



June 28, 2018

Docket No. 52-048

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

**SUBJECT:** NuScale Power, LLC Response to NRC Request for Additional Information No. 450 (eRAI No. 9498) on the NuScale Design Certification Application

**REFERENCE:** U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 450 (eRAI No. 9498)," 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. 9498:

- 15-9

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](mailto:pinfanger@nuscalepower.com).

Sincerely,

A handwritten signature in black ink, appearing to read "Zackary W. Rad".

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. 9498



**Enclosure 1:**

NuScale Response to NRC Request for Additional Information eRAI No. 9498

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

**eRAI No.:** 9498

**Date of RAI Issue:** 05/01/2018

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### **NRC Question No.:** 15-9

Appendix A to Part 50 - General Design Criteria (GDC) for Nuclear Power Plants states, "...The principal Design Criteria establish the necessary design, fabrication, construction, testing and performance requirements for structures, systems and components important to safety..." The categorization of the Design Basis Events (DBEs) specified for the NuScale design in Final Safety Analysis Report (FSAR) Section 15.0 determines, in part, which of the GDCs apply to which events. NuScale DSRS Section 15.0 notes that the staff must ensure that the applicant's selection and assembly of the plant transient and accident analyses represent a sufficiently broad spectrum of transients and accidents, or initiating events. In particular, initiating events are categorized according to expected frequency of occurrence and by type to provide a basis for selection of the applicable analysis acceptance criteria and to provide a basis for comparison between events, which makes it possible to identify and evaluate the limiting cases.

The staff finds the reference to not applicable (N/A) in Table 15.0-1, Design Basis Events, confusing. Some events, such as startup of an inactive loop or boiling water reactor (BWR) specific events, are not possible based on the lack of design features. In these instances, N/A is appropriate. However, N/A also appears when specific design features exist such that the event falls into a beyond design basis category. For example, the NuScale Power Module (NPM) drop, described in FSAR section 15.7.6, appears to state that specific design features of the NPM movement system are single failure proof, and hence NPM drop is categorized as a beyond design basis event.

- 1) The staff is requesting the applicant modify FSAR Table 15.0-1 to clarify and distinguish events that are not applicable based on a lack of design features from events that are considered beyond design basis based on component or system design features. Further, the staff seeks to understand why station blackout is not included in the special events section of Table 15.0-1, since FSAR Section 15.0.0.2 defines "special events" as beyond design bases events that are explicitly defined by regulation.
  - 2) The staff also requests the long-term, return to power scenario described in FSAR Section 15.0.6, and the computer codes used to evaluate the event, be added to denote its design basis event classification since the scenario can occur within 72 hours following an abnormal operating occurrence or postulated accident using design basis assumptions.
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**NuScale Response:**

1. NuScale has modified Final Safety Analysis Report (FSAR) Table 15.0-1: Design Basis Events, to distinguish the events that are classified as "N/A". Each event that is classified with N/A now contains a note that indicates why the event is not required to be classified. The Station Blackout (SBO) event has been added to Table 15.0-1 under Special Events, and is identified as belonging in Section 8.4. It should be noted that SBO is also considered as part of the loss of non-emergency AC power scenarios analyzed in Section 15.2.6 because the NuScale design has no emergency AC power.
2. NuScale has modified FSAR Table 15.0-1 to add the Return to Power phenomenon as described in FSAR section 15.0.6. This phenomenon does not meet regulatory criteria for event classification.

The designation of NuScale specific phenomenon is justified based on the following. While analytically this phenomenon is the result of extended passive cooling which could be initiated from an Anticipated Operational Occurrence (AOO) or an accident, it only occurs when very conservative assumptions are used. The realistic probability of this phenomenon occurring has been conservatively determined to be less than  $1e-6$ /yr. The Return to Power phenomenon is evaluated against AOO acceptance criteria.

**Impact on DCA:**

FSAR Table 15.0-1 has been revised as described in the response above and as shown in the markup provided in this response.

Table 15.0-1: Design Basis Events

| Section   | Type  | Classification           | Computer Code Used  |
|---|---|--------------------------|---|
| <b>15.0</b>   |   |                          |   |
| <b>Transient and Accident Analysis</b>                  |   |                          |   |
| 15.0.3  | Radiological Consequences of Category 2 Maximum Hypothetical Accident | Postulated Accident      | RADTRAD<br>ORIGEN<br>STARNAUA<br>pH <sub>T</sub><br>ARCON96 |
| <u>15.0.6</u>   | <u>Return to Power Event - NuScale specific phenomenon</u>            | <u>N/A<sup>(4)</sup></u> | <u>NRELAP5</u>  |
| <b>15.1</b>   |   |                          |   |
| <b>Increase in Heat Removal by Secondary System</b>     |   |                          |   |
| 15.1.1  | Decrease in Feedwater Temperature                                     | AOO                      | NRELAP5<br>VIPRE-01   |
| 15.1.2  | Increase in Feedwater Flow  | AOO                      | NRELAP5<br>VIPRE-01   |
| 15.1.3  | Increase in Steam Flow  | AOO                      | NRELAP5<br>VIPRE-01   |
| 15.1.4  | Inadvertent Opening of Steam Generator Relief or Safety Valve         | AOO                      | NRELAP5<br>VIPRE-01   |
| 15.1.5  | Steam Piping Failures Inside and Outside of Containment               | Postulated Accident      | NRELAP5<br>VIPRE-01<br>RADTRAD<br>ORIGEN<br>ARCON96         |
| 15.1.6  | Loss of Containment Vacuum/Containment Flooding                       | AOO                      | NRELAP5<br>VIPRE-01   |
| <b>15.2</b>   |   |                          |   |
| <b>Decrease in Heat Removal by the Secondary System</b> |   |                          |   |
| 15.2.1  | Loss of External Load   | AOO                      | NRELAP5<br>VIPRE-01   |
| 15.2.2  | Turbine Trip  | AOO                      | NRELAP5<br>VIPRE-01   |
| 15.2.3  | Loss of Condenser Vacuum  | AOO                      | NRELAP5<br>VIPRE-01   |
| 15.2.4  | Closure of Main Steam Isolation Valve                                 | AOO                      | NRELAP5<br>VIPRE-01   |

Table 15.0-1: Design Basis Events (Continued)

| Section     | Type  | Classification      | Computer Code Used   |
|-------------|---|---------------------|--|
| 15.2.5      | Steam Pressure Regulator Failure (Closed)   | N/A (U)             | N/A  |
| 15.2.6      | Loss of Non-Emergency AC to the Station Auxiliaries                                       | AOO                 | NRELAP5<br>VIPRE-01  |
| 15.2.7      | Loss of Normal Feedwater Flow   | AOO                 | NRELAP5<br>VIPRE-01  |
| 15.2.8      | Feedwater System Pipe Breaks Inside and Outside Containment                               | Postulated Accident | NRELAP5<br>VIPRE-01<br>RADTRAD<br>ORIGEN<br>ARCON96                |
| 15.2.9      | Inadvertent Operation of the Decay Heat Removal System                                    | AOO                 | NRELAP5<br>VIPRE-01  |
| <b>15.3</b> | <b>Decrease in RCS Flow Rate (not applicable)</b>   |                     |  |
| <b>15.4</b> | <b>Reactivity and Power Distribution Anomalies</b>  |                     |  |
| 15.4.1      | Uncontrolled Control Rod Assembly Withdrawal from a Subcritical or Low Power or Startup   | AOO                 | NRELAP5<br>VIPRE-01  |
| 15.4.2      | Uncontrolled Control Rod Assembly Withdrawal at Power                                     | AOO                 | NRELAP5<br>VIPRE-01  |
| 15.4.3      | Control Rod Misoperation (System Malfunction or Operator Error)                           | AOO                 | VIPRE-01<br>SIMULATES  |
| 15.4.4      | Startup of an Inactive Loop or Recirculation Loop at an Incorrect Temperature             | N/A (U)             | N/A  |
| 15.4.5      | Flow Controller Malfunction Causing an Increase in Core Flow Rate (Boiling Water Reactor) | N/A (U)             | N/A  |
| 15.4.6      | Inadvertent Decrease in Boron Concentration in Reactor Coolant System                     | AOO                 | N/A  |
| 15.4.7      | Inadvertent Loading and Operation of a Fuel Assembly in an Improper Position              | IE                  | SIMULATES,<br>VIPRE-01   |
| 15.4.8      | Spectrum of Rod Ejection Accidents  | Postulated Accident | SIMULATE-3K<br>NRELAP5<br>VIPRE-01<br>RADTRAD<br>ORIGEN<br>ARCON96 |

Table 15.0-1: Design Basis Events (Continued)

| Section  | Type   | Classification      | Computer Code Used                      |
|--|--|---------------------|---|
| <b>15.5</b>  |  |                     |   |
| <b>Increase in Reactor Coolant Inventory</b>             |  |                     |   |
| 15.5.1   | Chemical and Volume Control System Malfunction   | AOO                 | NRELAP5<br>VIPRE-01                     |
| <b>15.6</b>  |  |                     |   |
| <b>Decrease in Reactor Coolant Inventory</b>             |  |                     |   |
| 15.6.1   | Inadvertent Opening of Reactor Safety Valve  | AOO                 | See 15.6.6                              |
| 15.6.2   | Failure of Small Lines Carrying Primary Coolant Outside Containment  | IE                  | NRELAP5<br>RADTRAD<br>ORIGEN<br>ARCON96 |
| 15.6.3   | Steam Generator Tube Failure   | Postulated Accident | RADTRAD<br>NRELAP5<br>ORIGEN<br>ARCON96 |
| 15.6.4   | Main Steam Line Failure Outside Containment (BWR)  | N/A <sup>(1)</sup>  | N/A                                     |
| 15.6.5   | Loss-of-Coolant Accidents Resulting From a Spectrum of Postulated Piping Breaks Within the Reactor Coolant Pressure Boundary | Postulated Accident | NRELAP5                                 |
| 15.6.6   | Inadvertent Operation of Emergency Core Cooling System   | AOO                 | NRELAP5                                 |
| <b>15.7</b>  |  |                     |   |
| <b>Radioactive Release from a Subsystem or Component</b> |  |                     |   |
| 15.7.1   | Gaseous Waste Management System Leak or Failure  | N/A <sup>(2)</sup>  | N/A                                     |
| 15.7.2   | Liquid Waste Management System Leak or Failure   | N/A <sup>(2)</sup>  | N/A                                     |
| 15.7.3   | Postulated Radioactive Releases Due to Liquid Containing Tank Failures   | N/A <sup>(2)</sup>  | RADTRAD,<br>ORIGEN,<br>ARCON96          |
| 15.7.4   | Fuel Handling Accidents  | Postulated Accident | RADTRAD,<br>ORIGEN,<br>ARCON96          |
| 15.7.5   | Spent Fuel Cask Drop Accident  | Postulated Accident | Not analyzed                            |
| 15.7.6   | NuScale Power Module Drop Accident   | N/A <sup>(3)</sup>  | Not analyzed                            |
| <b>15.8</b>  |  |                     |   |
| <b>Special Events</b>                                    |  |                     |   |
|  | Anticipated Transient Without Scram <a href="#">(10 CFR 50.62)</a>   | Special Event       | No analysis required.                   |

Table 15.0-1: Design Basis Events (Continued)

| Section | Type  | Classification   | Computer Code Used |
|---------|---|--|--------------------|
| 15.9    | Stability - note that stability is not an event. The NPM is protected from this phenomenon by MPS trips and technical specification initial conditions. | N/A <sup>(4)</sup> <del>from occurring during AOOs</del> | PIM                |
| 8.4     | Station Blackout (10 CFR 50.63)   | N/A <sup>(5)</sup>                                       | NRELAP5            |

Notes:

- (1) Design feature is not part of NuScale design.
- (2) Events are described in Chapter 11.
- (3) Module drop is considered a Beyond Design Basis Event.
- (4) Event is analyzed to AOO Acceptance Criteria.
- (5) Event is included in the loss of non-emergency AC power analysis described in Section 15.2.6.