November 17, 2017 Docket No. 52-048

U.S. Nuclear Regulatory Commission
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11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Submittal of Changes to Final Safety Analysis Report, Section 8.4

REFERENCES: Letter from NuScale Power LLC, to Nuclear Regulatory Commission, "NuScale Power, LLC Submittal of the NuScale Standard Plant Design Certification Application," dated December 31, 2016 (ML17013A229)

During a November 8, 2017, NRC audit of the Station Blackout (SBO) Sensitivity Analysis, NuScale informed the staff that recent changes to the calculation for the SBO transient analysis would engender a revision to Final Safety Analysis Report (FSAR) Section 8.4, Station Blackout. NuScale also informed the staff that these changes would likely include a clarification of the purpose for the SBO sensitivity study. Accordingly, the Enclosure to this letter provides a mark-up of the FSAR pages incorporating revisions to FSAR Section 8.4, in redline/strikeout format. NuScale will include this change 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.

Please feel free to contact Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com if you have any questions.

Sincerely,

Zackary W. Rad
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Enclosure: "Changes to NuScale Final Safety Analysis Report Section 8.4"

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"Changes to NuScale Final Safety Analysis Report Sections 8.4"

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The SBO sequence of events is provided in Table 8.4-1. The SBO transient results in a turbine trip and a loss of feedwater flow. The resulting primary side pressure increase results in a module protection system (MPS) reactor trip signal on high pressurizer pressure, a decay heat removal system (DHRS) actuation, and a single cycle of a reactor safety valve (RSV). Within ~~30~~65 seconds, the MPS initiates automatic containment isolation on a ~~high containment pressure signal following RSV operation~~low AC voltage to battery charger signal. The containment isolation includes the chemical and volume control system valves, which prevents inventory loss due to letdown.

Within one minute, the DHRS begins to transfer heat from the reactor to the reactor pool and continues to operate for the event duration. ~~Under DHRS cooling, the reactor coolant system pressure and temperature continually decrease.~~ After 24 hours, the MPS actuates the emergency core cooling system (ECCS), and the ECCS vent and recirculation valves automatically open. At this point, ~~T~~the pressure and water level in the reactor pressure vessel (RPV) ~~rapidly~~ decrease, and containment vessel (CNV) pressure rapidly increases until equilibrium is reached. The DHRS cooling then declines in favor of cooling through the CNV wall via reactor coolant that circulates through the CNV. Stable cooling continues to the end of the transient, with a continued slow decrease in the temperature and pressure in the RPV and CNV. The water level in the RPV remains stable at more than ~~10~~9 feet above the top of the active fuel.

The analysis results show that a safe and stable shutdown is achieved, and that the reactor is cooled and containment integrity is maintained for the 72-hour duration with no operator actions. The core remains subcritical for the duration of the event. The reactor coolant inventory ensures that the core remains covered without the need for makeup systems. The RPV water level is well above the top of active fuel as shown in Figure 8.4-1. After the reactor trips ~~and the RSV operates~~, the RPV pressure decreases rapidly and stabilizes at low pressures as shown in Figure 8.4-2. In addition, containment pressure and temperature are well below the design limits of 1000 psia and 550 degrees F as shown in Figure 8.4-3 and Figure 8.4-4.

8.4.3 Station Blackout Coping Equipment Assessment

The design adequacy and capability of equipment needed to cope with an SBO for the 72-hour duration of the event was evaluated, and the applicable guidance of Section C.3.2 of RG 1.155 was considered. The evaluation provides reasonable assurance that the required SBO equipment remains operable, and that no special equipment provisions or operator actions are necessary to ensure the operability of SBO mitigation equipment for the 72-hour duration. Nonsafety-related equipment is not relied upon to mitigate an SBO, and there is no SBO mitigation equipment that requires regulatory oversight under the regulatory treatment of nonsafety systems process, which is described in Section 8.1.4.3 and Section 19.3.

Consistent with the 10 CFR 50.2 definition of an SBO, the SBO transient analysis assumes a loss of all AC power and that the EDSS remains operable during the transient. The EDSS batteries have sufficient capacity to provide power to post-accident monitoring and main control room emergency lighting loads for the 72-hour duration without charging. The EDSS design description, which includes testing and design criteria, is provided in Section 8.3.2.

Although not required to meet the requirements of 10 CFR 50.63, ~~A~~an SBO transient sensitivity case that considered a simultaneous loss of all AC and DC power was also evaluated. In the sensitivity case, ~~T~~the timing for the DHRS and the ECCS actuations change, ~~but~~however, the results show that the SBO acceptance criteria for reactor core cooling and containment integrity are met under conditions that exceed those required to demonstrate compliance with the rule. ~~The sensitivity case demonstrates that the NuScale Power Plant design does not rely on DC power from the EDSS to meet the requirements of 10 CFR 50.63.~~

The environmental conditions in the main control room during the SBO were evaluated. The control room remains habitable for the duration of the SBO event using the control room habitability system. The control room instrumentation to monitor the event mitigation and confirm the status of reactor cooling, reactor integrity, and containment integrity also remains available. The control room habitability system is described in Section 6.4.

Appropriate containment integrity is provided during the SBO event. The SBO transient analysis containment response demonstrates that the containment temperature and pressure are within design limits. The containment isolation valves automatically close following receipt of an MPS actuation signal. Containment isolation valve position indication is powered from the EDSS and is available for the operators to verify valve closure.

8.4.4 Station Blackout Procedures and Training

The SBO procedures and training consider the relevant guidance of RG 1.155 as it pertains to passive plants. Training and procedures to mitigate an SBO event are implemented in accordance with Section 13.2 and Section 13.5. The SBO mitigation procedures address SBO response (e.g. restoration of onsite standby power sources), AC power restoration (e.g. coordination with transmission system load dispatcher), and severe weather guidance (e.g. identification of site-specific actions to prepare for the onset of severe weather such as an impending tornado), as applicable. Restoration from an SBO event will be contingent upon AC power being made available from the offsite power system (if provided) or the backup power supply system, which are described in Section 8.2 and Section 8.3.

Table 8.4-1: Station Blackout Sequence of Events

Station Blackout Event	Time (Seconds)	Value
Loss of AC power	0	
High pressurizer pressure signal	9	2000 psia
~~Reactor trip system actuation signal~~RTS actuation signal	9	
~~Reactor trip system actuation~~RTS actuation	11	
~~RSV 1 opens~~Maximum primary pressure	~~13~~16	2081 psia
~~Maximum primary pressure~~DHRS valves fully open	~~13~~41	~~2095 psia~~
~~High containment pressure signal~~Maximum secondary pressure	~~19~~52	~~9.5 psia~~1247 psia
Containment isolation signal	~~19~~60	
~~RSV 1 closes~~Containment isolation	~~20~~62	
~~Containment isolation~~ECCS actuation signal	~~21~~86400	
~~DHRS valves open~~ECCS actuation	~~41~~86403	
~~Maximum secondary pressure~~Maximum containment temperature	~~83~~86545	~~1245 psia~~252 °F
~~ECCS actuation signal~~Maximum containment pressure	~~86400~~86648	36 psia
~~ECCS actuation~~	~~86403~~	
~~Maximum containment pressure~~	~~86435~~	~~53 psia~~
~~Maximum containment temperature~~	~~86490~~	~~266°F~~

Figure 8.4-1: Station Blackout Reactor Pressure Vessel Water Level Above Top of Active Fuel

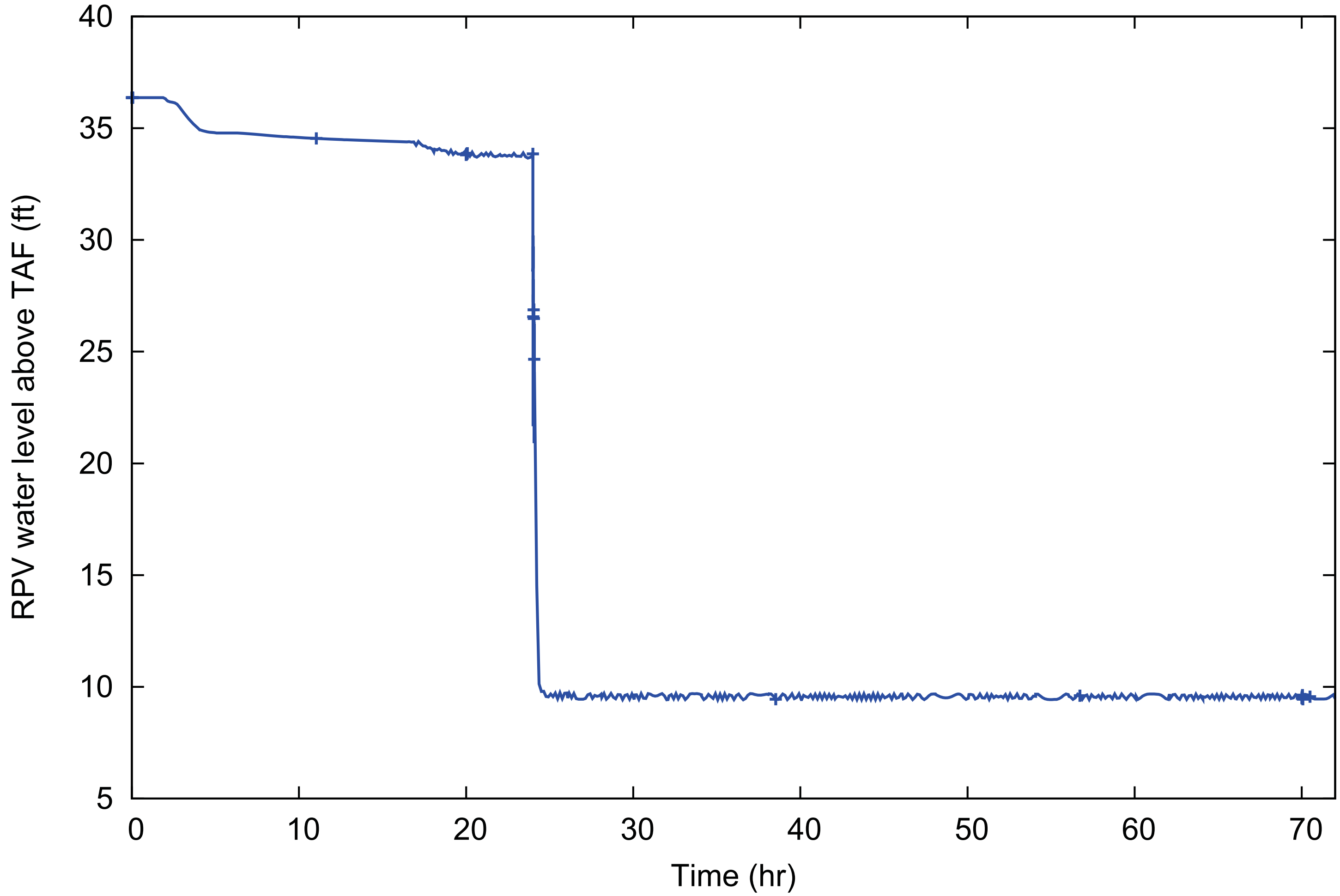

Figure 8.4-2: Station Blackout Reactor Pressure Vessel Pressure

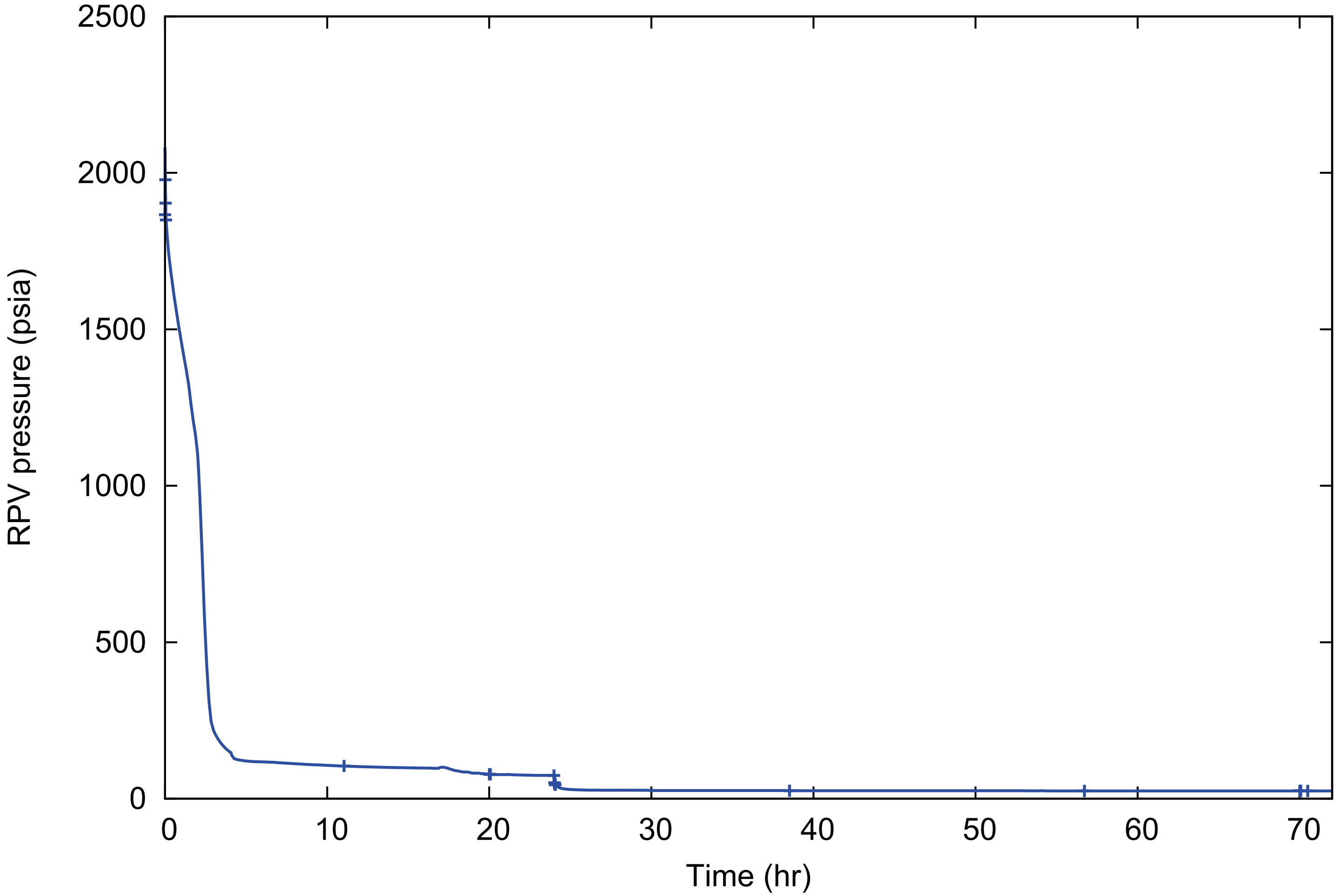

Figure 8.4-3: Station Blackout Containment Vessel Pressure

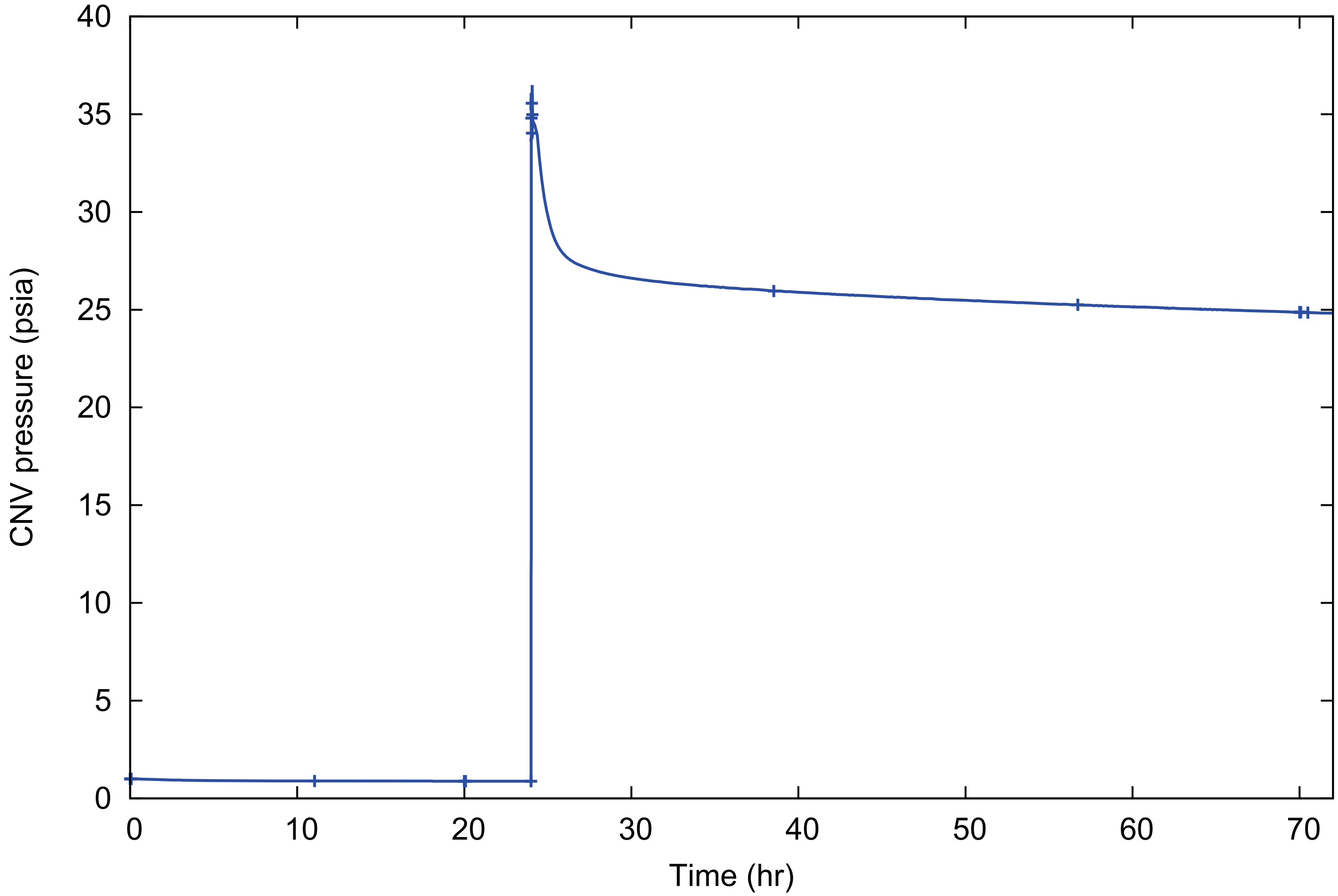

Figure 8.4-4: Station Blackout Containment Vessel Temperature