RAIO-0618-60590

June 25, 2018

Docket No. 52-048

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

SUBJECT: NuScale Power, LLC Response to NRC Request for Additional Information No. 434 (eRAI No. 9427) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 434 (eRAI No. 9427)," dated April 25, 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 Enclosures to this letter contain NuScale's response to the following RAI Questions from NRC eRAI No. 9427:

- 13.05.02.01-17
- 13.05.02.01-18
- 13.05.02.01-19

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 434 (eRAI No. 9427). NuScale requests that the proprietary version be withheld from public disclosure in accordance with the requirements of 10 CFR § 2.390. The enclosed affidavit (Enclosure 3) supports this request. Enclosure 2 is the nonproprietary version of the NuScale response.

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

If you have any questions on this response, please contact Steven Mirsky at 240-833-3001 or at smirsky@nuscalepower.com.

Sincerely,

Zackary W. Rad
Director, Regulatory Affairs
NuScale Power, LLC

Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
Prosanta Chowdhury NRC, OWFN-8G9A

Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9427, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9427, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0618-60591

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9427, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9427, nonproprietary

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

eRAI No.: 9427
Date of RAI Issue: 04/25/2018

NRC Question No.: 13.05.02.01-17

REGULATORY BASIS REQUIREMENTS

Title 10 of the *Code of Federal Regulations* (10 CFR) Section 52.47(a)(8) requires an applicant for a design certification to provide an FSAR (Final Safety Analysis Report) which includes the information necessary to demonstrate compliance with any technically relevant portions of the Three Mile Island requirements set forth in 10 CFR 50.34(f), with certain exceptions. Section 10 CFR 50.34(f)(2)(ii) requires an applicant to "Establish a program, to begin during construction and follow into operation, for integrating and expanding current efforts to improve plant procedures. The scope of the program shall include emergency procedures, ... "

TMI Action Plan Item I.C.1, a Post-TMI requirement approved by the Commission for implementation, requires the preparation of emergency procedure technical guidelines for development of the Emergency Operating Procedures (EOPs). Preparation of the technical guidelines is conducted in accordance with NUREG-0737, "Clarification of TMI Action Plan Requirements," and NUREG-0737, Supplement 1, "Requirements for Emergency Response Capability," which also specify submittal of the technical guidelines to the NRC for review and approval.

Meeting the requirements of TMI Action Plan Item I.C.1 as prescribed in NUREG-0737, Section I.C.1, and Supplement 1 to NUREG-0737, Section 7, is acceptance criteria in SRP 13.5.2.1, "Operating and Emergency Operating Procedures." Design-specific Generic Technical Guidelines (GTGs), otherwise referred to as the Emergency Operating Guidelines (EOGs), will be used by COL applicants to develop their Plant-Specific Technical Guidelines (P-STGs), from which their EOPs will be developed, and are the responsibility of the DC applicant.

By letter dated November 30, 2017 (ADAMS Accession No. ML17334B822) NuScale submitted technical report TR-1117-57216, "NuScale Generic Technical Guidelines," for docketing.

ISSUE

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}}2(a),(c). Because there is a possibility for design basis events to {{ }}2(a),(c), NRC staff is concerned that scenarios exist where an incomplete reactor trip could occur coincident with a CIS (e.g., {{ }}2(a),(c)), and operators are precluded from {{ }}2(a),(c). The {{ Core Heat Removal Safety Function flowchart in Section 5.3 of the NuScale GTGs shows that make-up inventory to the power module using CIS bypass is only conducted when there is indication of degraded core cooling }}2(a),(c). In this type of scenario, it appears that the NuScale GTGs do not provide direction to bring the power module to a safe shutdown condition. NRC staff is questioning whether the Reactivity Safety Function can be met following a reactor trip with the power module not in a safe shutdown state in the event of a control rod malfunction coincident with a CIS.

INFORMATION NEEDED

NRC staff requests that NuScale describe the indications and process used by the operators to bring the module to a safe shutdown condition in the event of an incomplete reactor trip with a CIS present, and to update the NuScale GTGs (flowcharts and basis) accordingly.

NuScale Response:

The CIS actuation is initiated by low pressurizer level or high containment pressure. Both conditions are caused by a loss of reactor pressure vessel (RPV) inventory. No inventory is lost from the RPV/containment vessel system and core heat removal proceeds via passive cooling from the RPV to the containment vessel to the ultimate heat sink. If an incomplete reactor trip is superimposed in parallel with the containment isolation, one of two conditions can arise. Either 1) there will be a negligible impact on the cooldown capability or 2) the heat production from the incomplete reactor trip will reach a steady state with the heat removal capability of the CNV passive cooling.

<u>Case 1</u>

CNV passive cooling will reduce CNV pressure and temperature until CIS is reset allowing boration to compensate for the incomplete reactor trip. In this case boration allows for shutdown margin to be established and consequently the safe shutdown conditions of Mode 3 can be

established.

Case 2, using the ATWS as a bounding example

At full power, the core exhibits a large negative temperature coefficient, even at beginning of cycle conditions. The initial loss of feedwater, due to the containment isolation, causes a loss of RCS cooling which results in a rise in RCS temperature. Due to the negative temperature coefficient, the core is subcritical shortly after the loss of feedwater, even without inserting control rods. The long-term ATWS response is unique because of the excess heat transfer capacity of the passive cooling systems. This excess heat transfer results from the relatively small core size, a large coolant mass-to-power ratio, and the efficient passive heat transfer systems. Return to power occurs only after passive heat transfer to the ultimate heat sink (UHS) has been established and RCS temperature is significantly reduced. The strong negative temperature coefficient and reduction in RCS temperature causes core fission power to increase until it is in equilibrium with the passive heat removal capacity. The core fission power never exceeds the passive heat removal capacity for an extended duration. The resulting fission power is well within the capacity of the passive cooling systems and UHS, and the core is protected.

The Generic Technical Guidelines ensure plant safety during an accident. For the scenario proposed in this RAI, plant safety is accomplished by the plant design. The Safety Function flowcharts are not constructed to manage specific events but to manage the safety functions so that the plant is placed in a safe condition regardless of the event. The goal is to manage the safety function in a way that results in no challenge to fuel integrity or containment integrity. As in the proposed event, specific, additional event-based corrective actions may be needed to obtain the safe shutdown condition prescribed by technical specifications. The safety function flow charts are not designed to be this prescriptive as that would negate their value in controlling the safety functions across an indefinite set of beyond design basis events. Therefore, the reactivity safety function flowchart is accurate for its intended purpose.

Impact on DCA:

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

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

eRAI No.: 9427
Date of RAI Issue: 04/25/2018

NRC Question No.: 13.05.02.01-18

REGULATORY BASIS REQUIREMENTS

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TMI Action Plan Item I.C.1, a Post-TMI requirement approved by the Commission for implementation, requires the preparation of emergency procedure technical guidelines for development of the Emergency Operating Procedures (EOPs). Preparation of the technical guidelines is conducted in accordance with NUREG-0737, "Clarification of TMI Action Plan Requirements," and NUREG-0737, Supplement 1, "Requirements for Emergency Response Capability," which also specify submittal of the technical guidelines to the NRC for review and approval.

Meeting the requirements of TMI Action Plan Item I.C.1 as prescribed in NUREG-0737, Section I.C.1, and Supplement 1 to NUREG-0737, Section 7, is acceptance criteria in SRP 13.5.2.1, "Operating and Emergency Operating Procedures." Design-specific Generic Technical Guidelines (GTGs), otherwise referred to as the Emergency Operating Guidelines (EOGs), will be used by COL applicants to develop their Plant-Specific Technical Guidelines (P-STGs), from which their EOPs will be developed, and are the responsibility of the DC applicant.

By letter dated November 30, 2017 (ADAMS Accession No. ML17334B822) NuScale submitted technical report TR-1117-57216, "NuScale Generic Technical Guidelines," for docketing.

ISSUE

The Reactivity Safety Function flowchart in Section 5.2 of the NuScale GTGs depicts the logic and specifies the operator actions necessary to assess and maintain the Reactivity Safety

Function. {{

}}[2(a),(c)], then the downstream DWS Isolation Sub-function logic of RD-2 and RD-3 would appear to be unnecessary, because the plant would have operated as designed with no operator action needed, culminating in a green endpoint on the flowchart, signifying that the Reactivity Safety Function was met.

INFORMATION NEEDED

NRC staff requests that NuScale: (1) explain the DWS Isolation Sub-function logic, and (2) make any necessary changes to the associated logic in technical report TR-1117-57216, to ensure the completeness and accuracy of the NuScale GTGs (flowcharts and basis).

NuScale Response:

TR-1117-57216, NuScale Generic Technical Guidelines, Section 5.2, Reactivity Safety Function flowchart and associated bases have been revised. The new decision point (RD-6) determines whether the Demineralized Water System Isolation (DWSI) signal has initiated rather than determining whether the DWS isolation valves are closed. Decision blocks for subcritical multiplication and RCS flow remain in series with "DWSI signal INITIATED" and together provide correct logic for assessing dilution caused by demineralized water flow. With the addition of a decision block addressing RCS flow (RD-1) added in response to RAI 9427 Question 13.05.02.01-19, the logic for the dilution evaluation is complete.

The Reactivity Safety Function flowchart and the flowchart explanation in TR-1117-57216 Section 5.2 have been revised as shown in the attached markup.

Impact on DCA:

Technical Report TR-1117-57216, NuScale Generic Technical Guidelines, has been revised as described in the response above and as shown in the markup provided with the response to question 13.05.02.01-19.

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

eRAI No.: 9427
Date of RAI Issue: 04/25/2018

NRC Question No.: 13.05.02.01-19

REGULATORY BASIS REQUIREMENTS

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By letter dated November 30, 2017 (ADAMS Accession No. ML17334B822) NuScale submitted technical report TR-1117-57216, "NuScale Generic Technical Guidelines," for docketing.

ISSUE

The Reactivity Safety Function flowchart in Section 5.2 of the NuScale GTGs depicts the logic and specifies the operator actions necessary to assess and maintain the Reactivity Safety

Function. {{

}}2(a),(c).

The Containment Integrity (CI) Safety Function flowchart in Section 5.1 of the NuScale GTGs depicts the logic and specifies the operator actions necessary to assess and maintain the Containment Integrity Safety Function. {{

}}2(a),(c). NRC staff is questioning why the logic associated with decision point CV-3 resides on the CI Safety Function flowchart rather than the Reactivity Safety Function flowchart, given that concern is one of reactivity and not containment integrity.

INFORMATION NEEDED

NRC staff requests that NuScale: (1) explain why CV-3 decision point logic is included on the CI Safety Function flowchart and not the Reactivity Safety Function flowchart, and (2) make any necessary changes to technical report TR-1117-57216, to ensure the completeness and accuracy of the NuScale GTGs (flowcharts and basis).

NuScale Response:

The function "CVCS isolation on RCS low flow" has been removed from the Containment Integrity Safety Function flowchart and added to the Reactivity Safety Function flowchart. The supporting documentation in TR-1117-57216, NuScale Generic Technical Guidelines, has been revised to reflect this change.

The changes to TR-1117-57216, Generic Technical Guidelines, are shown in the attached markup.

Impact on DCA:

Technical Report TR-1117-57216, NuScale Generic Technical Guidelines, has been revised as described in the response above and as shown in the markup provided in this response.

5.1 Containment Integrity Safety Function

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}}2(a),(c)

5.2 Reactivity Safety Function

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}}2(a),(c)

5.2.1 Reactor Trip System Actuation

This subfunction is intented to verify that the automatic protective action of reactor trip is complete. Reactor trip completion is verified by checking that the reactor trip breakers have opened resulting in de-energization of the control rod drives and insertion of the control rods. All operator actions to attempt to shutdown the reactor are contained within this subfunction.

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}}2(a),(c)

{{

}}2(a),(c)

~~5.2.2 Reactivity Verification~~

~~Reactivity verification is the lowest priority subfunction. The reactivity safety function is not jeopardized during ATWS and return to criticality events as the reactor fuel does not become damaged in these events. For this reason the reactivity safety function remains yellow if control rods are mechanically stuck or reactor power exhibits anomalous behavior. Failure of reactivity control safety systems to actuate are addressed in either the RTS actuation or dilultion isolation subfunctions.~~

~~{{~~

~~}}2(a),(c)~~

~~Figure 5-2 ATWS response under different conditions.~~

~~{{~~

~~}}2(a),(c)~~

~~{{~~

~~}}2(a),(c)~~

{{

}}2(a),(c)

5.2.3 5.2.2 Demineralized Water Isolation Dilution Isolation

The DWSI signal is generated by a low RCS flow or high subcritical multiplication signal. Additionally, any time a reactor trip signal is generated, the DWS receives a pulsed actuation signal to close the two demineralized water isolation valves. The logic includes a decision point that uses indication from MPS that the DWS has been sent an actuation signal. This is unique when compared to how other checks within this document are made against a specific parameter. The basis for using this 'Initiate" indicator is that following a reactor trip, operators are notified using the safety function checks that the DWSI has either actuated properly or not. Additionally, after a reactor trip, it allows operators to use demineralized water as an RCS makeup source without indicating a red or yellow reactivity safety function status.

Within this subfunction, the isolation of CVCS on low RCS flow is prioritized above the signals that would isolate the DWS isolation valves. The basis for this is that if a CVCS isolation signal on RCS low flow is generated, the ability to add diluted water to the RCS is stopped. The DWS isolation valves interface with the CVCS such that isolating CVCS effectively stops the dilution flow path at a higher level.

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}}2(a),(c)

{{

}}2(a),(c)~~FSAR Table 7.1-4 (Reference 7.2.1)~~

{{

}}2(a),(c)~~FSAR Table 7.1-4 (Reference 7.2.1)~~

{{

}}2(a),(c)

{{

}}2(a),(c)

{{

}}2(a),(c)~~This evaluation point determines if the DWSI actuation has completely occurred. If it has not then the status tree determines if the DWSI has partially occurred.~~

~~Instrument used: demineralized water isolation valve position indication~~

~~PAMS category: D~~

~~Setpoint basis: The DWS isolation valves are equipped with position indication. By design, a demineralized water isolation signal closes both valves.~~

~~RD-5 identification: BOTH DWS isolation valves OPEN~~

~~No: RD-6 actions to mitigate DWSI failure as a yellow priority~~

~~Yes: RD-7actions to mitigate DWSI failure as a red priority~~

~~Technical basis: This evaluation point determines to what degree the DWSI has occurred. The same actions are taken in either case. This evaluation determines the priority of the action. RD-6 would display a yellow indication that at least one DWSI isolation valve is closed. RD-7 would display a red indication that neither DWSI isolation valve is closed and a potential dilution path remains available.~~

~~Instrument used: demineralized water isolation valve position indication~~

~~PAMS category: D~~

~~Setpoint basis: The DWS isolation valves are equipped with position indication. By design, a demineralized water isolation signal closes both valves.~~ {{

}}2(a),(c)

{{

}}2(a),(c)

{{

}}2(a),(c)

{{

}}2(a),(c)

5.2.3 Reactivity Verification

Reactivity verification is the lowest priority subfunction. The reactivity safety function is not jeopardized during ATWS and return to criticality events as the reactor fuel does not become damaged in these events. For this reason the reactivity safety function remains yellow if control rods are mechanically stuck or reactor power exhibits anomalous behavior. Failure of reactivity control safety systems to actuate are addressed in either the RTS actuation or dilultion isolation subfunctions.

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}}2(a),(c)

{{

}}2(a),(c)

{{

}}2(a),(c)

{{

}}2(a),(c)

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0618-60591

NuScale Power, LLC

AFFIDAVIT of Zackary W. Rad

I, Zackary W. Rad, state as follows:

1. I am the Director, Regulatory Affairs of NuScale Power, LLC (NuScale), and as such, I have been specifically delegated the function of reviewing the information described in this Affidavit that NuScale seeks to have withheld from public disclosure, and am authorized to apply for its withholding on behalf of NuScale.
2. I am knowledgeable of the criteria and procedures used by NuScale in designating information as a trade secret, privileged, or as confidential commercial or financial information. This request to withhold information from public disclosure is driven by one or more of the following:
   a. The information requested to be withheld reveals distinguishing aspects of a process (or component, structure, tool, method, etc.) whose use by NuScale competitors, without a license from NuScale, would constitute a competitive economic disadvantage to NuScale.
   b. The information requested to be withheld consists of supporting data, including test data, relative to a process (or component, structure, tool, method, etc.), and the application of the data secures a competitive economic advantage, as described more fully in paragraph 3 of this Affidavit.
   c. Use by a competitor of the information requested to be withheld would reduce the competitor's expenditure of resources, or improve its competitive position, in the design, manufacture, shipment, installation, assurance of quality, or licensing of a similar product.
   d. The information requested to be withheld reveals cost or price information, production capabilities, budget levels, or commercial strategies of NuScale.
   e. The information requested to be withheld consists of patentable ideas.
3. Public disclosure of the information sought to be withheld is likely to cause substantial harm to NuScale's competitive position and foreclose or reduce the availability of profit-making opportunities. The accompanying Request for Additional Information response reveals distinguishing aspects about the method by which NuScale develops its generic technical guidelines.

   NuScale has performed significant research and evaluation to develop a basis for this method and has invested significant resources, including the expenditure of a considerable sum of money.

   The precise financial value of the information is difficult to quantify, but it is a key element of the design basis for a NuScale plant and, therefore, has substantial value to NuScale.

   If the information were disclosed to the public, NuScale's competitors would have access to the information without purchasing the right to use it or having been required to undertake a similar expenditure of resources. Such disclosure would constitute a misappropriation of NuScale's intellectual property, and would deprive NuScale of the opportunity to exercise its competitive advantage to seek an adequate return on its investment.

4. The information sought to be withheld is in the enclosed response to NRC Request for Additional Information No. 434, eRAI No. 9427. The enclosure contains the designation "Proprietary" at the top of each page containing proprietary information. The information considered by NuScale to be proprietary is identified within double braces, "{{ }}" in the document.
5. The basis for proposing that the information be withheld is that NuScale treats the information as a trade secret, privileged, or as confidential commercial or financial information. NuScale relies upon the exemption from disclosure set forth in the Freedom of Information Act ("FOIA"), 5 USC § 552(b)(4), as well as exemptions applicable to the NRC under 10 CFR §§ 2.390(a)(4) and 9.17(a)(4).
6. Pursuant to the provisions set forth in 10 CFR § 2.390(b)(4), the following is provided for consideration by the Commission in determining whether the information sought to be withheld from public disclosure should be withheld:
   a. The information sought to be withheld is owned and has been held in confidence by NuScale.
   b. The information is of a sort customarily held in confidence by NuScale and, to the best of my knowledge and belief, consistently has been held in confidence by NuScale. The procedure for approval of external release of such information typically requires review by the staff manager, project manager, chief technology officer or other equivalent authority, or the manager of the cognizant marketing function (or his delegate), for technical content, competitive effect, and determination of the accuracy of the proprietary designation. Disclosures outside NuScale are limited to regulatory bodies, customers and potential customers and their agents, suppliers, licensees, and others with a legitimate need for the information, and then only in accordance with appropriate regulatory provisions or contractual agreements to maintain confidentiality.
   c. The information is being transmitted to and received by the NRC in confidence.
   d. No public disclosure of the information has been made, and it is not available in public sources. All disclosures to third parties, including any required transmittals to NRC, have been made, or must be made, pursuant to regulatory provisions or contractual agreements that provide for maintenance of the information in confidence.
   e. Public disclosure of the information is likely to cause substantial harm to the competitive position of NuScale, taking into account the value of the information to NuScale, the amount of effort and money expended by NuScale in developing the information, and the difficulty others would have in acquiring or duplicating the information. The information sought to be withheld is part of NuScale's technology that provides NuScale with a competitive advantage over other firms in the industry. NuScale has invested significant human and financial capital in developing this technology and NuScale believes it would be difficult for others to duplicate the technology without access to the information sought to be withheld.

I declare under penalty of perjury that the foregoing is true and correct. Executed on June 25, 2018.

Zackary W. Rad