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Docket No. 52-048

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Submittal of Changes to Final Safety Analysis Report, Section 3.9.1, “Special Topics for Mechanical Components”

REFERENCES: Letter from NuScale Power, LLC to Nuclear Regulatory Commission, “NuScale Power, LLC Submittal of the NuScale Standard Plant Design Certification Application, Revision 3,” dated August 22, 2019 (ML19241A315)

During the Component Stress and Fatigue Analyses audit, conducted between May 1, 2019 to September 19, 2019, the need for additional clarification in the Final Safety Analysis Report (FSAR), Section 3.9.1, “Special Topics for Mechanical Components” was identified. As a result of this request, NuScale has changed the Section 3.9.1, “Special Topics for Mechanical Components.” The Enclosure to this letter provides a mark-up of the FSAR pages incorporating revisions to the FSAR Section 3.9.1 in redline/strikeout format. NuScale will include these changes as part of a future revision to the NuScale Design Certification Application.

This letter makes no regulatory commitments or revisions to any existing regulatory commitments.

If you have any questions, please feel free to contact Marty Bryan at 541-457-7172 or mbryan@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
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Enclosure: Changes to NuScale Final Safety Analysis Report Section 3.9.1, “Special Topics for Mechanical Components”

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Changes to NuScale Final Safety Analysis Report Section 3.9.1, “Special Topics for Mechanical Components”

These conditions include pressure tests required by ASME BPVC, Section III (Reference 3.9-1), and other tests required by the design specifications.

Table 3.9-1, Summary of Design Transients, lists the design transients by ASME service level and includes the number of events over the design life of the plant for each transient. Load combinations and their acceptance criteria are given in Section 3.9.3 for mechanical components and associated supports and in Section 3.12 for piping systems.

The Service Level A and B transients are representative of events that are expected to occur during plant operation. These transients are severe or frequent enough to be evaluated for component cyclic behavior and equipment fatigue life, and the analyzed conditions are based on a conservative estimate of the frequency and magnitude of temperature and pressure changes. When used as a basis for component fatigue evaluation, the bounding transients provide confidence that the component is appropriate for its application over the design life of the plant. Service Level C and D conditions are not typically included in fatigue evaluations in accordance with the ASME BPVC, Section III (Reference 3.9-1). For select component and transient combinations, Service Level C events are evaluated against Level B stress limits. This selection is made either because the event contains significant stress cycles or the transient is considered a normal design operation for that component. The following sections describe the assumptions used in thermal-hydraulic analysis for each Service Level.

3.9.1.1.1 Service Level A Conditions

Service Level A Transient 1 - Reactor Heatup to Hot Shutdown

This transient covers the heatup and pressurization from transition mode to hot shutdown. The event begins with a depressurized reactor vessel filled with water. The CNV also is filled initially with water up to the elevation of the pressurizer baffle plate.

The CNV is pressurized to at-or-above the minimum pressure required to begin the containment drain process. The RCS is pressurized equivalently by adding nitrogen gas to the pressurizer. Once pressurizer heaters are actuated to increase RCS pressure, the nitrogen is removed through the reactor pressure vessel (RPV) high point degasification line and is replaced with steam. A single SGS train is used in heatup while the other is isolated to ensure passive cooling capabilities. The RCS temperature changes are limited to ~~100 degrees F/hr and 200 degrees F/hr in the pressurizer~~allowable heatup rates for the RCS and pressurizer regions. Subcooling between the pressurizer and RCS hot leg is limited to less than 250 degrees F. After the RCS has reached the hot shutdown temperature and normal operating pressure of 1850 psia, a system leakage test is performed per the requirements of ASME BPVC Section XI (Reference 3.9-2).

Service Level A Transient 2 - Reactor Cooldown from Hot Shutdown

This transient encompasses the cooling from hot shutdown to transition mode and is generally the reverse of the reactor heatup to hot shutdown. The temperature of

the RCS is continually reduced by controlling the feedwater flow rate with one SGS train isolated to ensure passive cooling capabilities. The steam and feedwater flow rates are controlled to keep the cooling rate belowmaintain the maximum of 100 degrees F/hr (200 degrees F/hr in the pressurizer)allowable cooldown rates for the RCS and pressurizer regions. The RCS temperature changes also are limited to maintain subcooling between the pressurizer and RCS hot leg less than 250 degrees Fahrenheit. The chemical and volume control system (CVCS) is used to increase the boron concentration to shutdown levels and to add makeup to compensate for coolant shrinkage. The containment flooding and drain system is used to add pool water to containment to continue cooling the CNV and RPV. Once the pressurizer steam bubble is collapsed, nitrogen gas is added to the pressurizer to control primary pressure.

Service Level A Transient 3 - Power Ascent from Hot Shutdown

This transient covers the power ascent from hot zero power conditions in hot shutdown mode to 15 percent of full power at which point the control systems are placed in automatic mode. Automatic mode is expected to cover power levels above 15 percent of full power. Throughout this transient, the steam and feedwater flow rates through the unisolated SGS train are controlled to match the demanded load ramp, which is specified to be limited to 0.5 percent of full power per minute. Reduced flow through the SG may result in flow oscillations. The feedwater temperature remains at the condenser hot well temperature as the feedwater heaters are unavailable.

Service Level A Transient 4 - Power Descent to Hot Shutdown

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This transient covers the reactor conditions that span from 15 percent of full power to hot zero power conditions in hot shutdown mode. The lower limit of the power range where the reactor is under automatic control occurs at 15 percent of full power. Since the turbine is offline, steam from the unisolated SGS train produced by cooling the RCS is diverted through the turbine bypass valve. Reduced flow through this SGS train may result in flow oscillations. The maximum allowed ramp decrease in power is a rate of 0.5 percent of full power per minute. The reactor is tripped after the turbine is tripped, at which point the cooldown rate is controlled to below 100 degrees F/hr (200 degrees F/hr in the pressurizer)allowable cooldown rates for the RCS and pressurizer regions. Feedwater heating is not available as the turbine is offline and, therefore, the feedwater temperature is equal to the condenser hot well temperature.

Service Level A Transient 5 - Load Following

The reactor could be required to provide load following capabilities to match the electrical demand of the grid over a 24-hour period. The load begins at full power and ramps down to 20 percent of full power over two hours. The load then remains constant for up to ten hours before ramping back to full power over two hours. The load remains constant at full power for the remainder of a 24-hour cycle.

An inadvertent closure of an MSIV will cause a sudden decrease in the secondary-side flow for the affected SG and an increase in flow in the other SG. The closed MSIV causes the SG pressure to increase. The reactor trips on either high-steam pressure or high-pressurizer pressure.

The RSVs do not lift. Both trains of the DHRS are actuated. The DHRS removes heat through the two SGs and rejects the heat to the reactor pool. The components of the DHRS are sized to remove decay heat and cool the RCS.

Service Level B Transient 7 - Inadvertent Operation of the Decay Heat Removal System

The inadvertent operation of the DHRS could occur in two ways. The first is the inadvertent opening of one of the DHRS actuation valves. Opening an actuation valve allows flow between the DHRS condenser and the steam line as the steam and feedwater pressures equalize. The initial pressure equalization in the secondary side causes a disruption in the primary temperature. Both DHRS trains actuate and the reactor trips. The second way to inadvertent DHRS actuation is by the module protection system (MPS) sending a signal to actuate the DHRS by closing the MSIVs and feedwater isolation valves and opening the DHRS actuation valves on both trains of the DHRS. This results in the full-power operation of both trains of the DHRS. The DHRS actuation signal causes a reactor trip. The RSVs do not lift for either occurrence.

Service Level B Transient 8 - Reactor Trip from Full Power

A reactor trip from full power could be caused by multiple spurious sensor signals to the module protection system (MPS), or a spurious trip signal from the MPS, or miscellaneous failures that cause a reactor trip setpoint to be reached and are not already included in other transients. Once the trip begins, the control rods drop into the core to take the core subcritical. This reduces the core thermal power to decay heat and causes the hot- and cold-RCS temperatures to converge close to the average RCS temperature. Cooling is then initiated by one of two methods, either normal feedwater or actuating the DHRS. If the DHRS is actuated, then a containment isolation signal may also be generated. When circulating feedwater through the SGs, the steam produced is directed through the turbine bypass valve to the condenser. The steam and feedwater flow rates are controlled to keep the cooling rate below the ~~maximum of 100 degrees F/hr (200 degrees F/hr in the pressurizer)~~allowable cooldown rates for the RCS and pressurizer regions. This transient ends once the reactor reaches approximately steady hot shutdown conditions. Any cooldown from there is accounted for in the cycles of the cooldown from hot shutdown. If the DHRS is actuated for a more severe failure, heat is removed through the DHRS condenser to the pool.

Service Level B Transient 9 - Control Rod Misoperation

This transient includes misoperations of the control rod assemblies (CRAs), such as the drop of a single CRA, the drop of a bank of CRAs, withdrawal of a single CRA, or withdrawal of a CRA bank. The CRA adds significant negative reactivity to the core that quickly reduces reactor power. Such a reduction in power leads to a decrease