October 24, 2019 Docket No. 52-048

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Submittal of ECCS Valve FMEA Audit Supplemental Items

REFERENCES:

1. Memorandum from Samuel Lee, U.S Nuclear Regulatory Commission to Marieliz Vera Amadiz, "U.S. Nuclear Regulatory Commissions Staff Report of Regulatory Audit of Failure Modes and Effects Analysis and Other Supporting Documents for Emergency Core Cooling System Valves in the NuScale Power, LLC Design Certification Application," dated August 14, 2018 (ML18219B634)
2. Letter from NuScale Power, LLC to U.S. Nuclear Regulatory Commission, "NuScale Power, LLC Submittal of Resolution Plans and Classification for ECCS Valve FMEA Audit Follow-Up Items," dated September 21, 2018 (ML18264A312)
3. Letter from NuScale Power, LLC to U.S. Nuclear Regulatory Commission, "NuScale Power, LLC Submittal of Responses to ECCS Valve FMEA Audit Follow-Up Items," dated August 21, 2019 (ML19233A203)

During an August 15, 2018 public teleconference with the NRC Staff, NuScale Power, LLC (NuScale) discussed a proposed path forward for resolution of follow-up items from the Reference 1 audit report. As a result of this discussion, NuScale submitted the proposed closure plan, Reference 2, for these follow up items. Reference 3 responds to the following items in Reference 2, discussed during an August 7, 2019 teleconference: 28, 37, 39, 43, 46, 47, 53, 57, 62, 64, 102 and 104.

The purpose of this letter is to provide an update on three issues: updates to the Design Certification Application (DCA) describing the new inadvertent actuation block (IAB) range, document control for emergency core cooling system (ECCS) valve design changes, and changes to in-service testing (IST) for the ECCS valves. The DCA changes that will be implemented in Revision 4 are in the enclosure to this letter. The remainder of the follow-up items identified for action were closed by the ECCS Valve DCA Demonstration Test program or by revising and issuing the ECCS design documents described in Reference 2.

NuScale intends to address the Staff's concern regarding engineering document control ECCS design changes, resulting from lessons learned from ECCS valve DCA demonstration testing, as follows. The IAB range shift has been changed in the design specification document EQ-B020-2140, and engineering change orders (ECOs) have been approved for all effected documents. Whenever an engineering document is revised or used as validation, the ECOs assigned to the document are analyzed for impact and will be tracked until integration. The design changes to the ECCS valve (e.g., the change in orifice placement and sizes), will be updated in the component models and drawings maintained by the vendor. Both the main ECCS valve and IAB valve internals may be subject to further refinement in future performance or qualification testing, so design details for internal orifices will not be added or changed in NuScale documentation.

NuScale intends to create a new IST test for ECCS valves with regard to OM Code 2012 ITSC 3510, “Exercising Testing Frequency,” as discussed with Staff on public calls. A further update letter will be provided once this change is finalized.

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

If you have any questions, please contact Rebecca Norris at 541-602-1260 or at RNorris@nuscalepower.com.

Sincerely,

Zackary W. Rad
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Enclosure: Revision 4 Changes to DCA Section 6.3, “Emergency Core Cooling System,” for IAB Range Shift

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Revision 4 Changes to DCA Section 6.3, “Emergency Core Cooling System,” for IAB Range Shift

boundary and the RCPB. Valve bonnet seals on each pilot valve establish the pressure boundaries internal to the valve assembly body. The entire RVV actuator assembly is submerged in the reactor pool.

Each reset pilot valve controls a hydraulic line that supplies coolant from the CVCS to its associated main valve control chamber. The reset pilot valve is an energize-to-open, normally closed, fail closed DC solenoid-operated valve. Energizing the reset pilot valve solenoid ports CVCS (RCS/CVCS coolant) to the main valve to pressurize the control chamber and close the main valve against spring pressure. When reactor pressure is sufficient to maintain control chamber pressure against main valve spring pressure, the pilot valve solenoid is de-energized to close the reset valve.

The trip pilot valve controls a hydraulic line that vents the main valve control chamber into the CNV allowing spring force and RCS pressure to open the main valve. The trip pilot valve is a de-energize-to-open, normally closed, fail open DC solenoid-operated valve. A loss of power to the actuator solenoid results in the opening of the actuator trip valve.

RAI 06.02.01.01.A-18S3

Each ECCS main valve includes an inadvertent actuation block (IAB) feature designed to reduce the frequency of inadvertent operation (opening) of the main valve during power operations. The IAB is located in the path from the main valve control chamber to the trip and reset pilot valves. The IAB consists of a block valve with a spring-loaded disc that functions to block venting of the main valve control chamber when the RPV to CNV differential pressure is above a predetermined threshold. When differential pressure across the block valve lowers to below the IAB release pressuresetpoint, the spring retracts the block valve to open the control chamber vent path.

RAI 06.02.01.01.A-18S3

The threshold pressure for operation of the IAB to prevent spurious opening of the main ECCS valve is 1300 psid. Therefore, the IAB prevents main valve opening for all reactor pressures 1300 psid and greater with respect to containment. Given an initial IAB block, the IAB releases at 950 psid +/- 50 psi once reactor pressure is reduced. The IAB does not prevent main valve opening for initial pressures of 900 psid and below. The threshold pressure for operation of the IAB to prevent spurious opening of the main ECCS valve is set to [1100 +/- 100]psid. The IAB valves block the opening and the ECCS main valves remain closed until RPV pressure has lowered sufficiently to establish a differential pressure of less than the IAB valve release pressure when actuated on a valid ECCS actuation signal.

If the trip valve is inadvertently opened (vented to containment) while the reactor is at normal operating pressure, the IAB valve seats to prevent the main valve control chamber from depressurizing and the main valve from opening.

The RVVs are NPS 5 power-actuated relief valves attached to the reactor vessel head and connected directly to the PZR steam space of the RPV.

RAI 06.02.01.01.A-18S3, RAI 06.03-7

The RRVs are NPS 2, power-actuated relief valves attached to the upper shell section of the RPV, above the flange and about six feet above the top of the reactor core. The valves are connected directly to the downcomer space of the RPV and are designed with a minimum flow coefficient of 55 and a maximum flow coefficient of 100. For ECCS demands, where reactor pressures are below the IAB functional range, the RRVs fully open within 10 seconds after trip valve solenoid power is removed.~~The RRVs fully open within 10 seconds after the trip valve solenoid power is removed with the reactor vessel at the IAB threshold pressure, plus tolerance or below.~~

RAI 06.02.01.01.A-18S3, RAI 06.03-7, RAI 06.03-7S1

Stainless steel bolt-on flow diffusers are provided on the discharge of the RVVs to diffuse the high pressure steam and water flow discharged to the CNV. RRVs do not require diffusers since they are smaller and more distant from equipment requiring protection. The RVV and diffuser, as a combined unit, are designed with a minimum flow coefficient of 375 and a maximum flow coefficient of 490. Additionally, the RVVs are designed with a minimum terminal pressure drop ratio (Xt) of 0.62 and a maximum terminal pressure drop ratio of 0.90. For ECCS demands, where reactor pressures are below the IAB functional range, the RVVs fully open within 10 seconds after trip valve solenoid power is removed.~~The RVVs fully open within 10 seconds after the trip valve solenoid power is removed with the reactor vessel at the IAB threshold pressure, plus tolerance or below.~~

The containment shell provides passive heat removal by transferring decay and sensible heat to the reactor pool. The accumulated discharge of coolant into the CNV provides conductive heat transfer to the reactor pool. The CNV is described in Section 6.1 with additional information on the heat removal function provided in Section 6.2.2.

The capability for containment heat removal (long-term ECCS operation) is maintained without operator action for at least 72 hours. The reactor pool (UHS) is described in detail in Section 9.2.5.

The containment heat removal function includes heat transfer through the CNV wall to the cooling pool. The maximum calculated containment pressure for design basis events is less than design pressure.

Upon a sensed loss of AC power to the highly reliable DC power system battery chargers, reactor trip, decay heat removal actuation, demineralized water system isolation, and containment isolation are initiated by the MPS to reduce battery load. In addition, three 24-hour digital timers in each division of the MPS are started. If AC power cannot be restored within 24 hours, the timers initiate the ECCS by de-energizing the engineered safety features actuation system (ESFAS) MPS divisions. If an ECCS actuation signal (high CNV water level) is received during the 24-hour timing period, the ECCS immediately initiates. This ECCS hold mode maintains ECCS trip valve solenoids energized when an actuation signal is not present, but sheds the load at 24 hours to ensure sufficient battery power for post-accident monitoring for at least 72 hours.