The STS Revision 2 version of LCO 3.0.4 allows entry into a MODE or a specified condition in the Applicability, while relying on the associated ACTIONS, only if (a) the ACTIONS permit continued operation in the MODE or other specified condition in the Applicability for an unlimited period of time, or (b) if an NRC-approved allowance is provided in the Specification to be entered (LCO 3.0.4 is not applicable"). SR 3.0.4 is also revised to reflect the concepts of the changes to LCO 3.0.4. The applicability of LCO 3.0.4 and SR 3.0.4 is expanded to include transition into all MODES or other specified conditions in the Applicability, except when required to comply with ACTIONS or that are part of a shutdown of the unit.	In conformance with the commitment required as a condition of adopting TSTF-359-A, the staff requested that NuScale "perform a qualitative risk assessment for NuScale; the scope of the PWR risk assessment should focus on the transition from MODE 5 to 4, MODE 4 to 3, MODE 3 to 2, and MODE 2 to 1. Also consider unique events to the MODE of interest, such as LTOP protection. Should address 'initiating events of interest' in each Mode of operation, and determine if any systems, if inoperable, or any parameters outside its limits, should preclude entering its Mode of Applicability as allowed by LCO 3.0.4.b." SER Section 16.4.4.1 discusses the adequacy of the applicant's risk assessment and the making of a NuScale design-related change to the Bases for STS LCO 3.0.4. NuScale revised the STS Bases for LCO 3.0.4 so that the GTS Bases for LCO 3.0.4 say: "...In this context, a unit shutdown is defined as a change in MODE or other specified condition in the Applicability associated with transitioning from MODE 1 to MODE 2, and MODE 2 to MODE 3 and not PASSIVELY COOLED, and not PASSIVELY COOLED to PASSIVELY COOLED." This change was also made to the GTS Bases for LCO SR 3.0.4.
*366-A, Revision 0	Elimination of Requirements for a Post-Accident Sampling System (PASS); inserts Reviewer's Notes in W-STS 5.5.3, PASS	This traveler does not apply to NuScale, which has no PASS. The W-STS Reviewer's Notes state: "This program may be eliminated based on

TSTF Traveler No.	Purpose of Traveler	Conditions for Adoption/Reviewer's Note(s)
	CE-STS 5.5.3, PASS	the implementation of WCAP-14986, Rev. 1, 'Post Accident Sampling System Requirements: A Technical Basis,' and the associated NRC Safety Evaluation, dated June 14, 2000, and implementation of the following commitments: 1. [LICENSEE] has developed contingency plans for obtaining and analyzing highly radioactive samples of reactor coolant, containment sump, and containment atmosphere. The contingency plans will be contained in [emergency plan implementing procedures] and [implemented with the implementation of the License amendment]. Establishment of contingency plans is considered a regulatory commitment. 2. The capability for classifying fuel damage events at the Alert level threshold has been established for [PLANT] at radioactivity levels of 300 mCi/cc dose equivalent iodine. This capability will be described in emergency plan implementing procedures and implemented with the implementation of the License amendment. The capability for classifying fuel damage events is considered a regulatory commitment. 3. [LICENSE] has established the capability to monitor radioactive iodine that have been released to offsite environs. This capability is described in our emergency plan implementing procedures. The capability to monitor radioactive iodine is considered a regulatory commitment." In its response (ML19010A409) to RAI 512-9634, Question 16-60, Subquestion 44, the applicant stated the following, in part: NuScale has addressed this issue in the responses to eRAI listed below: 8837 dated May 18, 2018 (ML18138A383) 9044 dated October 31, 2017 (ML17304B483) 9278 dated May 16, 2018 (ML18136A870) As discussed in SER Section 9.3.2, the staff has determined that the requested exemption from the requirement for a PASS in

TSTF Traveler No.	Purpose of Traveler	Conditions for Adoption/Reviewer's Note(s)
		10 CFR 50.34(f)(2)(viii) should be granted. The exemption provides a regulatory basis for concluding that a PASS does not significantly contribute to NuScale plant safety or accident recovery. Therefore, no technical specification program is required.
*409-A, Revision 2	Containment Spray System Completion Time Extension (CE NPSD-1045-A); inserts Reviewer's Note in CE-STS Bases Subsection B 3.6.6.A, "Containment Spray and Cooling Systems (Atmospheric and Dual)," Actions section.	The CE-STS Bases Subsection B 3.3.6.A Reviewer's Note for Bases for Required Action A.1 states: "Utilization of the 7 day Completion Time for Required Action A.1 is dependent on the licensee adopting CE NPSD-1045-A (Ref. 6) and meeting the requirements of the Topical Report and the associated Safety Evaluation including the following commitment: '[LICENSEE] has enhanced its Configuration Risk Management Program, [as implemented under 10 CFR 50.65(a)(4), the Maintenance Rule,] to include a Large Early Release Fraction assessment to support this application.' Otherwise, a 72 hour Completion Time applies." This traveler does not apply to NuScale, which has no containment spray system.
*422-A, Revision 1	Change in Technical Specifications End States (CE NPSD-1186); inserts Reviewer's Note in CE-STS Bases Subsections.	Not applicable to NuScale GTS action requirements. The NRC staff determined that the generic TS Chapter 3 default Actions for shutting down a unit after the time allowed for restoring compliance with the LCO has expired, and the final state of the unit, are acceptable. SER Table 16.4.7-1 summarizes these Actions.
425-A, Revision 3	Relocate Surveillance Frequencies to Licensee Control - [Risk-Informed] TSTF Initiative 5b. Affects B&W-STS, W-STS, and CE-STS. Relocates most periodic surveillance frequencies and associated Bases to documentation required by a new program specified in STS Section 5.5., "Administrative Controls—Programs and Manuals," Subsection 5.5.18, "Surveillance Frequency Control Program."	DCA Part 2, Section 16.1, includes a complete listing of SRs with Frequencies controlled by the Surveillance Frequency Control Program, along with the base Frequency, and the basis of each Frequency.

TSTF Traveler No.	Purpose of Traveler	Conditions for Adoption/Reviewer's Note(s)
*427-A, Revision 2	Allowance for Non-Technical Specification Barrier Degradation on Supported System OPERABILITY. Addition of LCO 3.0.9 and associated Bases includes a Reviewer's Note regarding commitments. Affects Section B 3.0, "LCO Applicability," of B&W-STS, W-STS, and CE-STS.	Adoption of LCO 3.0.9 requires the licensee to make the following commitments: 1. [LICENSEE] commits to the guidance of NUMARC 93-01, Revision 2, Section 11, which provides guidance and details on the assessment and management of risk during maintenance. 2. [LICENSEE] commits to the guidance of NEI 04-08, "Allowance for Non-Technical Specification Barrier Degradation on Supported System OPERABILITY (TSTF-427) Industry Implementation Guidance," March 2006. SER Section 16.4.4.1 discusses the adoption of this traveler. Adoption of LCO 3.0.8 is part of COL Information Item 16.1-1.

Conclusion for TSTF Traveler Disposition

Based on its review of the Regulatory Conformance and Development Report and the above evaluation, the staff finds that NuScale's disposition of the listed TSTF travelers is acceptable.

16.5 <u>Combined License Information Items</u>

Revision 3 of DCA Part 2, Tier 2, Section 16.1.1, "Introduction to Technical Specifications," describes COL Information Item 16.1-1, as follows:

> A COL applicant that references the NuScale Power Plant design certification will provide the final plant-specific information identified by [ ] in the generic Technical Specifications and generic Technical Specification Bases.

Table 16.5-1 lists and describes COL information sub-items, as enumerated by the staff, related to bracketed information in Revision 3 of DCA Part 4, GTS and Bases.

Table 16.5-1 NuScale COL Information Item 16.1-1

Sub-Item Number	COL 16.1-1 Sub-Item Description	GTS or Bases Location
1	Confirm or update each listed critical heat flux ratio [reactor core Safety Limit correlation CHFR value]	2.1.1.1
2.1 3	Confirm Setpoints will be in owner-controlled requirements manual .... Confirm applicable edition of ASME, Boiler and Pressure Vessel Code........	B 2.1.1 B 2.1.2
4	Confirm adoption of LCO 3.0.8 and correctly phrase B 3.0 LCOs .... Confirm adoption of LCO 3.0.8 and correctly phrase LCO 3.0.1 .... Confirm performance of risk assessment if adopting LCO 3.0.8................... Confirm performance of risk assessment if adopting LCO 3.0.8................... Confirm if adopting LCO 3.0.8, and include LCO 3.0.8 if applicable .... Confirm if adopting LCO 3.0.8, and include LCO 3.0.8 if applicable............. Confirm initiating event categories if adopting LCO 3.0.8	B 3.0 LCOs LCO 3.0.1 LCO 3.0.8 B LCO 3.0.8 LCO 3.0.8 B LCO 3.0.8 B LCO 3.0.8

Sub-Item Number	COL 16.1-1 Sub-Item Description	GTS or Bases Location
	Confirm licensee commitment to NEI 04-08 if adopting LCO 3.0.8...............	B LCO 3.0.8
5	Update reference to NuScale Reload Safety Evaluation Methodology report Update reference to NuScale Reload Safety Evaluation Methodology report	B 3.1.8 ASA B 3.1.8 Ref
2.2 6 2.3 2.4	Confirm Setpoints will be in owner-controlled requirements manual .... Confirm use of sensor response time allocations (COL Item 16.1-3) .... Confirm Setpoints will be in owner-controlled requirements manual .... Confirm Setpoints will be in owner-controlled requirements manual	B 3.3.1 B SR 3.3.1.3 B 3.3.2 B 3.3.3
7 8.1 8.2 9	Confirm correct Revisions of references .... Confirm use of “required” for automatic actuation valves.............................. Confirm use of valves with actuators with pressurized accumulators .... Confirm correct Revisions of references	B 3.4.5 Ref SR 3.4.6.1 B SR 3.4.6.1 B 3.4.9 Ref
8.3 8.4 9.1 9.2 8.5 8.6 8.7 8.9 8.10 8.11	Confirm use of “required” for automatic actuation valves.............................. Confirm use of valves with actuators with pressurized accumulators .... Confirm SG level band needed to support decay heat removal system .... Confirm SG level band needed to support decay heat removal system .... Confirm use of “required” for automatic actuation valves.............................. Confirm use of valves with actuators with pressurized accumulators .... Confirm use of “required” for automatic actuation valves.............................. Confirm use of valves with actuators with pressurized accumulators .... Confirm use of “required” for automatic actuation valves.............................. Confirm use of valves with actuators with pressurized accumulators	SR 3.5.2.1 B SR 3.5.2.1 SR 3.5.2.3 B SR 3.5.2.3 SR 3.6.2.1 B SR 3.6.2.1 SR 3.7.1.1 B SR 3.7.1.1 SR 3.7.2.1 B SR 3.7.2.1
10 11 12	Insert statement describing Site Location .... Insert statement describing Site and Exclusion Boundaries .... Insert statement describing Low-Population Zone	4.1 4.1.1 4.1.2
13	Replace “[Plant Manager]” with equivalent site-specific title .... Replace “[Shift Manager (SM)]” with equivalent site-specific title .... Replace “[Plant Manager]” with equivalent site-specific title .... Replace “[specified corporate officer]” with equivalent site-specific title .... Replace “[Plant Manager]” with equivalent site-specific title .... Replace “[shift manager]” with equivalent site-specific title...........................	5.1.1 5.1.2 5.2.1 5.2.1 5.5.1.c.2 5.7.2.a.1
14 15	Confirm percent flaw depth criterion for steam generator tube plugging .... Confirm version of NuScale Instrument Setpoint Methodology.....................	5.5.4.c 5.5.10.b
16	Replace “[FSAR/QA Plan]” with equivalent site-specific title	5.2.1
17	Confirm or update each listed [document describing the NRC reviewed and approved analytical methods used to determine the core operating limits, and the supported LCOs that reference the limits in the COLR]..........................	5.6.3.b
18	Replace “[2013 Edition]” with the site-specific edition of Section III of the ASME, Boiler and Pressure Vessel Code in the Applicable Safety Analyses section of the Bases for RCS Pressure SL, and in reference 2 in the References section of the Bases..	B 2.1.2
19	Replace “[2013 Edition]” with the site-specific edition of Section XI, Article IWA-5000 of the ASME, Boiler and Pressure Vessel Code in reference 3 in the References section of the Bases.....................................	B 2.1.2
20	Confirm Revision to TR-1015-18177, “PTL Methodology”	5.6.4
Abbreviations:		

Sub-Item Number	COL 16.1-1 Sub-Item Description	GTS or Bases Location
ASA Applicable Safety Analysis section of a Bases Subsection B Bases Ref References section of a Bases Subsection		

DCA Part 2, Section 16.1.1 describes COL Information Item 16.1-2 as follows:

> A COL applicant that references the NuScale Power Plant design certification will prepare and maintain an owner-controlled requirements manual that includes owner-controlled limits and requirements described in the Bases of the Technical Specifications or as otherwise specified in the FSAR.

DCA Part 2, Section 16.1.1 describes COL Information Item 16.1-3 as follows:

> A COL applicant that references the NuScale Power Plant design certification, and uses allocations for sensor response times based on records of tests, vendor test data, or vendor engineering specifications as described in the Bases for Surveillance Requirement 3.3.1.3, will do so for selected components provided that the components and methodology for verification have been previously reviewed and approved by the NRC.

The staff finds that the proposed COL information related to DCA Part 4 is appropriate for completion by a COL applicant referencing the design.

16.6 <u>Conclusion</u>

The staff finds that the NuScale GTS and Bases comply with 10 CFR 50.34, “Contents of Applications; Technical Information”; 10 CFR 50.36; and 10 CFR 50.36a, and are therefore acceptable.