RAIO-0118-58116

January 10, 2018

Docket No. 52-048

U.S. Nuclear Regulatory Commission
ATTN: Document Control Desk
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11555 Rockville Pike
Rockville, MD 20852-2738

SUBJECT: NuScale Power, LLC Supplemental Response to NRC Request for Additional Information No. 171 (eRAI No. 9032) on the NuScale Design Certification Application

REFERENCES:
1. U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 171 (eRAI No. 9032)," dated August 12, 2017
2. NuScale Power, LLC Response to NRC "Request for Additional Information No. 171 (eRAI No.9032)," dated October 03, 2017

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

The Enclosure to this letter contains NuScale's supplemental response to the following RAI Question from NRC eRAI No. 9032:

- 07.01.DSRS-4

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 Darrell Gardner at 980-349-4829 or at dgardner@nuscalepower.com.

Sincerely,

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Enclosure 1: NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9032

Enclosure 1:

NuScale Supplemental Response to NRC Request for Additional Information eRAI No. 9032

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

eRAI No.: 9032
Date of RAI Issue: 08/12/2017

NRC Question No.: 07.01.DSRS-4

Title 10 of the *Code of Federal Regulations* (10 CFR), Part 50, Appendix A, General Design Criterion 22, "Protection System Independence," states that the protection system shall be designed to assure that the effects of natural phenomena, and of normal operating, maintenance, testing, and postulated accident conditions on redundant channels do not result in loss of the protection function, or shall be demonstrated to be acceptable on some other defined basis. Design techniques, such as functional diversity or diversity in component design and principles of operation, shall be used to the extent practical to prevent loss of the protection function.

NuScale Design Control Document, Part 2 – Tier 2, Section 7.1.5.2.2, “Results of Coping Analyses for Postulated Digital-Based Common Cause Failure Vulnerability,” describes the results of the coping analysis of the NuScale design. The applicant states the following within the ‘low reactor coolant system flow’ topic: "RCS [Reactor Coolant System] flow rate is a function of reactor power in the NuScale design, such that low RCS flow is only possible during startup conditions. The low-low RCS flow protective function is credited for actuating RTS [Reactor Trip System] and CVCS [chemical and volume control system] isolation in the event of a MHS malfunction that causes an RCS flow reversal. This event is not considered credible in combination with a digital-based CCF [common-cause failure] of the RCS flow sensor due to the very short, and limited operating window where the MHS [module heatup system] failure could occur."

The staff requests the applicant to provide the technical basis which led them to conclude that an MHS malfunction event in combination with a digital-based CCF of the RCS flow is not credible.

NuScale Response:

NuScale provided its response to RAI 9032, Question 07.01.DSRS-4 in letter RAIO-1017-56356, dated October 3, 2017. NuScale is adding additional information to its response with regard to the FSAR markup, as follows:

FSAR Table 7.1-18

- Modified note 2 for the digital-based RCS flow sensors

Impact on DCA:

Table 7.1-18 has been revised as described in the response above and as shown in the markup provided in this response.

RAI 07.01.DSRS-4S1

Table 7.1-18: Digital Sensors Credited for Mitigating Anticipated Operational Occurrences and Postulated Accidents

Design Basis Event	Signals Credited in Plant Safety Analysis Described in Chapter 15	Signals Credited in D3 Best-Estimate Coping Analysis	Comments
Category 1 Events			
For these events listed in this category, the digital-based sensors subject to a CCF are not relied upon or credited in either the plant safety analysis described in Chapter 15 or the best-estimate D3 coping analysis. The sensors credited do not use digital-based technology and are not subject to a digital-based CCF; therefore, sufficient diversity is provided by the FPGA technology diversity within the MPS as shown in Table 7.1-17.			
Decrease in Feedwater Temperature	high power range linear power high power range positive rate	high power range linear power high power range positive rate	No digital-based sensor relied upon for deterministic plant safety analysis (Chapter 15) or best estimate analysis. FPGA technology diversity within the MPS limits digital-based CCF impact to one of two divisions - the other division remains fully functional.
Increase in Feedwater Flow	high power range linear power high main steam pressure	high power range linear power high main steam pressure	No digital-based sensor relied upon for deterministic plant safety analysis (Chapter 15) or best estimate analysis. FPGA technology diversity within the MPS limits digital-based CCF impact to one of two divisions - the other division remains fully functional.
Increase in Steam Flow	high power range linear power high power range positive rate low main steam pressure	high power range linear power high power range positive rate low main steam pressure	No digital-based sensor relied upon for deterministic plant safety analysis (Chapter 15) or best estimate analysis. FPGA technology diversity within the MPS limits digital-based CCF impact to one of two divisions - the other division remains fully functional.
Inadvertent Opening of Main Steam Safety Valve	low main steam pressure	low main steam pressure	No digital-based sensor relied upon for deterministic plant safety analysis (Chapter 15) or best estimate analysis. FPGA technology diversity within the MPS limits digital-based CCF impact to one of two divisions - the other division remains fully functional.
Closure of Main Steam Isolation Valve	high main steam pressure high steam superheat	high main steam pressure high steam superheat	No digital-based sensor relied upon for deterministic plant safety analysis (Chapter 15) or best estimate analysis. FPGA technology diversity within the MPS limits digital-based CCF impact to one of two divisions - the other division remains fully functional.
Inadvertent Operation of DHRS	RCS hot temperature high main steam pressure	RCS hot temperature high main steam pressure	No digital-based sensor relied upon for deterministic plant safety analysis (Chapter 15) or best estimate analysis. FPGA technology diversity within the MPS limits digital-based CCF impact to one of two divisions - the other division remains fully functional.

Table 7.1-18: Digital Sensors Credited for Mitigating Anticipated Operational Occurrences and Postulated Accidents (Continued)

Design Basis Event	Signals Credited in Plant Safety Analysis Described in Chapter 15	Signals Credited in D3 Best-Estimate Coping Analysis	Comments
Category 4 Events			
For the design basis events listed below, while the deterministic plant safety analyses described in Chapter 15 credit the function provided by the digital-based sensors that are subject to a CCF; however, the evaluation of the plant response for these events using best-estimate analysis methods determined that the plant response does not progress to the point where the digital-based sensor is relied upon to provide required protection. In these events, other sensors that do not use digital-based technology and are not subject to a digital-based CCF provide the required safety function and the FPGA technology diversity in the MPS divisions ensures a digital-based CCF does not prevent the MPS from performing its required safety function (note 2).			
Control Rod Misoperation	high power range linear power high RCS hot temperature high PZR pressure (digital-based) high power range negative rate (control rod drop)	high power range linear power high RCS hot temperature high power range negative rate (control rod drop)	Diverse sensors not subject to a digital-based CCF provide required protection. FPGA technology diversity within the MPS limits digital-based CCF impact to one of two divisions - the other division remains fully functional.
Inadvertent Operation of Emergency Core Cooling System (ECCS)	high CNV pressure low RPV water level (note 1)	high CNV pressure low RPV water level (note 1)	Diverse sensors not subject to a digital-based CCF provide required protection. FPGA technology diversity within the MPS limits digital-based CCF impact to one of two divisions - the other division remains fully functional.
Failure of Small Lines Carrying Primary Coolant Outside Containment	low PZR level (see note 1) low PZR pressure (digital-based)	low PZR level (see note 1)	Diverse sensors not subject to a digital-based CCF provide required protection. FPGA technology diversity within the MPS limits digital-based CCF impact to one of two divisions - the other division remains fully functional.
Instability Events	high RCS hot temperature low pressurizer level (note 1) low PZR pressure (digital-based)	high RCS hot temperature low pressurizer level (note 1)	Diverse sensors not subject to a digital-based CCF provide required protection. FPGA technology diversity within the MPS limits digital-based CCF impact to one of two divisions - the other division remains fully functional.

Note 1: The digital-based level measurement function incorporates equipment diversity between sensor blocks I and II such that a postulated CCF of the digital-based level measurement function is limited to one sensor block only. Since the other sensor block remains functional, sufficient diversity exists for those functions that rely on the digital-based level measurement function, see Section 7.1.5.1.2.

Note 2: ~~The design basis for the digital-based RCS flow sensor is to ensure minimum RCS flow rates exist during dilution events to ensure proper mixing within the RCS. Best-estimate analysis of this event concludes the event is non-limiting, and does not rely on the digital-based RCS flow sensor to function. The FPGA technology diversity in the MPS divisions ensures a digital-based CCF does not prevent the MPS from performing its required safety function.~~The design basis for the digital-based RCS flow sensors in the plant safety analysis described in Section 15.4.6 is to ensure minimum RCS flow rates exist during dilution events to ensure proper mixing within the RCS; therefore, the RCS flow sensors are not included in Table 7.1-18 as they are not relied upon for detection or mitigation of AOOs or PAs as described in Section 7.1.5.2. The plant safety analysis credits the high subcritical multiplication protective function for detection and mitigation of an uncontrolled RCS dilution. Best-estimate analysis of this event concludes the event is non-limiting and does not rely on the digital-based RCS flow sensor to function. The consequences of RCS flow stagnation or reversal during low power conditions are addressed in NuScale Power, LLC topical report, "Non-Loss-of-Coolant Accident Analysis Methodology," TR-0516-49416. The FPGA technology diversity in the MPS divisions ensures a digital-based CCF does not prevent the MPS from performing its required safety function.