RAIO-0618-60371

June 11, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
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SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 415 (eRAI No. 9472) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 415 (eRAI No. 9472)," dated April 11, 2018

The purpose of this letter is to provide the NuScale Power, LLC (NuScale) response to the referenced NRC Request for Additional Information (RAI).

The Enclosure to this letter contains NuScale's response to the following RAI Questions from NRC eRAI No. 9472:

- 15.02.01-13
- 15.02.01-14

This letter and the enclosed response make no new regulatory commitments and no revisions to any existing regulatory commitments.

If you have any questions on this response, please contact Paul Infanger at 541-452-7351 or at pinfanger@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9472

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9472

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NuScale Power™

Response to Request for Additional Information
Docket No. 52-048

eRAI No.: 9472
Date of RAI Issue: 04/11/2018

NRC Question No.: 15.02.01-13

General Design Criterion (GDC) 15 in 10 CFR Part 50, Appendix A, requires that the reactor coolant system (RCS) and associated auxiliary, control, and protection systems shall be designed with sufficient margin to assure that the design conditions of the reactor coolant pressure boundary (RCPB) are not exceeded during any condition of normal operation, including anticipated operational occurrences (AOOs).

Design-Specific Review Standard (DSRS) for NuScale Small Modular Reactor Section 15.2.1-15.2.5, "Loss of External Load; Turbine Trip; Loss of Condenser Vacuum; Closure of Main Steam Isolation Valve; and Steam Pressure Regulator Failure (Closed)," provides the staff guidance on reviewing the listed undercooling events to determine compliance with GDC 10 and 15, among other regulations. DSRS Section 15.2.1-15.2.5 guides the reviewer to review the timing of the initiation of protection, engineered safety, and other systems needed to limit the consequences of the transient.

Based on the sequence of events tables (FSAR Tables 15.2-4 through 15.2-6) for the FSAR Section 15.2.1-15.2.3 events (Loss of External Load, Turbine Trip, and Loss of Condenser Vacuum), these events assume it takes 7 seconds for the feedwater isolation valves (FWIVs) and main steam isolation valves (MSIVs) to close after the decay heat removal system (DHRS) actuation signal. However, the FSAR Section 15.2.4 MSIV closure event assumes it takes 5 seconds for the FWIVs to close, according to the corresponding sequence of events table (Tables 15.2-11 through 15.2-13). The reason for the inconsistency is not clear.

Furthermore, FSAR Tier 2, Section 6.2.4.4.1, states that the containment isolation valves are verified to close within (emphasis added) the time specified in Table 6.2-4, which shows a closure time of 5 seconds and an isolation signal of 2 seconds for the FWIVs and MSIVs. From this statement, it appears possible for the valves to close more quickly than the listed times. For reduction in heat removal events, the staff expects the earliest possible FWIV and MSIV closure to be limiting for RCS pressure due to the earlier loss of cooling, though the earliest possible MSIV closure and latest possible FWIV closure would be limiting for steam generator

pressure. The most limiting valve characteristics for the particular analysis should be applied to ensure a conservative calculation of transient response. Therefore:

1. Justify the difference in assumed FWIV closure times between FSAR Sections 15.2.1-15.2.3 and FSAR Section 15.2.4.
2. Confirm whether the MSIVs and FWIVs can close faster than what is listed in FSAR Tier 2, Table 6.2-4.
3. Justify the conservatism of the assumed FWIV and MSIV closure times for each of the above-mentioned events and for all FSAR Chapter 15 events, including the differences in limiting closure times for the different acceptance criteria being examined (e.g., RCS pressure, SG pressure, MCHFR). Alternatively, update the analyses to incorporate the most conservative closure times.
4. Update the FSAR as necessary.

NuScale Response:

Item 1

As stated in FSAR Section 6.2.4.3, the secondary system containment isolation valves (SSCIVs) are designed to begin closing within two seconds of de-energization and fully stroke closed within five seconds of beginning the stroke for a total of seven seconds. The analyses performed in FSAR Sections 15.2.1 through 15.2.3 assumed the full seven seconds while FSAR Section 15.2.4 only considered the five second stroke time of the valves (i.e., the valves immediately begin to close once de-energized). The conservatism of these assumptions is discussed in part 3 to this response.

Item 2

Once de-energized, the maximum time until the SSCIVs are fully closed is seven seconds as identified in FSAR Section 6.2.4.3. It is possible that the SSCIVs reach a fully closed position in less than 7 seconds, with the minimum bounding time being instantaneous valve closure.

Item 3

The impact of assumed SSCIV closure times for different acceptance criteria is discussed. In terms of reactor coolant system (RCS) pressure, the maximum observed pressure is typically dominated by an assumed loss of AC power. A loss of AC power includes feedwater flow isolation, which in effect bounds instantaneous SSCIV closure time. Therefore, the impact of different SSCIV closure times on peak RCS pressure is addressed in other FSAR Section 15.2 events which assume a loss of AC power.

In terms of steam generator (SG) pressure, the maximum observed pressure occurs while the decay heat removal system (DHRS) conditions are coming to equilibrium with the RCS at a time after the SSCIVs have already fully stroked. For example, FSAR Table 15.2-12 shows peak SG pressure occurs 68 seconds after the feedwater isolation valves (FWIVs) have fully closed for the main steam isolation valve (MSIV) closure event. This time delay means FWIV closure time

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has little impact on peak SG pressure. Sensitivity studies evaluating FWIV closure time for the limiting SG pressure case from FSAR Section 15.2.4 are presented in Table 1. The case presented in FSAR Section 15.2.4, with a 5 second FWIV closure time, is shown to be limiting; however it is noted that the difference in peak SG pressure is less than 1 psia across all cases. For MSIV closure time, it is noted that FSAR Section 15.2.4 assumes a bounding minimum closure time, while all other FSAR Section 15.2 events typically assume a bounding maximum seven second closure time.

Table 1. Sensitivity to FWIV Closure Time for Closure of MSIVs Event

Description	Peak SG Pressure (psia)
5 second closure time (Limiting SG Pressure Case)	1481.0
7 second closure time	1480.4
0.1 second closure time	1480.5

In terms of minimum critical heat flux ratio (MCHFR), SSCIV closure time has no impact due to event sequence timing. The SSCIV closure does not begin until DHRS actuation occurs, which occurs either coincident to or after reactor trip. The reduction in power following reactor trip mitigates the MCHFR event before any impact from SSCIV closure time can be observed.

Item 4

No FSAR updates are required for the reasons discussed in the response to Item 3.

Impact on DCA:

There are no impacts to the DCA as a result of this response.

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Date of RAI Issue: 04/11/2018

NRC Question No.: 15.02.01-14

GDC 10 requires that the reactor core and associated coolant, control, and protection systems shall be designed with appropriate margin to assure that specified acceptable fuel design limits are not exceeded during any condition of normal operation, including the effects of AOOs. GDC 15 requires that the RCS and associated auxiliary, control, and protection systems shall be designed with sufficient margin to assure that the design conditions of the RCPB are not exceeded during any condition of normal operation, including AOOs. DSRS Section 15.2.1-15.2.5 provides guidance for meeting the requirements of GDC 10 and 15 and guides the reviewer to evaluate the values of system parameters and initial core and system conditions as input to the model.

The high-biased initial feedwater temperature assumed for the events in FSAR Sections 15.2.1-15.2.4 is inconsistent with the event-specific methodologies described in TR-0516-49416-P, "Non-Loss-of-Coolant Accident Analysis Methodology," which is referenced in FSAR Chapter 15. Because the scope of TR-0516-49416-P includes parameter bias directions, the staff would expect consistency between the FSAR and TR-0516-49416-P in this regard. Provide justification for the difference relative to the methodology, and update either the FSAR or TR- 0516-49416-P as necessary.

NuScale Response:

"Non-Loss of Coolant Accident Analysis Methodology," TR-0516-49416 describes these events as insensitive to feedwater temperature. Therefore, no bias needs to be applied. However, for cases where a bias is used, the results are not impacted. This is not viewed as an inconsistency with the stated methodology.

Impact on DCA:

There are no impacts to the DCA as a result of this response.