SAFETY EVALUATION BY THE OFFICE U.S. NUCLEAR REGULATORY COMMISSION

REVIEW OF NUSCALE PRESSURE AND TEMPERATURE LIMITS METHODOLOGY

NUSCALE POWER, LLC

THIS NRC STAFF DRAFT SE HAS BEEN PREPARED AND IS BEING RELEASED TO SUPPORT INTERACTIONS WITH THE ACRS. THIS DRAFT SE HAS NOT BEEN SUBJECT TO FULL NRC MANAGEMENT AND LEGAL REVIEWS AND APPROVALS, AND ITS CONTENTS SHOULD NOT BE INTERPRETED AS OFFICIAL AGENCY POSITION

1.0 INTRODUCTION

By letter dated November 29, 2022, NuScale Power, LLC. (NuScale or the applicant) submitted Technical Report TR-130877, Revision 0, "Pressure and Temperature Limits Methodology," in support of the NuScale Standard Design Approval Application (SDAA). The purpose of this report is to provide the generic basis for the generation of pressure-temperature (P-T) limits referenced in NuScale SDAA Section 5.3. As such, this pressure and temperature limits methodology report (PTLM) contains an evaluation of the NuScale Power Module (NPM) supporting the generation of pressure-temperature limit reports (PTLR). The NPM includes all of the reactor pressure vessel (RPV), including beltline, closure flange; and the upper NPM which includes components such as the steam plenum shell and pressurizer shell. The information in this report is generic to the preliminary NuScale design and is expected to apply to all combined license (COL) applicants referencing the NuScale SDAA.

The first part of the staff's review was to ensure that the information in the SDAA PTLM and the SDAA technical specification (TS) pages is in accordance with the guidance in Generic Letter (GL) 96-03, "Relocation of the Pressure Temperature Limit Curves and Low Temperature Overpressure Protection System Limits," dated January 31, 1996. The second part of the staff's review was to verify that the proposed P-T limits methodology appropriately analyzes the NuScale SDAA design. The staff noted significant design changes between the SDAA and previously approved NuScale Design Certification (DC); consequently, the review of the SDAA PTLM and PTLR approach could not rely substantially on the past DC PTLR review.

2.0 REGULATORY EVALUATION

2.1 10 CFR Part 50 Requirements for Generating Pressure-Temperature Limits and Low Temperature Overpressure Protection System Limits for Pressurized-Water Reactors

The NRC has established requirements in Appendix G, "Fracture Toughness Requirements," to Title 10 of the *Code of Federal Regulations* (10 CFR) Part 50, "Domestic Licensing of Production and Utilization Facilities," in order to protect the integrity of the reactor coolant pressure boundary (RCPB) in nuclear power plants. Appendix G to 10 CFR Part 50 requires the P-T limits for an operating light-water nuclear reactor to be at least as conservative as those that would be generated using the methods of Appendix G to Section XI of the American Society of Mechanical Engineers Boiler and Pressure Vessel Code (ASME Code). For conditions with the core critical, P-T limits must be more conservative than the limits in ASME Code Section XI, Appendix G. Table 1 of 10 CFR Part 50, Appendix G summarizes the requirements for P-T limits relative to the criteria in ASME Code Section XI, Appendix G, as well as the minimum temperature requirements for bolting up the RPV during normal and pressure testing operations.

Appendix G to 10 CFR Part 50 requires that applicable surveillance data from RPV material surveillance programs be incorporated into the calculations of plant-specific P-T limits, and that the P-T limits for operating reactors be generated using a method that accounts for the effects of neutron irradiation on the RCPB. Appendix G to 10 CFR Part 50 also establishes conservative requirements for determining the temperature and pressure setpoints for low temperature overpressure protection (LTOP) systems. P-T limits and LTOP system limits are subject to General Design Criterion (GDC) 14, "Reactor Coolant Pressure Boundary," GDC 15, "Reactor Coolant System Design," GDC 30, "Quality of Reactor Coolant Pressure Boundary," and GDC 31, "Fracture Prevention of Reactor Coolant Pressure Boundary," of Appendix A, "General Design Criteria for Nuclear Power Plants," to 10 CFR Part 50.

Appendix H, "Reactor Vessel Material Surveillance Program Requirements," to 10 CFR Part 50 provides the NRC's criteria for the design and implementation of RPV material surveillance programs for operating light-water reactors. The requirements for protecting the RVs of pressurized-water reactors against pressurized thermal shock (PTS) events appear in 10 CFR 50.61, "Fracture Toughness Requirements for Protection against Pressurized Thermal Shock Events." Regulatory Guide (RG) 1.99, Revision 2, "Radiation Embrittlement of Reactor Vessel Materials," issued May 1988, contains staff regulatory guidance related to determining the effects of radiation embrittlement on RPV material parameters and P-T limit curves. The staff guidance related to the review of P-T limit curves and PTS criteria appears in Section 5.3.2, "Pressure-Temperature Limits, Upper-Shelf Energy, and Pressurized Thermal Shock," of NUREG-0800, "Standard Review Plan for the Review of Safety Analysis Reports for Nuclear Power Plants: LWR Edition," while NUREG-0800, Section 5.2.2, "Overpressure Protection," contains staff guidance related to the review of LTOP system limits.

GDC 14, 30, and 31 specify the regulatory requirements for RPV neutron fluence calculations. In March 2001, the staff issued RG 1.190, "Calculational and Dosimetry Methods for Determining Pressure Vessel Neutron Fluence." The staff has approved RPV neutron fluence calculation methods that satisfy the requirements of GDC 14, 30, and 31 by adhering to the guidance in RG 1.190. Neutron fluence calculations are acceptable if they are done with approved methods or with methods that are shown to conform to the guidance in RG 1.190.

The most recent version of ASME Code Section XI, Appendix G that the NRC has endorsed in 10 CFR 50.55a, "Code and Standards," and therefore by reference in Appendix G to 10 CFR Part 50, is the 2019 Edition of the ASME Code. The NuScale SDAA references the 2017 Edition of the ASME Code. Additionally, 10 CFR Part 50, Appendix G imposes minimum head flange temperatures when the system pressure is at or above 20 percent of the preservice hydrostatic test pressure.

GL 96-03 addresses the technical information necessary for a licensee to implement a PTLR. It establishes the information that must be included in (1) an acceptable PTLR methodology (with the P-T limit methodology as its subset) and (2) the PTLR itself. Technical Specification Task Force-419, "Revise PTLR Definition and References in ISTS 5.6.6, RCS PTLR," dated September 16, 2001 (ML012690234), provides additional guidance that gives an alternative format for documenting the implementation of a PTLR in the "Administrative Controls" section of a facility's TS. GL 96-03 specifically notes that PTLR should be provided to the NRC upon "issuance after each fluence period or EFPYs." For the specific case of the NuScale SDAA the relevant consideration in updating the PTLR to account for changes in fluence is whether any ferritic materials above the austenitic materials have or will have fluence sufficiently high to require verification of the P-T Limits.

The NuScale SDAA, Part 7, includes two Exemptions: 6 “10 CFR 50.60 Acceptance Criteria for Fracture Prevention Measures,” and 15 “10 CFR 50.61 Fracture Toughness Requirements for Protection Against Pressurized Thermal Shock Events,” (hereafter referred to as the Exemptions) to the requirements above. These Exemptions are subject to 10 CFR 50.12, “Specific Exemptions.” These Exemptions impact several aspects of the PTLM review. The nature and review of these Exemptions is documented in the NRC staff evaluation of the SDAA.

In addition, NuScale SDAA, Part 2, Section 5.3.2 includes a combined operating license (COL) action item 5.3-1 which details information a COL applicant should include in order to use the PTLM. RG 1.206, Section C.2.11 describes COL Action Items, describing them as regulatory matters deferred to the COL applicant to address in COL applications. Not all aspects of COL Action Items must be completed during the COL application period, some may be completed after through post-license information commitments identified by the COL applicant or by the NRC staff during application review.

2.2 Technical Specification Requirements for Pressure-Temperature Limits and Low Temperature Overpressure Protection System Limits

Section 182a of the Atomic Energy Act of 1954, as amended, requires applicants for nuclear power plant operating licenses to include TS as part of the operating license. The Commission sets forth its regulatory requirements related to the content of the TS in 10 CFR 50.36, “Technical Specifications.” That regulation requires that the TS include items in five categories: (1) safety limits, limiting safety system settings and limiting control settings, (2) limiting conditions of operation (LCOs), (3) surveillance requirements, (4) design features, and (5) administrative controls.

In 10 CFR 50.36(c)(2)(ii), the NRC requires that LCOs be established for the P-T limits and LTOP system limits because the parameters fall within the scope of Criterion 2 identified in the rule:

> 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.

The P-T limits and LTOP system limits for pressurized water reactors fall within the scope of Criterion 2 of 10 CFR 50.36(c)(2)(ii) and are therefore ordinarily required to be included within the TS LCOs for a plant-specific facility operating license.

On January 31, 1996, the staff issued GL 96-03, which informed licensees that they may request a license amendment to relocate the actual P-T limit curves and LTOP system limit values from the TS LCOs on P-T limits and LTOP system limits and into a PTLR or other licensee-controlled document that would be administratively controlled through the administrative controls section of the TS. COL applicants referencing previously certified standard designs may include the design-limiting P-T limits, LTOP system limits, and related input parameters in a PTLR that is generic to the certified design. GL 96-03 indicated that licensees or applicants seeking to locate P-T limits and LTOP system limits for their reactors in PTLRs would need to generate their limits in accordance with an NRC-approved methodology, and that the method used to generate the limits would need to comply with the requirements of Appendices G and H to 10 CFR Part 50. Furthermore, the method used to generate the P-T limits and LTOP system limits would need to be incorporated by reference in the administrative controls section of the TS. The GL also mandated that the TS administrative controls section for the PTLR would need to reference the staff's safety evaluation issued on the PTLR methodology and that the PTLR be defined in Section 1.0 of the TS. Attachment 1 to GL 96-03 listed the criteria that the approved PTLR methodology and PTLR application would need to meet.

3.0 TECHNICAL EVALUATION

3.1 NuScale Generic Technical Specification Requirements for Implementation and Control of a Pressure and Temperature Limits Report

The staff reviewed the NuScale SDAA generic TS to ensure that they contain all of the necessary provisions required for the implementation and control of a PTLR. Part 4 of the NuScale SDAA references the NuScale generic TS. The relevant generic TS requirements include the TS definition of the PTLR (TS Section 1.1); the TS LCOs for the reactor coolant system (RCS) P-T limits (LCO 3.4.3) and the LTOP system (LCO 3.4.10), including LCO action statements, surveillance requirements, and related applicability criteria; and the necessary administrative controls governing the PTLR content and reporting requirements (TS 5.6.4). The staff found all of the TS pages related to the implementation and control of a PTLR acceptable, pending the approval of a PTLM that is generic to the NuScale design.

3.2 Evaluation of the NuScale Generic PTLR Contents and Methodology against the Seven Criteria for PTLR Contents in Attachment 1 of GL 96-03

The NuScale SDAA PTLM provides the generic P-T limits and LTOP system limits for the NuScale NPM and the methodology for their development. This report is generic for the preliminary NuScale SDAA design and is specifically referenced in Section 5.6.4 of the NuScale generic TSs as the controlling document governing future changes to PTLRs for NuScale SDAA plants. Accordingly, the PTLM uses generic inputs for NPM material chemistry, initial nil-ductility reference temperature (RT_{NDT}) values, and projected neutron fluence to determine the P-T limit curves. These generic inputs are intended to be bounding for the NuScale SDAA design; they represent the maximum allowable limits on the input parameters for any specific NuScale SDAA plant. The analysis conducted supporting the generation of a PTLR relies on preliminary design information which lacks several aspects supporting a staff finding. The information gaps are presented in NuScale SDAA COL Item 5.3-1.

> An applicant that references the NuScale Power Plant US460 standard design will choose the final transients to generate the reactor vessel pressure-temperature limits report and limiting conditions for operation. An applicant that references the NuScale Power Plant US460 standard design will confirm that the design geometries, final transients, and material properties of the reactor pressure vessel are bounded by (or identical to) those used in the Pressure and Temperature Limits Methodology to confirm that the example curves in the Standard Design Approval Application are applicable. Operating procedures will ensure that pressure-temperature limits for the as-built reactor are not exceeded. These procedures will be based on the limits defined in the pressure-temperature limits report and material properties of the as-built reactor vessel.

Consequently, the creation of a PTLR relies on COL applicant inputs and NRC verification that appropriate P-T analysis have been conducted. This will ensure that the operating procedures are adequately bounded by the approved methodology.

Attachment 1 of GL 96-03 contains seven technical criteria to which the contents of PTLRs should conform if P-T limits and LTOP system limits are to be located in a PTLR as described in GL 96-03. The subsections that follow give the staff's evaluations of using the NuScale PTLM to generate future PTLRs against the seven criteria in Attachment 1 of GL 96-03.

3.2.1 PTLR Criterion 1

PTLR Criterion 1 states that the PTLR contents should include the neutron fluence values that are used in the calculations of the adjusted reference temperature (ART) values for the P-T limit calculations. Accurate and reliable neutron fluence values are required in order to satisfy the provisions of GDC 14, 30, and 31 of 10 CFR Part 50, Appendix A, as well as the specific fracture toughness requirements of 10 CFR Part 50, Appendix G, and 10 CFR 50.61. Section 3.1.1 of the NuScale PTLM, detailing the reactor vessel (RV) neutron fluence calculation method, indicates that the neutron fluence is greater than 1 x 10^{17} n/cm^2 (E > 1 MeV) only within the austenitic stainless steel lower NPM (e.g. the RPV and lower RPV flange region). The ferritic materials in the upper NPM are projected to accrue fluence less than 1 x 10^{17} n/cm^2 (E > 1 MeV) over the design life of the NuScale SDAA design.

Because the lower RPV is designed to be constructed from austenitic stainless steel, the staff recognized that the subject neutron fluence necessary to significantly impact the fracture toughness of the lower RPV is considerably higher for the NuScale SDAA than for a vessel constructed of traditional ferritic steel. Exemptions 6 and 15 of the NuScale SDAA discuss the impact of this material selection and approval thereof exempt the applicant from aspects of 10 CFR 50.60 and 50.61 due to the superior fracture toughness properties of the selected lower RPV material. Consequently, the staff reviewed the fluence estimates for the RPV to understand whether there was any likelihood of measurable neutron fluence impacts on the fracture toughness of the lower RPV or upper RPV. This is discussed further in the staff evaluation of the NuScale SDAA.

The fluence calculation methodology for the NuScale SDAA NPM is in accordance with RG 1.190 with exceptions as described in Technical Report TR-118976-P, Revision 1, "Fluence Calculation Methodology and Results." The staff discusses its evaluation of that technical report in the safety evaluation report for NuScale SDAA, Section 4.3. In addition, NuScale provided peak RPV lower flange neutron fluence values projected to 57 effective full-power years (EFPY) of operation in Section 4.3.1 of the PTLM. Because the lower RPV is constructed of austenitic stainless steel, the staff reviewed the PTLM to verify that estimation of the fluence received by ferritic materials in the upper NPM were adequately projected. Based on the above, the staff find that the likelihood of measurable neutron fluence impacts on the fracture toughness of the lower and upper RPV has been appropriately analyzed and is very low.

The staff has determined that these neutron fluence values were calculated using an NRC approved methodology that is appropriately consistent with the guidelines in RG 1.190. The inclusion of valid peak RPV lower flange neutron fluence values calculated using a neutron fluence methodology that is in conformance with RG 1.190 fulfills the provisions of PTLM Criterion 1. Therefore, the staff determined that PTLR Criterion 1 is satisfied for PTLRs generated using the PTLM.

3.2.2 PTLR Criterion 2

PTLR Criterion 2 states, in part, that the RV material program shall comply with Appendix H to 10 CFR Part 50. The NuScale SDAA Exemptions exempt, in part, the design from the requirements of 10 CFR 50.60, e.g. compliance with 10 CFR Part 50, Appendix H. This is discussed in the staff evaluation of Exemption 6 in the NuScale SE Section 5.3.4.

The peak fluence of the lower RPV is substantially lower than what would cause significant reduction in fracture toughness in austenitic stainless steel. Further the ferritic portions of the NPM receive fluence such that neutron fluence embrittlement would be too small to measure. Consistent with the staff evaluation of the Exemptions, there is no justifiable need for a surveillance program.

Based on the staff evaluation of the Exemptions, the NuScale SDAA NPM has adequate provision for surveillance (e.g. surveillance is unnecessary). Consequently, for the purposes of Criterion 2 the NuScale SDAA and PTLM have an adequate surveillance program.

3.2.3 PTLR Criterion 3

The RPV and connected components of the RCPB are designed to withstand the effects of system pressure and temperature variations introduced by controlled heatup and cooldown operations, and operational transients for a specific RPV fluence period or the EFPYs in accordance with the SDAA TS 5.6.4. However, the RPV is considered the most critical component susceptible to non-ductile failure because of the neutron fluence experienced over the vessel lifetime. GL 96-03, Criterion 3 states that the LTOP System lift setting limits developed using NRC-approved methodologies may be included in the PTLR. The detailed analytical methodology for developing the LTOP system limits is described in the PTLR.

The NuScale LTOP mode of operation controls the RCS pressure at low temperatures such that the integrity of the RCPB is not compromised by violating 10 CFR Part 50, Appendix G. Based on the criticality status and RPV pressure, 10 CFR Part 50, Appendix G, Table 1, in concert with ASME, Section XI, Appendix G derived limits, defines requirements for pressure-temperature limits and the minimum temperature. The LTOP mode of operation for overpressure protection of the NuScale RPV consists of two emergency core cooling system reactor vent valves (RVV) mounted on the upper head of the RPV above the pressurizer volume which discharge reactor coolant directly into the containment. Each RVV is designed with sufficient relief capacity to prevent any pressure transient from exceeding the brittle fracture stress limits of the RPV and RCPB pressure-retaining components when operating at low temperature conditions. The NuScale FSAR Sections 5.2.2 and 6.3 provide a discussion of the RVV design with a summary of the design parameters in FSAR Table 6.3-2.

NuScale SDAA FSAR, Table 5.2-5 provides the LTOP pressure setpoint values as a function of cold temperature using linear interpolation between the values up to the LTOP limit of 290 °F and NuScale SDAA FSAR, Figure 5.2-3 provides a graphical profile of the variable setpoint. This temperature dependent pressure setpoint array is programmed into the module protection system (MPS) which monitors these process variables and actuates the engineered safety features actuation system (ESFAS) whenever the pressure setpoint is reached. ESFAS provides the valve control actuation to the RVV's pilot valve assembly when RPV temperature is below the LTOP enabling temperature. TSs LCOs 3.3.1, 3.4.3, and 3.4.10 are applicable to ensure the RVVs are operable to maintain the pressure and temperature within the limits specified in the PTLR during LTOP heatup and cooldown operation.

As described in NuScale FSAR Section 6.3.2.2, "Equipment and Component Descriptions," for low temperature operations, the RVV main valve is actuated automatically by a safety function signal from the MPS that de-energizes the actuator trip valve solenoid whenever the reactor pressure reaches the setpoint value. The de-energized trip pilot valve allows the hydraulic line from the main valve control chamber to vent into the containment vessel allowing spring force and RCS pressure to open the main valve.

In addition, COL Item 5.2-1 states that the COL applicant that references the NuScale Power Plant design certification will provide a certified Overpressure Protection Report in compliance with the ASME Code, Section III, NB-7200 and NC-7200 to demonstrate the RCPB and secondary system design contains adequate overpressure protection features, including low temperature overpressure protection features.

A plant-specific pressure and temperature limit curves are addressed in the PTLR, consistent with an approved methodology. Based on the above, the staff has concluded that the provisions of PTLR Criterion 3 is satisfied.

3.2.4 PTLR Criterion 4

PTLR Criterion 4 states that the adjusted reference temperature (ART) for each reactor beltline material shall be calculated, accounting for irradiation embrittlement, in accordance with RG 1.99, Revision 2. This supports use of ART to comply with regulations such as Appendix G to 10 CFR Part 50.

Appendix G to 10 CFR Part 50 requires that the P-T limits for operating reactors be generated using a method that accounts for the effects of neutron embrittlement on the fracture toughness of RPV beltline materials. As discussed in previous sections, and detailed in the staff evaluation of the Exemptions in the SDAA, the NuScale SDAA design will not accrue appreciable neutron embrittlement in any of the subject materials. Consequently, the initial RT_{NDT} is the bounding RT_{NDT} for the design life of the NPM and will not change. The maximum RT_{NDT} is given in Sections 3.5 and 4.2 of the PTLM report.

The staff verified that the subject limitations based on initial (bounding) RT_{NDT} were appropriately calculated consistent with Appendix G, as modified by the Exemptions, and consistent with the stated maximum initial (bounding) RT_{NDT}. Therefore, the staff determined that the provisions of PTLR Criterion 4 are satisfied for PTLRs generated using the PTLM.

3.2.5 PTLR Criterion 5

Section IV.A.2 of 10 CFR Part 50, Appendix G requires that the P-T limits for operating reactors and the minimum temperatures established for the stressed regions of RPVs (i.e., for the RPV flange and stud assemblies) be met for all conditions. Section IV.A.2 also requires that the P-T limits for operating reactors must be at least as conservative as those that would be generated if the methods of analysis in ASME Code, Section XI, Appendix G were used to generate the P-T limit curves. Table 1 of 10 CFR Part 50, Appendix G summarizes the required criteria for generating the P-T limits for operating reactors.

To ensure that PTLRs are in compliance with the above requirements, PTLR Criterion 5 states that the PTLR contents should provide the P-T limit curves for heatup and cooldown operations, core critical operations, and pressure testing conditions for operating light-water reactors. Figures 4-1 through 4-7 of the NuScale SDAA PTLM give the P-T limit curves for inservice-leak and hydrostatic testing; heatup and power-ascent; and power descent and cooldown.

Because the impact of neutron embrittlement is minor for the NuScale SDAA design, the potential limiting locations in the NPM are not those with the highest embrittlement, rather they are those where geometric discontinuities create stress risers. Section 3.3.3 of the NuScale SDAA PTLM indicates that axial and circumferential flaw locations at the most limiting thermal and pressure stress locations were analyzed with postulated flaws. The staff audited the NuScale SDAA PTLM to verify that the potential locations were appropriately identified and analyzed. This audit focused principally on detailed review of the internal NuScale P-T Limits calculation EC-107452, Revision 2. The staff conducted independent confirmatory calculations, for example regarding those described in TLR-RES/DE/REB-2024-01, "Confirmatory Calculation: Influence of Cladding Modeling Assumptions for NuScale Pressure - Temperature Limits" (ML24061A036) using non-proprietary and illustrative inputs. The TLR referenced above documents staff FAVPRO calculations (an NRC developed RPV probabilistic fracture mechanics code package). The staff also: (1) conducted hand calculations to verify elements of the PTLM approach; (2) verified that the PTLM was implemented according to modern best practices (calculation setup, modeling of clad, selection of nodes, etc.); and thoroughly evaluated potentially limiting locations as described in the PTLM through the audit process.

The staff noted that the transients analyzed under the PTLM are meant to be bounding, as discussed in Section 3.3 of the PTLM. This includes nominal maximum rate of temperature change greater than expected operation such as bounding rates of 100 degrees F per hour for the average coolant temperature and 200 degrees F per hour for the pressurizer temperature; or the maximum rate possible with plant-specific equipment. The staff noted that the PTLM analysis includes transients where these rate limits are held on average, but which include peak rates higher than this for short periods of time. Because these transients are input directly into the PTLM calculations, the staff found that this is acceptable (e.g. the stress peaks caused by such rapid temperature changes are accounted for in the calculations).

The staff further noted that the transients used in the NuScale SDAA PTLM are based on the preliminary design available prior to the NuScale SDAA review. NuScale SDAA COL Item 5.3-1 requires,

> An applicant that references the NuScale Power Plant US460 standard design will choose the final transients to generate the reactor vessel pressure-temperature limits report and limiting conditions for operation. An applicant that references the NuScale Power Plant US460 standard design will confirm that the design geometries, final transients, and material properties of the reactor pressure vessel are bounded by (or identical to) those used in the Pressure and Temperature Limits Methodology to confirm that the example curves in the Standard Design Approval Application are applicable. Operating procedures will ensure that pressure-temperature limits for the as-built reactor are not exceeded. These procedures will be based on the limits defined in the pressure-temperature limits report and material properties of the as-built reactor vessel.

Adherence to NuScale SDAA COL Item 5.3-1 is an essential portion of the PTLM and necessary for use of this approval as discussed below.

The staff reviewed the approach the applicant took to generating their analyses for the P-T curves for inservice-leak and hydrostatic testing; heatup and power-ascent; and power descent and cooldown in the NuScale SDAA PTLM. Based on this review, the staff determined that the applicant developed its proposed P-T limits in accordance with ASME Code, Section XI, Appendix G, and that the limits therefore satisfy the requirements of 10 CFR Part 50, Appendix G subject to the NuScale SDAA preliminary transients. Hence, the applicant's proposed P-T limit curves are acceptable for operation of the NPM subject to the preliminary transients and with the NPM geometries available during the generation of the NuScale SDAA PTLM. The staff finds that the provisions of PTLR Criterion 5 are satisfied for these preliminary inputs, and that implementation of NuScale SDAA COL Item 5.3-1 by users of the PTLM to generate PTLRs will ensure that COL design transients are bounded by the preliminary curves, or new curves generated with the final transients consistent with the PTLM; and that the COL applicant confirms that any results used relying on the PTLM geometries bound the COL design geometries.

3.2.6 PTLR Criterion 6

Section IV.A.2 of 10 CFR Part 50, Appendix G requires that the P-T limits for operating reactors and the minimum temperature requirements for the highly stressed regions of the RVs (i.e., for the RPV flange and stud assemblies) be met for all conditions. Table 1 of 10 CFR Part 50, Appendix G provides the criteria for meeting the minimum temperature requirements for the highly stressed regions of the RPV. The applicant provided a completed Table 1 in Table 4-1 of the NuScale SDAA PTLM.

PTLR Criterion 6 states that the minimum temperature requirements of 10 CFR Part 50, Appendix G shall be incorporated into the P-T limit curves, and the PTLR shall identify minimum temperatures on the P-T limit curves such as the minimum boltup temperature and the hydrotest temperature. The staff determined that the curves were in compliance with the minimum temperature requirements of 10 CFR Part 50, Appendix G. Furthermore, the PTLM clearly identifies the minimum boltup temperature and hydrotest temperature on the P-T limit curves. Therefore, the staff determined that the provisions of PTLR Criterion 6 are satisfied for PTLRs generated using the PTLM.

3.2.7 PTLR Criterion 7

This criterion does not apply to the NuScale SDAA. No surveillance program is necessary for the NuScale SDAA as described in Section 3.2.2 of this SE, consequently the use of results of surveillance does not apply.

The staff determined that the provision of PTLR Criterion 7 is satisfied because no capsules will be removed and Criterion 7 will not be triggered. Consequently, the staff find that PTLRs generated using the PTLM are adequate under PTLR Criterion 7.

5.0 CONCLUSION

The staff has completed its review of the NuScale SDAA PTLM and determined that the contents of the NuScale PTLM conform to the staff's technical criteria for supporting generation of PTLRs as defined in Attachment 1 of GL 96-03 based on the information available during review. The staff has also determined that the PTLM has satisfied the requirements of 10 CFR Part 50, Appendix G based on the information available during review. Furthermore, the staff has determined that the NuScale SDAA PTLM is compatible with the NuScale generic TS and that the PTLR-related TS provisions meet the technical criteria of GL 96-03. Based on this evaluation, the staff concludes that the latest revision of the NuScale SDAA PTLM, in concert with NuScale SDAA COL Item 5.3-1, provides an adequate basis to generate PTLRs as described in GL 96-03.

The staff notes that NuScale SDAA COL Item 5.3-1 would require detailed technical review and without the information detailed in COL Item 5.3-1 the PTLM is incomplete.

Should such review conclude with an approval, pursuant to TS 5.6.4c, future NuScale SDAA COL holders would be required to provide the PTLR to the NRC upon issuance for each RPV neutron fluence period or EFPYs and for any PTLR revision or supplement thereto; in addition, they must meet NuScale SDAA COL Item 5.3-1, and be subject to the NuScale SDAA Exemptions 6 and 15. Finally, in accordance with GL 96-03, the NRC must approve any subsequent changes in the method used to develop the P-T limits.