



January 02, 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. 272 (eRAI No. 9160) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 272 (eRAI No. 9160)," dated November 01, 2017

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. 9160:

- 03.02.01-4
- 03.02.01-5
- 03.02.01-6
- 03.02.01-7
- 03.02.01-8
- 03.02.01-9
- 03.02.01-10

Enclosure 1 is the proprietary version of the NuScale Response to NRC RAI No. 272 (eRAI No. 9160). 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 Marty Bryan at 541-452-7172 or at mbryan@nuscalepower.com.

Sincerely,

A handwritten signature in black ink, appearing to read 'Zackary W. Rad', written over a horizontal line.

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



Distribution: Gregory Cranston, NRC, OWFN-8G9A
Samuel Lee, NRC, OWFN-8G9A
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Enclosure 1: NuScale Response to NRC Request for Additional Information eRAI No. 9160, proprietary

Enclosure 2: NuScale Response to NRC Request for Additional Information eRAI No. 9160, nonproprietary

Enclosure 3: Affidavit of Zackary W. Rad, AF-0118-57992



RAIO-0118-57991

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9160, proprietary

Enclosure 2:

NuScale Response to NRC Request for Additional Information eRAI No. 9160, nonproprietary

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

eRAI No.: 9160

Date of RAI Issue: 11/01/2017

NRC Question No.: 03.02.01-4

10 CFR 52.47(a)(2) requires that a standard design certification applicant provide a description and analysis of the structures, systems, and components (SSCs) of the facility, with emphasis upon performance requirements, the bases, with technical justification therefore, upon which these requirements have been established, and the evaluations required to show that safety functions will be accomplished.

While reading the current FSAR, staff finds several occurrences where a bioshield (a concrete/steel structure positioned above the nuclear power module) is mentioned. However, inconsistencies and lack of details in the description of the bioshield leave the staff not fully understanding the function of such a component in the NuScale design:

- There are references to venting of the bioshield (pages 3.7-55, 3C-11), but no drawing/information is provided on what this venting looks like or how it operates.
- On FSAR Tier 2, page 1.2-11, it is mentioned that the “vertical portion goes into the water”. No mention of venting exists.
- The lack of detailed drawings forces the staff to try to infer the location of the lower tip of the vertical shield from a short description of elevations. From FSAR Tier 2, pages 3.7- 24 and 3.7-173, the staff concludes that the lower tip of the vertical shield either touches the pool water or is 2 feet above the water. Again there is no mention of how venting is achieved.

The applicant is requested to address the following questions:

- A. What is the exact function of the bioshield steel vertical faceplate: fire protection, radiation protection, prevention of foreign material deposition onto the NPMs, release of pressure and heat during normal ops and accident conditions? What foreign material could be deposited onto the NPMs? Why does the design require a vertical face plate? Why does it need to go all the way into the water? Are any functions safety related? Detailed drawings of the bioshield should be provided. The FSAR should be checked for consistency accordingly.

NuScale Response:

To assist the NRC staff in understanding the function of the bioshield in the NuScale design, the following details are provided in the responses pertaining to RAI 9160. ED-F012-3661, Revision 2, available in the electronic reading room for the Containment and Ventilation NRC audit, contains the current design of the bioshield. FSAR Tier 2, Section 3.7.3.3.2 is revised to describe the venting of the bioshield.

The vertical face plate of the bioshield performs the following design functions:

1. provide ventilation to aid in maintaining an environment for which the equipment can remain qualified (FSAR Tier 2, Section 3.11 and Section 9.4.2)
2. provide a 3 hour fire barrier (FSAR Tier 2, Section 9.5.1.2.4)
3. accommodate the effects and be compatible with environmental conditions associated with normal operations, maintenance, testing, and postulated accidents (FSAR Tier 2, Section 3.2)
4. provide a means of venting the atmosphere under the bioshield to relieve high pressure and temperature environments (FSAR Tier 2, Section 3.11)
5. provide physical security protection to SSCs in the operating bay, including from events such as a loss of large area beyond design basis event (FSAR Tier 2, Section 13.6.1 and NuScale TR-0816-50796)
6. allow airflow from the main pool area to under the bioshield during normal operations (FSAR Tier 2, Section 9.4.2)
7. release the buildup of hydrogen gas that may occur during severe accident conditions (FSAR Tier 2, Section 19.2)
8. provide radiation protection (FSAR Tier 2, Section 12.3.2.4)

The design functions listed above are not safety-related, in accordance with 10 CFR 50.2. The bioshield is designed to survive a SSE with another bioshield attached to it while in the refueling configuration. Based on structural analyses, no parts of the bioshield were shown to fail and break off, striking the NPMs. No foreign material between the bioshield and the NPM will break off and strike the NPM. Foreign material above the bioshield will not drop onto the NPM as there is no SSC other than the Reactor Building Crane above the bioshield during normal operation, and equipment used during a refueling outage is not large enough to cause the bioshield to fail and allow the equipment to strike the NPM.

The vertical portion of the bioshield extends down into the water approximately 1 foot (water El 94', bottom of bioshield El 93') giving the vertical piece a total length of 30 feet. Extending the bioshield into the water performs functions for radiation protection, security, and fire protection.



Impact on DCA:

FSAR Tier 2, Section 3.7.3.3.2 has been revised as described in the response above and as shown in the markup provided with this response.

~~P_{cs} = credible critical load,~~

~~P'_e = CSDRS or CSDRS-HF loads, and~~

~~P_{wo} = operating wind load (not applicable).~~

RAI 03.07.03-5

~~Structural crane components are constructed with ASTM A572 Grade 50 material or better. Allowable stress for the ASTM A572 Grade 50 material used in the trolley and bridge are given in Table 3.7.3-3 for extreme environmental conditions.~~

RAI 03.07.03-5

~~Table 3.7.3-4 through Table 3.7.3-7 show the summary of combined stresses in the bridge and trolley for all configurations based on the CSDRS and CSDRS-HF. Maximum normal stress and shear stress are highlighted in the tables. The maximums are less than the allowable given in Table 3.7.3-3.~~

3.7.3.3.2

Bioshields

The bioshields are nonsafety-related, not risk-significant, Seismic Category II components that are placed on top of each module bay at the 125' elevation to provide an additional radiological barrier to reduce dose rates in the RXB and support personnel access. Bioshields are removed while a NPM is being detached and refueled. During that time, the removed bioshield is placed on top of an in-place bioshield.

RAI 03.02.01-4

Each bioshield is comprised of a horizontal slab supported by the bay walls and a hanging vertical face plate attached to the horizontal slab. The horizontal slab consists of 21.5-in. thick reinforced 5000 psi concrete with a 2-in. layer of high-density polyethylene on the top. The concrete and high-density polyethylene are encapsulated in 1/4-in. steel plates for a total thickness of two feet. The vertical plate is constructed of a stainless steel tube framing system and stainless steel face plates. The vertical plate is vented for heat removal during normal operation via two fire and pressure rated louvered vents, and heat and pressure mitigation in the event of a high energy line break and slow leak, high temperature event above the NPM via hinged pressure relief panels providing one way ventilation. The vents for normal operation are located two feet off the surface of the pool, with one vent on the left and one on the right side of the front face of the vertical portion of the bioshield. The pressure relief panels cover the space between the vents for normal operation and all the way up the vertical face of the bioshield. A solid design is used as a representative weight for the structural analysis.

The bioshields are attached to the bay walls and outer pool wall using 1.5-in. diameter removable anchor bolts. Figure 3.7.3-1 shows six installed bioshields and Figure 3.7.3-2 shows a vertical faceplate.

Reinforced Concrete Properties and Slab Capacity

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eRAI No.: 9160

Date of RAI Issue: 11/01/2017

NRC Question No.: 03.02.01-5

- B. The bioshields are currently classified as nonsafety-related, not risk-significant, Seismic Category II components (FSAR Tier 2, Table 3.2-1, "Classification of Structures, Systems, and Components," identifies them as B2). Are the vents in the bioshield vertical faceplate considered to provide a nuclear safety function (e.g., do they establish environmental conditions for safety-related components related to safe shutdown)? If the vents are mechanical devices credited for heat and pressure relief in order to establish the environmental conditions for safety related components related to safe shutdown, explain how the current classification is appropriate?
-

NuScale Response:

The bioshield vents are non-safety related, non-risk significant components that serve to provide protection from adverse environments that could result in preventing safety related SSCs from performing required safety-related functions. Based on this supporting function, the bioshield vents are considered a hazard barrier. NRC RIS-2001-09, "Control of Hazard Barriers," defines a hazard barrier as "plant features or structures that are credited with protecting plant equipment from external and internal hazards such as flooding, tornado missiles, turbine missiles, and the effects of design basis events such as a loss-of-coolant accident (LOCA) or a high energy line break (HELB)." (ML003768935) Many systems in existing operating plants require barriers in order to perform their function. For example, there are barriers to protect systems from the effects of internal flooding, such as floor plugs and retaining walls, and barriers are used to prevent steam impingement in case of a HELB. Barriers are used to protect systems against missiles, either internally generated or generated by external events. Barriers that are support systems and do not directly perform safety-related functions, as defined by 10 CFR 50.2, need not be classified as safety-related.

As described in the response to question 03.02.01-04, the bioshield performs no safety-related functions as defined in 10 CFR 50.2 either during or after the 72-hour period following a design basis accident. Therefore, although the bioshield performs a support function to ensure safety-related SSCs remain functional, the bioshield and the associated ventilation and panels, are not safety-related. The bioshield is classified as B2 (non-safety related and non-risk significant), but



has augmented quality requirements as specified in FSAR Tier 2, Table 3.2-1, to prevent their failure under SSE conditions. The classification of the bioshield is listed in Tier 2, FSAR Table 3.2-1.

Impact on DCA:

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

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eRAI No.: 9160

Date of RAI Issue: 11/01/2017

NRC Question No.: 03.02.01-6

- C. What is the design of the vent(s)? Is it a simple mechanical damper? What kind of maintenance will be applied to the vents? What kind of lubrication material will be used? Wouldn't radiation affect the characteristics of the lubricant forcing it to be replaced at certain time intervals?
-

NuScale Response:

There are two types of vents on the vertical face of the bioshield. The vents used for HVAC purposes are shown in Figure 1. These vents include steel grating and a 5 psid pressure rated, 3 hour automatic fire damper and are for normal operating conditions. The pressure and temperature relief panels, shown in Figure 2, are hinged panels of steel construction. The front face (facing towards the main pool area) of the panels are ¼" steel plate with angled steel welded around the perimeter to provide volume to fill with an aluminum honeycomb material. The back portion of this panel is a 16 gauge steel plate welded to the angle steel to encapsulate the honeycomb material. The hinge of the panel is welded to the front steel plate and top angle steel. At the bottom of the panel, there is a ¼" steel plate welded to the bottom in order to provide a cover for the hinges of the panel located below.

Development of procedures and maintenance activities related to the environmental qualification (EQ) operational program is the responsibility of the COL applicant as described in FSAR Tier 2, Sections 13.4 and 13.5. COL Item 13.4-1 addresses site specific information for EQ operational programs and COL Item 13.5-3 addresses site specific maintenance and other operating procedures.



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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.: 9160

Date of RAI Issue: 11/01/2017

NRC Question No.: 03.02.01-7

- D. How will the vent(s) work when one bioshield is stacked on top of another and how, in this configuration, will the top bioshield be restrained in order to properly respond to seismic activity?
-

NuScale Response:

The bioshield vents for normal operation and performs as designed even when another bioshield is stacked on top of it. As seen in Figure 1, there is a 3.5" gap between the two vertical portions of the bioshields when they are in a stacked configuration. This gap is sufficient to allow the RXB HVAC system to continue to control the environment under the bioshield. The NuScale temperature profile for the area under the bioshield was developed using multiple failure modes to determine equipment qualification conditions (see FSAR Tier 2, Section 3.11). The emergency ventilation panels will open into the back of the vertical portion of the bioshield in the stacked position and allow ventilation around the side of the vertical portion of the bioshield in front.

When placed in the refueling position, the two bioshields are connected via the horizontal slab bolting connection points. Each bioshield is designed to survive the SSE while a bioshield is stacked on top of it, without failure of components causing them to strike the module. The stacked bioshield is attached to the bioshield below it using the horizontal slab bolts. The bolts go through the stacked bioshield and into the threaded inserts in the bioshield below as shown in Figure 1. This bolt configuration exists in each corner of the horizontal slab of the bioshield. The stacked bioshield is not bolted to the pool wall while it is in this stacked position.

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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.: 9160

Date of RAI Issue: 11/01/2017

NRC Question No.: 03.02.01-8

- E. What happens if the vent fails? What happens if the temperature monitor (under the bioshield) fails? Are there supporting calculations?
-

NuScale Response:

As described in the response to question 03.02.01-5, the bioshield is considered a support system or hazard barrier. The vertical portion of the bioshield contains two vent designs that aid the bioshield in performing its intended support functions. Additionally, augmented quality was applied to the bioshield to ensure it remains functional for its support function, as shown in Tier 2, FSAR Table 3.2-1. The vents in the bioshield are designed with sufficient redundancy and reliability to ensure that these components perform their intended support functions, and therefore, the effects of both vents failing was not specifically analyzed. A failure of both vents in the bioshield coincident with a high energy line break, fire, loss of large area or security event is not considered credible. A barrier which cannot perform its related support function while operating will be evaluated and managed by a COL applicant under the Maintenance Rule plant configuration control requirement, 10 CFR 50.65(a)(4), and the associated industry guidance (NUMARC 93-01, Revision 3).

With respect to the failure of the temperature sensors, a failure of all four of the temperature sensors under the bioshield coincident with a high energy line break (HELB) is also not considered credible because of the redundancy and seismic qualification of the components. Therefore, the simultaneous failure of the temperature sensors coincident with a HELB is not considered credible.

As described in FSAR Tier 2, Section 7.1.3.1, redundancy in the under the bioshield (UTB) temperature sensors and the module protection system is achieved by using four separation groups of sensors. The module protection system uses two-out-of-four voting so that a single failure of a sensor does not prevent a reactor trip or engineered safety feature (ESF) actuation. The physical and electrical independence attributes of the module protection system which includes the UTB temperature sensors are described in FSAR Tier 2, Section 7.1.2.



Impact on DCA:

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

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eRAI No.: 9160

Date of RAI Issue: 11/01/2017

NRC Question No.: 03.02.01-9

- F. Identify and provide engineering documents which establish currently approved bioshield design. Does ED-F012-3661, rev 2, "BioShield General Arrangement and Details", 13 Apr 2017, reflect the design?
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NuScale Response:

NuScale drawing ED-F012-3661, Revision 2, reflects the current bioshield design. Supporting technical documents for the bioshield design described in the NuScale DCA, such as the NuScale drawing ED-F012-3661, are available for NRC audit.

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.: 9160

Date of RAI Issue: 11/01/2017

NRC Question No.: 03.02.01-10

- G. If the recommended redesign to the bioshield is to add blowout panels to the vertical plates, at what differential pressure would these panels open? See DD-F010-4444, Rev 0, "Bioshield Re-Design to Support Environmental Qualification Profile", 2 Sept 2016.
-

NuScale Response:

The blowout panels were added to reduce the maximum temperature under the bioshield following a main steam line break. These panels open at pressures less than 1/4 psi. Behind these panels is a support frame weldment to prevent the panels from swinging towards the reactor module. Therefore, these panels will only swing towards the main pool area when pressure is generated inside the operating bay (due to steam leak, HELB, etc.) After back pressure has ceased, the panels will swing back into place from gravitational forces.

Impact on DCA:

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



RAIO-0118-57991

Enclosure 3:

Affidavit of Zackary W. Rad, AF-0118-57992

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 component by which NuScale develops its bioshield.

NuScale has performed significant research and evaluation to develop a basis for this component 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 RAI No. 272, eRAI No. 9160. 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 1/2/2018.



Zackary W. Rad