NuScale Power

RAIO-0618-60716

June 29, 2018

Docket No. 52-048

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

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 448 (eRAI No. 9506) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 448 (eRAI No. 9506)," dated May 01, 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 Question from NRC eRAI No. 9506:

- 15-8

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
NuScale Power, LLC

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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9506

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9506

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

eRAI No.: 9506
Date of RAI Issue: 05/01/2018

NRC Question No.: 15-8

10 CFR 50, Appendix A, General Design Criteria for Nuclear Power Plants, states,

"Under the provisions of § 50.34, an application for a construction permit must include the principal design criteria for a proposed facility. Under the provisions of 10 CFR 52.47, 52.79, 52.137, and 52.157, an application for a design certification, combined license, design approval, or manufacturing license, respectively, must include the principal design criteria for a proposed facility. The principal design criteria establish the necessary design, fabrication, construction, testing, and performance requirements for structures, systems, and components important to safety; that is, structures, systems, and components that provide reasonable assurance that the facility can be operated without undue risk to the health and safety of the public.

These General Design Criteria establish minimum requirements for the principal design criteria for water-cooled nuclear power plants similar in design and location to plants for which construction permits have been issued by the Commission. The General Design Criteria are also considered to be generally applicable to other types of nuclear power units and are intended to provide guidance in establishing the principal design criteria for such other units."

As the return to power analysis in FSAR 15.0.6 can occur, assuming a stuck rod, within a few hours from either an AOO or postulated accident initiating event, the AOO acceptance criteria of GDC 10 applies. GDC 10, Reactor design, requires that the reactor core and associated coolant, control, and protection systems be designed with appropriate margin to assure that SAFDLs are not exceeded during any condition of normal operation, including the effects of AOOs.

In FSAR Section 15.0.6 and Section 15.2.1, Technical Basis for the GDC 27 exemption, the applicant makes the statement that a return to power only occurs under very low decay heat levels. The basis of this statement is unclear for the scenario when DC power to the ECCS valves is available leading to a DHRS cooldown. As demonstrated in EE-000-4820, one of the analyses which supports FSAR Section 15.0.6, return to power occurred for a range of decay heat assumptions. The staff is requesting additional information which supports that very low decay heat levels are needed to return to power for a DHRS cooldown scenario and revise FSAR Section 15.0.6 and Technical Basis Section 15.2.1 of the exemption to GDC 27 as necessary.

NuScale Response:

The overcooling return to power phenomena is described in FSAR Section 15.0.6 and Section 15.2.1, Technical Basis for the GDC 27 exemption from a realistic perspective to accurately characterize the likelihood the event could occur. This is in contrast to how the phenomena is analyzed to ensure the acceptability of the results from a safety perspective. In reality, the combination of exposure-dependent boron concentration, accumulated poisonous fission products, and limits of the decay heat removal system (DHRS) cooling capability keep the core from experiencing a return to power within the first 24 hours even with the highest worth control rod stuck in a fully withdrawn position. For these more realistic conditions, the core is calculated to be sufficiently below technical specifications shutdown margin.

After 24 hours, if AC power has not been restored, the module will transition to ECCS cooling. When this occurs the core moderator temperature will continue to drop, however, the heat transfer transitions to boiling instead of subcooled convection. The boiling generates voiding in the core region resulting in negative reactivity feedback which suppresses the moderator temperature-driven reactivity insertion. Depending on the reactor pool conditions, decay heat levels as low as approximately 100 kW are sufficient to generate the void feedback required to keep the core subcritical. In summary, when considering the realistic event progression and realistic physics it can be concluded that the return to power can only occur for ECCS cooling at very low power levels.

This realistic characterization does not impact the safety analysis of the event where bounding conservatisms are applied to demonstrate critical heat flux limits are not reached. In the conservative NRELAP5 analysis, a spectrum of initial decay heat levels are analyzed to show that the transient power response, driven by the DHRS overcooling temperature transient, is insensitive to initial decay heat that could reasonably be expected at startup, low power, or after extended shutdown conditions. For the conservative NRELAP5 analysis, the initial conditions are deterministically prescribed even though the combination of zero ppm boron, no negative reactivity from xenon and no decay heat is not a realistic condition. The conservatism of the over cooling return to power phenomena analysis is evidenced in the fact that the calculated k_{eff} for the NRELAP5 bounding conditions and peak power is more than 5% subcritical for realistic xenon level that would correspond to an initial condition with no soluble boron.

Impact on DCA:

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