RAIO-0118-58386

January 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. 289 (eRAI No. 9215) on the NuScale Design Certification Application

REFERENCE: U.S. Nuclear Regulatory Commission, "Request for Additional Information No. 289 (eRAI No. 9215)," dated November 29, 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 Enclosure to this letter contains NuScale's response to the following RAI Question from NRC eRAI No. 9215:

- 06.02.05-10

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 Marty Bryan at 541-452-7172 or at mbryan@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. 9215

Enclosure 1:

NuScale Response to NRC Request for Additional Information eRAI No. 9215

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

eRAI No.: 9215
Date of RAI Issue: 11/29/2017

NRC Question No.: 06.02.05-10

NuScale has requested an exemption from the combustible gas control requirements of 10 CFR 50.44(c)(2), which states that:

> *All containments must have an inerted atmosphere, or must limit hydrogen concentrations in containment during and following an accident that releases an equivalent amount of hydrogen as would be generated from a 100 percent fuel clad-coolant reaction, uniformly distributed, to less than 10 percent (by volume) and maintain containment structural integrity and appropriate accident mitigating features.*

10 CFR 52.47(a)(12) requires a design certification applicant to include an analysis and description of the equipment and systems for combustible gas control as required by 10 CFR 50.44.

10 CFR 50.12(a)(1) states that, *in part,* the Commission may grant exemptions from the requirements of the regulations od 10 Part 50, which are "Authorized by law, will not present an undue risk to the public health and safety."

NUREG-0800, Section 19.0, Design-Specific PRA (Procedures Specific to Integral Pressurized Water Reactors) states the following:

> *For small, modular integral pressurized water reactor designs, the staff reviews the results and description of the applicant's risk assessment for a single reactor module; and, if the applicant is seeking approval of an application for a plant containing multiple modules, the staff reviews the applicant's assessment of risk from accidents that could affect multiple modules to ensure appropriate treatment of important insights related to multi-module design and operation.*

The staff will verify that the applicant has:

i. Used a systematic process to identify accident sequences, including significant human errors that lead to multiple module core damages or large releases and described them in the application

ii. Selected alternative features, operational strategies, and design options to prevent these sequences from occurring and demonstrated that these accident sequences are not significant contributors to risk. These operational strategies should also provide reasonable assurance that there is sufficient ability to mitigate multiple core damages accidents.

Questions

The NuScale biological shield (i.e., bioshield) is a first of a kind structure / component. Current understanding of the bioshield is that for each nuclear power module (NPM), a bioshield is located above the reactor module and extends down on the pool side. The bioshield, in part, creates a compartment above the module. The compartment is created around each NPM by two side walls which are (often) shared with the next module, the reactor building pool wall, the bioshield above and on one side (as a wall in/above the reactor pool), and the water surface and exposed portion of the containment dome. The bioshield is removed while a NPM is being detached and refueled. During that time, the removed bioshield is placed on top of another NPM's in-place bioshield. The size of the compartment and the means of air/gas exchange with the reactor building is unclear from the documentation.

To assess the potential for hydrogen combustion and any safety impacts, more detailed geometric information is required of the bioshield. In the responses to questions 1-4 below, address both the typical configuration of the operating NPM under a single bioshield, and the configuration of the operating NPM under the stacked bioshield configuration.

1) Describe the region / compartment above the containment vessel and below the bioshield, including clarifying the above statements. Provide the volumes, elevations, and shapes of each compartment. Provide dimensions and compositions of the solid structures (walls, etc.) that bound or define the compartment. Additionally and/or alternatively, provide drawings of or describe the gas-occupied compartment immediate above the reactor bay pool.

2) Describe the areas/ openings in the compartment that would inter-connect the compartment with the larger space of the reactor building that could allow gas flow (e.g., number of the doors or openings and dimensions of each for the connecting compartments).

3) From supporting NuScale documents it appears that the biological shield is a type of reinforced block/plug located above the containment vessel of each plant modules; describe the functions of the bioshield. Information about the biological shield has been requested separately. For the purpose of a combustion analysis, the bioshield will be a barrier and a heat sink. Provide the thickness, composition, mass, and elevation information for the bioshield, the reactor. Also, provide the dimensions and compositions of the solid structures (walls, etc.) that bound or define the compartments.

4) To better understand the relationship of each compartment and the adjacent environment, provide volume, elevation, and compartments in the gas space within the reactor building.

NuScale Response:

In order for the NRC staff to assess the potential for hydrogen combustion and any safety impacts of the bioshield, more detailed geometric information has been included in the responses below:

1)

The NRC has correctly understood the configuration of the operating bay surrounding the NPM. Using FSAR Tier 2, Figures 1.2-19 and 3.8.2-3 as reference, Figures 1 and 2 of this response show that the volume created by the bioshield, operating bay and pool walls, and the water surface is as follows: the distance between the bay walls is approximately 19'-7" from inside face to inside face (Figure 2 below), the distance from the pool bay wall to the vertical portion of the bioshield is approximately 20'-1" from inside face to inside face (Figure 2 below), the distance from the pool water to the horizontal portion of the bioshield is 29'-0" from the water surface (EL 94') to inside face (Figure 1 below), and the containment vessel occupies space approximately 5'-2" above the water surface and is approximately 14'-9" in diameter. Above the module, space is occupied by various pipe, electrical/I&C SSC, and steel. This is the only compartment enveloped by the operating bay walls, pool wall, bioshield, and pool water surface, and the space/volume can be described as a cube with the upper module and supporting SSC occupying some of that space. The dimensions and compositions of the solid structures are the same for a single bioshield and stacked bioshield configuration.

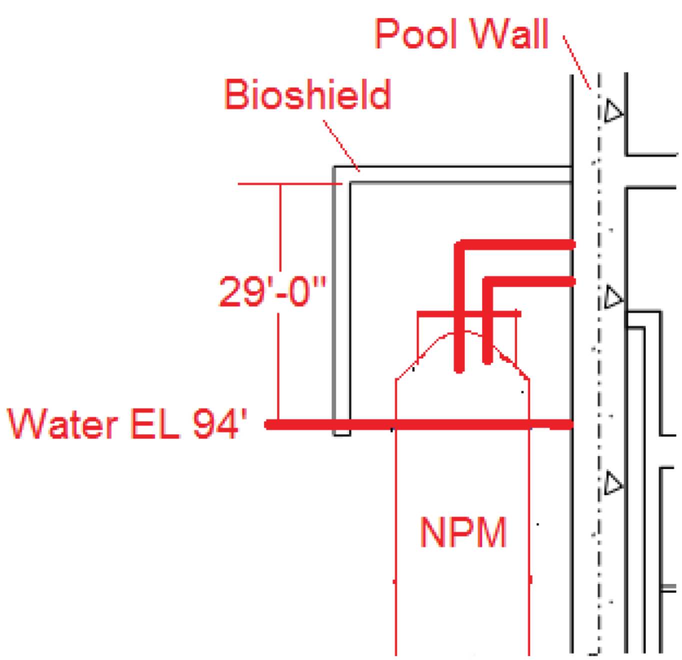

Figure 1: Bay Height

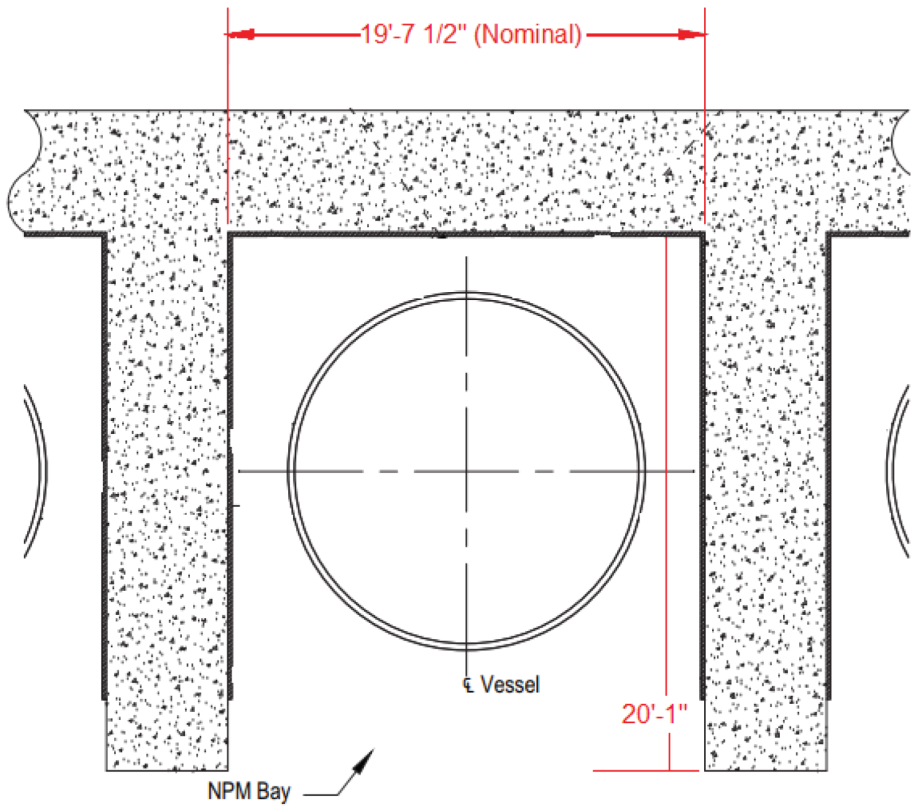

Figure 2: Bay Width and Depth

2)

The compartment surrounding the NPM as described in question 1 interconnects to the larger space of the reactor building in 4 ways:

1. There is an approximately 2' square HVAC vent from the compartment through the pool wall which aids in maintaining favorable operating conditions to the compartment. This vent is equipped with a damper that will close in an event causing high pressure or high heat. These vents are designed to perform this function in both a stacked and unstacked configuration.

2. There are two 4' square HVAC vents in the vertical piece of the bioshield allowing air from the main pool area to be drawn through the compartment to aid in maintaining favorable operating conditions. These HVAC vents are also equipped with dampers that will close in high pressure or high heat. These vents are designed to perform this function in both a stacked and unstacked configuration.

3. There are one way emergency vents in the vertical portion of the bioshield that are designed to allow air to flow from the compartment to the larger pool area. These vents

are hinged and require back pressure to begin to open. These vents close due to gravity after back pressure ceases. These vents are designed to perform this function in both a stacked and unstacked configuration.

4. There is a small diameter hole through the vertical piece of the bioshield located where the horizontal piece connects to the vertical piece (near the top of the vertical piece of the bioshield) to allow the escape of lighter-than-air gases to escape the compartment to the larger space of the pool area. These vents are designed to perform this function in both a stacked and unstacked configuration.

3)

The bioshield acts as a cap that closes off the open space created above the pool by the operating bay walls, encapsulating the top of the NPM. Response to RAI 9160, Question 03.02.01-4 contains details about the functions of the bioshield. In general, the bioshield aids in EQ environment, fire protection, HVAC, security, LOLA, and radiation protection functions. Additionally, the bioshield may serve as a platform for personnel and small SSC during refueling operations.

The operating bay walls and the pool wall are 5' thick reinforced concrete walls. The horizontal piece of the bioshield is a 2' thick reinforced concrete slab. The vertical piece of the bioshield is a steel structure primarily consisting of a 4"x4" square tube steel lattice with the members spaced on 2' centers in both the horizontal and vertical direction. On top of this lattice (away from the compartment) are the pressure relief panels. These panels are steel boxes of varying heights and widths but are all 4 inches thick, and they cover most of the vertical portion of the bioshield. The boxes are 1/4" and 16 gauge steel filled with an aluminum honeycomb structure for pressure relief. From question 1, the volume created by the bioshield, operating bay and pool walls, and the water surface is approximately 19'-7" wide, 20'-1" deep, and 29'-0" tall. The protruding portion of the NPM and supporting structures and SSC occupy space inside this volume.

4)

The compartments within the reactor building were broken into 4 parts for modeling gas space: the top of NPM bay (1S), the bottom of NPM bay (2S), the RXB pool room (3S), and the gallery spaces of the RXB (4S). The dimensions of each compartment are provided in Table 1.

Table 1: Dimensions of Compartments within the Reactor Building

Maximum Initial Conditions					
Vol #	Description	Vol Ft^3	Elev (ft)	Ht (ft)	D_H (ft)
1S	Top of NPM Bay	8,672	101	24	14.6
2S	Bottom of NPM Bay	16,226	25	76	7.9
3S	RXB Pool Room	$2.88x10^6$	25	152	67
4S	Gallery	$2x10^7$	101	101	10

Impact on DCA:

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